THIS DOCUMENT CONTAINS THE WORKING ARRANGEMENTS AND DETAILED PRESCRIPTIONS JOINTLY AGREED BETWEEN ALCOA AND THE DEPARTMENT OF CONSERVATION AND LAND MANAGEMENT IN RESPECT OF ALCOA'S OPERATIONS IN STATE FOREST WHICH IS NOT WITHIN PROCLAIMED DISEASE RISK AREAS.

EFFECTIVE FOR OPERATIONS YEAR 1988/89.

THESE ARRANGEMENTS WILL BE REVIEWED IN JULY ANNUALLY.

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WORKING ARRANGEMENTS FOR PRESCRIPTIONS

Introduction

The 1986 document "Working Arrangements for Alcoa's Bauxite Mining Operations in State Forest" was divided into two parts. Part one dealt with Field Operations and Organisational Responsibilities while Part two contained Prescriptions.

Strictly speaking, Part one contained the agreed arrangement governing Alcoa/C.A.L.M. operations and could more properly be called the "Working Arrangements". The prescriptions then formed an appendix to the working arrangements.

In 1987 the prescriptions only were issued.

It is now proposed to review and re-draft the "Working Arrangements" in the light of experience and organisational changes and to once again include them in front of the prescriptions.

Scope

These working arrangements presently cover Alcoa's operations outside D.R.A. Developmental prescriptions have recently been prepared for operations in designated areas of good quality forest including those in D.R.A. The developmental prescriptions will be added to the Working Arrangements at a later date.

PART 1

1. Introduction

These arrangements set the framework for control of Alcoa's field operations in State Forest at Jarrahdale, Huntly, Del Park and Wagerup. A brief description of mining and a definition of Alcoa and C.A.L.M. responsibilities in State Forest is included. These two parts are likely to remain unchanged unless new mining methods develop or Alcoa enters new agreements with the State. Detailed prescriptions form an appendix to these working arrangements. The Prescriptions should be updated when new research information has been produced and verified.

A co-ordinated approach between Alcoa and C.A.L.M. is required for effective and efficient control of mining operations. This is important so that better use is made of information in both organisations. Prescriptions represent mutually agreed, practical, and technically sound specifications for executing field operations. Working groups including representatives from Alcoa and C.A.L.M. have been nominated with responsibility for developing (where necessary) and updating prescriptions.

2. Field Operations in Bauxite Mining

Bauxite mining follows a sequence of exploration, mining and rehabilitation. This includes a number of discrete operations:

- Exploration drilling at a grid spacing of 120 metres,
- Ore development drilling at spacings of 60 metres and 15 metres,
- Removal of marketable timber,
- Stacking and burning forest residues,
- Removal and direct return or stockpiling of top soil and stockpiling of overburden,

- Drilling and blasting caprock,
- Extracting bauxite ore by loading and transport to a crusher,
- Crushing and transport to refinery,
- Rehabilitation of mined pits.
- On-going management of rehabilitated areas.

Jarrah forest surrounding bauxite mining operations is treated to improve resistance to dieback disease or rehabilitated if it is heavily degraded. These operations are carried out under the Forest Improvement and Rehabilitation Scheme (F.I.R.S.).

Within the list of mining operations above, prescriptions are required in every case where forest values are likely to be affected, particularly by the spread of dieback disease.

Prescriptions exist for:

- Exploration and Ore Development Drilling,
- Logging and Clearing and Burning of Forest Residue,
- Rehabilitation, and
- the Forest Improvement and Rehabilitation Scheme.

3. Organisational Responsibilities

3.1 Department of Conservation and Land Management

Under the provisions of the C.A.L.M. Act 1985, the Department of Conservation and Land Management is charged with the responsibility for management of State Forest included in the Alcoa lease area.

In fulfilling this responsibility C.A.L.M. aims to ensure that forest resources are managed for maximum long term social and economic benefit. To this end, C.A.L.M. has adopted a multiple use management system seeking to minimise conflict between land uses whilst having regard to overall balanced development, including economic considerations. Mining is recognised as being a conditional land-use in areas of State Forest with a priority use of Water Production, Recreation, Catchment Protection, or Forest Production. Mining is not considered compatible in areas where Nature Conservation is the priority land use.

Mining is a transient land use and C.A.L.M. is charged with ensuring it takes place with minimum long term deleterious effects on the forest environment and that rehabilitation is consistent with the land use needs.

3.2 Alcoa

Alcoa's responsibilities in State Forest are defined in Alumina Refinery Agreement Acts (Kwinana, Pinjarra, Wagerup) and under the Wagerup E.R.M.P.

3.2.1 Alcoa's Rights and Obligations under Agreement Acts. (Forest requirements only).

- Alcoa may remove overburden and forest produce for its own operations.
- Alcoa will give the Executive Director 6 months notice of such intentions.
- Executive Director will remove millable timber from areas to be mined.

- Alcoa will dispose of overburden and forest waste so as not to damage adjacent forest.

- Alcoa will leave areas clean and tidy after mining, but not necessarily on original contour.

- Alcoa will pay compensation for areas of State Forest cleared for mining.

- The District Manager may prohibit use of C.A.L.M. roads and give Alcoa directions on roads that can be used. This does not apply to roads built by organisations other than C.A.L.M.

- Damage to C.A.L.M. roads from Alcoa's operations will be repaired at the company's expense.

- Alcoa will restore and reafforest mined areas.

- Alcoa will comply with the bush fires Act and take precautions to prevent the spread of fire in its lease area and in adjacent areas, as directed by the District Manager.

3.2.2 Alcoa's Undertakings Under Wagerup E.R.M.P.

Although developed as part of the Wagerup E.R.M.P. these undertakings are being applied to other mine sites, i.e., Jarrahdale, Del Park and Huntly.

- Alcoa submits a mining and management programme which specifies areas and methods for mining and rehabilitation. Five year mining plans are submitted for Jarrahdale, Huntly and Del Park and ten year mining plans for Willowdale.

These are revised annually and for the basis for clearing applications for areas to be mined. Two year clearing plans are submitted annually and checked by District Managers and the Mining Operations Group before approval is recommended to the Executive Director.

° Exploration drilling is subject to stringent dieback hygiene specified by C.A.L.M.

° Rehabilitation proposals are developed to best suit the designated land use. The Mine Site Environmental Scientist is responsible for the preparation of conceptual rehabilitation plans. Rehabilitation includes the following stages:

- Reshaping mined areas to control drainage,
- Return of top soil,
- Contour or grade ripping,
- Establishing ground vegetation and trees with the aid of fertiliser,
- Controlling drainage and water discharge from pits,
- Providing access for future forest management.

° Alcoa has undertaken to rehabilitate dieback infect forest adjacent to its mining areas.

Prescriptions have been developed and the C.A.L.M. work programme is funded by Alcoa through F.I.R.S. (Forest Improvement Rehabilitation Scheme).

° Alcoa will dismantle its facilities on termination of mining and will carry out rehabilitation measures.

3.3 Water Authority

The Water Authority has particular responsibility for the protection and production of water supplies. Alcoa and C.A.L.M. consult Authority staff as required. The Authority is represented on the M.M.P. and M.O.G. groups and contributes to the planning and implementation processes as shown on the attached diagram.

3.4 Implementation

The attached diagram illustrates the procedures for the determination of working arrangements and for the annual drafting, review and approval of five year and two year plans. The diagram applies specifically to the generation of a dieback prescription and planning system, but applies generally to the planning and control of all mining operations.

PART 2

Part two comprises detailed working prescriptions which specify objectives, strategy, technical specifications and works programme requirements in terms of timing, resources and funding. Responsibilities for the co-ordination and review of existing prescriptions are shown overleaf. Existing prescriptions are reviewed by a working group (overleaf) annually and necessary amendments made.

Further prescriptions are being prepared on -

° Dieback Control in Ore Extraction, and
° Post Rehabilitation Management Programmes.

Working groups are as shown overleaf.

Prescriptions for all facets of the mining operation will be produced in due course including:

° Top soil and overburden handling, and
° Access.

Overall Prescription Co-ordination

C.A.L.M. - R/L Bauxite Liaison

Alcoa - Senior Mine Site Environmental Scientist - Jarrahdale

The above representatives will have primary responsibility for the annual review of prescriptions. The working group convenors will carry out the review of each prescription respectively with input from the working group as required. Convenors will forward their reviews to the co-ordinators for distribution.

Prescription Title	Objective	Working Group
Exploration & Development Drilling	Ensure dieback hygiene & minimise damage to vegetation	Convenor: Alcoa Senior MES Members: D/M Jarrahdale R/L Ops. North For. Mining Dwp For. Mining Hvy
Logging, clearing and burning	Ensure dieback hygiene, sale of MFP and proper fire control	Convenor: R/L Ops. North Members: Alcoa Rep. DF Fire control, North Snr For. Prot., Central
Mining and Dieback Control	Develop dieback management prescriptions	Convenor: R/L Bauxite Liaison Member: Alcoa MES - Dieback Management

Prescription Title	Objective	Working Group
Rehabilitation of mined pits	Update "rehab." prescriptions	Convenor: D/M Dwellingup Members: Alcoa rep. D/M Jarrahdale D/M Harvey S/M Dwp Res. Landscape Expert Environmental Prot. Rep.
F.I.R.S.	Update Specification	Convenor: D/M Jarrahdale Members: Alcoa Rep. S/M Dwp Res. D/M Dwellingup D/M Harvey R/L Bauxite Liaison

Prescriptions should include:

- Objectives
- Strategy
- Technical Specifications
- Work Programme Requirement
  - Timing
  - Resources
  - Funding

Functional responsibilities at C.A.L.M. for mining operations are as follows:

Planning - R/L Planning North - Jarrahdale, Del Park, Huntly
- R/L Planning Central - Willowdale
- Five Year Plans, Two Year Plans, Clearing Applications

Liaison - R/L Bauxite Liaison
- Standards, Prescriptions, New Projects

Operations - R/L Operations North and Central
Fire Control, Timber Production, M.F.P.
- D/M Jarrahdale, Dwellingup, Harvey
Operational matters day to day

Finance - Deputy R/M North - F.I.R.S. Finances

PRESCRIPTION FOR OPERATIONS IN THE
EXPLORATION AND DEVELOPMENT OF BAUXITE
IN ALL STATE FOREST OUTSIDE D.R.A.

(Including Survey and Drilling)

1. INTRODUCTION

1.1 The Ore Development Process:

1.1.1 Geological mapping and aerial photography interpretation to delineate prospective areas.

1.1.2 Broad-spaced exploration drilling of lateritic areas. Drill holes are usually located off local bench marks using chain and compass. Drill grids range from 60m to 240m.

1.1.3 Geological mapping of caprock grade and textures based on a surveyed 60m x 60m grid. This determines targets within potential ore zones for close-spaced control drilling.

1.1.4 Close-spaced drilling to provide proven ore reserves. This delineates lateral and vertical limits of the ore body, and provides information for grade control in the mining process.

2. PLANNING FOR DRILLING OPERATIONS

2.1 Five Year Drilling Plan:

Each July Alcoa will submit a 5 year drilling plan (1:25,000 scale) to the local office of the Department of Conservation and Land Management.

This plan should show the broad direction of drilling over each of the ensuring 5 years. This will assist in the co-ordination of drilling and associated operations with other forest activities, particularly F.I.R.S. and prescribed burning. Without such a plan there may be:

- Destruction of dieback symptoms and the creation of false symptoms resulting in greater difficulty in disease interpretation.

- Exposure of the soil (by burning) causes hygiene difficulties under moist soil conditions.

- Disturbance of pegs which have been accurately surveyed.

In addition, this plan permits commencement of C.A.L.M. hygiene planning well in advance of the operations.

2.2 Annual Drilling Plans:

By the first week of July each year Alcoa will submit proposals for the next 12 months drilling operations to the local office of C.A.L.M. These should include:

i) Broadscale plans showing areas and type of drilling at 1:25,000 scale.

ii) A programme indicating Alcoa's priority for operations.

iii) C.A.L.M. Officers will examine the dieback status and other forest values of the proposed drilling areas. From these considerations a hygiene strategy will be developed (Guidelines in section 3.2).

All dieback forest will be preferentially scheduled for moist soil operations.

The remaining area of forest programmed for drilling will be scheduled for dry and moist soil operations. The general priority for dry soil conditions will be:

One: Drilling areas within large continuous areas of dieback-free forest.

- where, due to soil conditions, maintaining clean vehicle under moist soil conditions will be difficult.

- forest types which are likely to suffer high impact if infected with Phytophthora.

Two: Forest types which are likely to suffer low impact if infected with Phytophthora.

- Small areas of dieback-free forest which are likely to be vulnerable to the natural spread of the disease.

It is recognised that some areas of dieback-free forest will have to be scheduled for moist soil operation subject to the appropriate hygiene (section 4).

iv) The programme for drilling operations is resolved from an amalgamation of Alcoa's priorities and the hygiene strategy. This will be returned to Alcoa within 2 weeks of arrival of the programme if a five year drilling plan is available and four weeks if not.

2.3 Changes and additions to drilling operations are possible through-out the year, provided adequate notice for dieback demarcation is given.

3. SCHEDULE OF OPERATIONS

3.1 Dieback Interpretation and Demarcation is a C.A.L.M. responsibility and should occur in advance of all field operations to ensure that hygiene conditions are consistently applied to those operations.

3.2 Dieback Location Maps (1:25,000) and hygiene conditions (including access) should be forwarded to the mine site geologist for areas of operation in the ensuing drill season. Early notification is assisted by 5 year drilling plans.

3.3 Dieback Mapping and Hygiene Conditions:

Prior to drilling two copies of the layout will be sent to the local office of C.A.L.M. Officers there will mark the dieback management lines, access routes and points for vehicle clean down on the layout and forward one copy to the appropriate Alcoa personnel.

3.4 Notification:

Survey crew and drill rig locations are to be available at all times from the mine site security office.

4. HYGIENE OPERATIONS

4.1 Objective:

To carry out field operations in such a manner that the risk of spreading dieback disease into dieback-free forest is minimised.

4.2 Dieback Categories:

Areas of forest in which field operations are to take place will be categorised into:

Dieback
Suspect
Dieback-free

In the forest these categories will be separated by Management Lines of yellow painted blazes on trees and will be demarcated by C.A.L.M. Officers. Old management lines will be painted over.

4.2.1 Access

Access to each category will be designated and checked by C.A.L.M. Officer.

Field Operations will be confined separately to each category. Transfer from one category to another requires specific hygiene conditions.

4.2.2 Standards

Vehicle and plant cleanliness is the basis for controlling dieback spread in the field operation. This can be achieved by:

Washdown with fungicide - treated water from a high pressure/low volume pump.

Airhose to blow using compressor.

Brushing down.

4.3 Operating Conditions:

4.3.1 Exploration Operations

Permitted in dieback forest under all soil conditions.

Permitted in suspect and dieback-free forest only under dry soil conditions. In the event of dry season rainfall, operations may continue provided soil is not picked up by vehicles; however, support vehicles must be left outside the dieback-free boundary.

4.3.2 Grade Control Operations

Permitted in dieback forest under all soil conditions.

Permitted in suspect and dieback-free forest under all soil conditions provided:

i) Conventional support vehicles (e.g. light trucks, four wheel drives, trailers) remain outside the dieback-free boundary or on nominated hard surfaced roads when moist soil conditions exist.

ii) Drill rigs do not pick up and transfer soil while operating in the drill area or travelling on access roads.

Responsibility for control of (i) and (ii) lies with the operator(s) and will be subject to control inspection by C.A.L.M. Officers.

4.3.3 Field Hygiene Practice

4.3.3.1 Suspect and Dieback-Free Forest

i) Every vehicle is to be inspected prior to entry into the area to ensure that no soil has been picked up in transit. A cleandown is required at the dieback boundary or nominated cleandown point, if the vehicle is not clean. (Nominated cleandown points should always be located as low in the land profile as possible).

ii) Each vehicle traversing an area must be continually checked to ensure that soil is not being picked up. If soil conditions deteriorate the operation must transfer to dieback forest via an approved access road.

iii) After drilling each hole and prior to departure for the next hole, the drill rig must be inspected by the operator for cleanliness. If the rig is not clean of soil, cleandown is required. Control inspections may be carried out by C.A.L.M. Officers.

iv) Cleandown must take place at least once per day as a safety measure. Where practicable, routine daily cleandown is to be carried out as low in the land profile as possible in relation to daily operational areas.

v) Prior to leaving suspect or dieback forest, vehicles are to be free of soil.

4.3.3.2 Dieback Forest

- Cleandown between holes is not necessary.

- Do not cross moist low-lying flats or creeks.

- Prior to leaving dieback forest, vehicles are to be free of soil.

4.4 Training:

Vehicle operators must be trained in hygiene principles, techniques of inspection for vehicle cleanliness and vehicle cleandown. All training will be subject to an annual update and current prescription review.

Prior to departure from the base depot all vehicles must be in a clean condition.

4.5 Rubbish:

No refuse is to be left behind after any field operation.

4.6 Forest Disturbance:

All field operations must minimise damage and disturbance to forest vegetation.

4.7 Review:

Prescription to be reviewed July, 1989.

PRESCRIPTION FOR LOGGING, CLEARING AND BURNING OF STATE FOREST PRIOR TO BAUXITE MINE DEVELOPMENT

AND

FOREST COMPENSATION ARRANGEMENTS

1.0 SEQUENCE OF EVENTS

1.1 Five year mining plans for Northern Forest Region (10 year Willowdale) revised annually by Alcoa and available to Executive Director September - October.

1.2 Inspection and consideration by Districts, and M.O.G. Comments and recommendations from Executive Director to M.M.P. Group.
Note: C.A.L.M. is represented on the M.M.P. Group.

1.3 The above plans are submitted to the Minister for approval about December.

1.4 Alcoa submits clearing notices in March. It is the objective to provide two year advance proposals to facilitate planning and implementation of appropriate intensive dieback management measures. A minimum of six months notice is required.

1.5 Areas subject of the clearing notice are marked in the field by Alcoa.

1.6 The clearing plan is assessed by Districts and M.O.G. and Region recommends to Executive Director. Areas of non ore or marginal ore within the proposed clearing boundaries will be identified by Alcoa at the time of submission of the clearing plan.

At that time, areas for which there is no predetermined mining operational requirement (access, overburden storage, etc.) and which will not be cleared, will also be identified. Those areas of non ore or marginal ore within the clearing boundary, for which there is an operational need for clearing, will be discussed between the C.A.L.M. District Manager and an Alcoa representative. The justification for clearing will be demonstrated and the appropriate management strategy agreed upon as a joint submission to the M.O.G.

In the event of disagreement between the District Manager and Alcoa the specific issue will be referred back to the prescription Working Group.

1.7 Executive Director approves the clearing plan about June.

1.8 Field marking of agreed proposals are checked and adjusted by Alcoa according to approvals.

1.9 In July Alcoa submits to Districts a clearing schedule for next twelve months.

1.10 Districts check area for dieback and demarcate categories in the field. A dieback plan is given to Alcoa.

1.11 Districts arrange salvage of saw-logs and minor forest produce.

1.12 Alcoa heaps and burns unsaleable debris.

1.13 The area is ready for mining.

2.0 OBJECTIVES

To carry out the sequence of events with maximum efficiency having due regard for:

2.1 Timber salvage and clearing being confined to areas which are to be mined.

2.2 Minimising the spread of dieback disease into dieback free forest.

2.3 Minimising fire damage to surrounding forest.

3.0 HYGIENE STRATEGY

3.1 C.A.L.M. will categorise all forest into the various dieback categories. Each of the categories will be indicated in the field and on 1:10,000 scale plans given to Alcoa. In the rare cases where uninterpretable dieback occurs, special local arrangements should be made for marking as it should be regarded as dieback-free for entry of vehicles but dieback for exit.

3.2 Field operations will be confined to a single disease category. Transfer from one to another requires specific hygiene measures.

3.3 Access will be defined in advance by C.A.L.M. as shown on plan at 3.1 above.

3.4 In field operations the strategy to prevent infected soil movement into uninterpretable or dieback-free forest is based on vehicle and plant cleanliness. It can be achieved by:

- Wash-down using a high pressure, low volume pump.
- Air-hose to blow down by use of compressor. (Dry soil)
- Brushing down. (Dry soil)

3.5 Soil Conditions

i) Dry Soil.
Timber salvage, clearing and burning will be possible in all dieback categories during dry soil conditions when the probability of spread is lowest.

All plant must be clean on entry to "uninterpretable" or "dieback-free" areas and on leaving dieback or uninterpretable to travel through dieback-free forest.

ii) Wet Soil.
Similar operations in "dieback" are permitted providing plant is cleaned down before leaving. In uninterpretable" and "dieback-free" operations should be avoided if possible but are permitted providing plant is clean on entry but support vehicles must remain outside the disease category boundary or enter on nominated hard surface roads.

iii) Hygiene requirements above apply equally to all operations by all parties involved in timber salvage and clearing of mine sites.

4.0 PLANNING FOR TIMBER SALVAGE AND CLEARING

4.1 The sequence of planning and operational events are 1.0 - 1.12.

4.2 1:10,000 scale plans are used at all stages.

4.3 Changes to the plan are possible provided adequate notice is given to allow for dieback demarcation, timber salvage, clearing and burning.

5.0 FIELD OPERATIONS

5.1 General Dieback Hygiene Requirements

i) Training - Vehicles and plant operators must be trained in the techniques of inspection for vehicle cleanliness, clean-down and hygiene principles.

C.A.L.M. will train Alcoa staff when required, Alcoa staff will train their own operators.

ii) Prior to departure from the base depot all vehicles must be in clean condition.

iii) Access is to be confirmed to routes approved by C.A.L.M. This is important during wet and moist soil conditions.

iv) Dieback-free Forest

Prior to entry into the above, every vehicle is to be inspected by the operator to ensure no soil has been picked up in transit. Such inspection should be monitored from time to time by both Alcoa and C.A.L.M. staff. Clean-down is required at the dieback boundary or nominated clean-down point of the vehicle is not clean.

v) Uninterpretable Forest

As for "Dieback-free Forest", except prior to leaving uninterpretable forest, vehicles and plant are to be free of soil.

vi) Dieback Forest

Prior to leaving dieback forest, vehicles are to be free of soil.

5.2 Clearing Boundary Definition

i) Boundaries of proposed clearing area are marked in the field by Alcoa using yellow plastic tape attached to trees or stumps.

ii) Following inspection and approval of proposed clearing boundaries by local C.A.L.M. staff, Alcoa overmarks the yellow plastic tape with white paint prior to the commencement of clearing operations.

iii) When necessary, Alcoa will prepare site drainage plans for approval by M.O.G. prior to commencement of clearing.

5.3 Dieback/Dieback-free Forest Boundary Definition

i) C.A.L.M. will reinspect dieback boundaries established for surveying and drilling operations prior to commencement of clearing operations.

ii) Dieback boundaries are established by means of yellow painted blazes on trees along the boundary. The yellow blazes face into the dieback infected forest and act as a warning to all machine operators that should they pass through the line they infect dieback-free forest.

iii) Dieback boundary markings removed during timber salvage will be replaced by C.A.L.M. Any removed during clearing will be replaced by Alcoa using yellow painted pegs. Within the pit they will also use yellow painted pegs. If there is doubt regarding which side is dieback, Alcoa will over-paint these pegs as per 'traffic lights'.

iv) In a largely dieback area secure dieback-free areas will be separated for hygienic operations.

5.4 Forest Produce Removal

i) Salvage of merchantable timber in State Forest is performed by licensed private contractors under the direction of C.A.L.M.

ii) Identical hygiene conditions apply to timber removal operations as those described for clearing operations 3.1 to 3.5.

iii) C.A.L.M. is responsible for ensuring that operator's equipment is cleaned down when required.

iv) C.A.L.M. is responsible for clear definition of dieback boundaries during the forest produce removal phase.

5.5 Clearing Methods

i) A forest officer will inspect each clearing area prior to the commencement of clearing operations to ensure that merchantable timber has been removed.

ii) Any non-merchantable timber remaining within the cleared areas is pushed by bull-dozer, heaped and burnt by Alcoa. C.A.L.M. will direct Alcoa concerning fire protection requirements.

iii) Concurrent with bull-dozing operations, cleared areas are raked to remove large surface rocks and tree roots. Depending upon quantity of rocks the raked material may be heaped and burnt or separately removed by loader and truck to a site approved by C.A.L.M. using approved access.

iv) The dieback boundary definition is to be maintained by Alcoa during clearing operations.

v) All clearing machinery coming on site, i.e., entering State Forest, must be cleaned and this will be monitored by Alcoa and C.A.L.M.

vi) Any machine which is to clear dieback-free forest must be clean upon entry. Low loaders are to use C.A.L.M. nominated access and to be clean on entry to dieback-free roads and forest.

vii) Where an approved mining area contains dieback and dieback-free forest the dieback-free forest should be cleared first.

viii) Drainage and run-off from wash-down points is to be provided to the satisfaction of C.A.L.M.

Temporary drainage control is to be established during clearing on all slopes, e.g., a strip at the bottom is cleared first and a small windrow of overburden built up to prevent run-off from the cleared area.

Run-off from dieback infected sections of an area to be cleared must be contained and not allowed to enter the dieback-free sections.

5.6 Burning Debris

i) The burning operations must comply with the provisions of the Bushfires Act 1954 and are subject to a permit issued by the Shire.

ii) In State Forest C.A.L.M. is responsible for prescribing the conditions and retaining power of veto. On private property the same conditions apply as on any other private property burning. The local C.A.L.M. office must be advised on the day of the burn.

iii) All burning is banned during the prohibited period as prescribed by the Bushfires Act 1954, e.g., normally 15th December until 15th March, C.A.L.M. will arrange necessary extensions where burning cannot be completed during the prescribed period.

iv) Heaps are to be located so that retained surrounding forest is not damaged when the heaps are burnt.

v) Heaps may be burnt at any time during the unrestricted burning period.

vi) Hygiene during pushing up of burning heaps is to be as outlined above for the clearing operations.

6.0 FOREST COMPENSATION

6.1 Legislation

The Alumina Refinery Agreement Act 1961 provides for compensation to be paid by Alcoa to C.A.L.M. for loss of forest in connection with mining. Subsequently the Alumina Refinery (Pinjarra) Agreement Act 1969 made provision to review the amount of compensation payable at seven(7) yearly intervals calculated from 1st January, 1970. Each review has regard to the average hardwood log royalty during the financial year preceding the commencement of the new seven year term.

The current term covers the period 1st January, 1984 to 1st January, 1991. Rate of compensation during this period is $2,003.30 per hectare.

6.2 Method of Payment, Assessment and Reconciliation of Areas Cleared

i) Alcoa provides C.A.L.M. with an area estimate of forest clearing requirements for the coming year in January.

ii) C.A.L.M. invoices Alcoa based on above estimate and compensation payment made in advance by 31st January.

iii) The following January, Alcoa provides 1:20,000 scale aerial photography covering all mining development. Areas cleared are mapped at 1:10,000 scale and hectares computed by both Alcoa and C.A.L.M. Differences are reconciled, where necessary involving field checks by respective district offices.

iv) Mapped areas cleared are compared to previous January estimate and payments balanced by issuing "reconciliation invoice" for amount due or recording credit against Alcoa.

"REHAB. 89"

PRESCRIPTION FOR REHABILITATION OF BAUXITE MINES IN THE WESTERN JARRAH FOREST

1. INTRODUCTION

1.1 Environmental aspects of bauxite mine planning, operations and rehabilitation in the jarrah forest are complex. Overlapping tenures and legislation are involved, together with interactions between land use and biological factors.

1.2 However, the complexity of the system must not deter the formulation and clear statement of objectives, strategies and most up-to-date techniques. This statement can then provide an agreed basis for review and up-date by all parties involved as well as operating guidelines for field personnel.

1.3 The first such statement was entitled "Rehab. 80". It was produced by the Department of Conservation and Land Management (C.A.L.M.) in consultation with Alcoa.

1.4 Following a period of implementation and further research and analysis by Alcoa and C.A.L.M., previous prescriptions were withdrawn and replaced by this prescription after joint review.

Rehab. 89 is the current document describing techniques to be used in bauxite mine rehabilitation in the higher rainfall zone of the jarrah forest.

1.5 New techniques (i.e., departures from this prescription) may be introduced as research projects, as long as:

- the location and timing is approved by C.A.L.M. in consultation with the Water Authority where water catchments are concerned.

- accepted research procedures for experimental design, measurement and follow-up are fulfilled.

1.6 The prescription will be reviewed annually, at which time new strategies or techniques will be considered for incorporation.

Input for this review will be considered from the interested groups or those involved in the rehabilitation operation. The review will be co-ordinated by C.A.L.M. Any proposed changes to objectives, strategies or operational techniques will be fully documented, outlining the reasons, and detailing the data to support the proposed change. They will be subject to comment and acceptance by appropriate government authorities and the mining company.

2. THE OBJECTIVE

Bauxite mine rehabilitation is to be consistent with the Regional Management Plan. The overall objective of bauxite mine rehabilitation in the Jarrah forest is to maximise the forest's potential by:

Establishing a stable, self regenerating forest ecosystem, planned to enhance or maintain water, timber, recreation, conservation and/or other nominated forest values".

Specific goals (not listed in order of importance since priorities may vary with designated land use) are:

2.1 Water values: to ensure that mined areas provide acceptable water quality and quantity.

2.2 Timber: to grow a forest which has the potential for sawlog production.

2.3 Recreation: to maintain existing recreational values where possible and to provide increased opportunities for forest based recreational activities in accordance with C.A.L.M. regional and district recreation plans.

2.4 Protection: to conserve the residual soils; to control dieback spread and to manage potential fire hazards.

2.5 Landscape: to create a rehabilitated landscape visually compatible with the adjoining indigenous forest.

2.6 Conservation: to encourage the development of floral, faunal and soil characteristics of the indigenous jarrah forest ecosystem.

2.7 Economical management: to produce a rehabilitation system which can flourish (in the short term) and become self sustaining (in the long term) without continual applications of nutrient/management resources.

To meet multiple use forestry goals, long term rehabilitation management must be compatible with that of surrounding jarrah forest (in terms of points 2.1 - 2.7).

3. REHABILITATION STRATEGIES

These are:

3.1 The development of prescriptions for rehabilitation procedures for each mined area, in accordance with the designated land use priority and land use management plans.

3.2 To conduct research programmes to improve rehabilitation procedures. In the event of research information becoming available, then modification to this prescription may take place before the next review by mutual agreement.

3.3 The monitoring of rehabilitated areas to determine their capacity to sustain long-term production of the forest values listed in the objective, and

3.4 The development of remedial treatments should monitoring reveal that rehabilitation objectives are not achieved.

4. REHABILITATION PLANNING

Rehabilitation planning occurs at two levels:

i) The first is broad-scale regional mine site planning on a five year time scale.

ii) The second is annual detailed operational planning on a pit-by-pit basis.

4.1 Regional Planning: the mining company is required to produce an annually updated five year mining and management plan for government approval. Those plans should be drawn up in consultation with appropriate government departments and should consider the following regional aspects:-

- the sequence of mining and rehabilitation
- access for mining, public and future management
- location of mine facilities
- dieback management
- aesthetic and landscaping considerations
- fire protection planning
- integration of mining into land use plans so as to minimise adverse impact on priority uses
- requirements for long-term management
- broad description of site vegetation types and reconnaissance for rare flora and fauna
- water management systems and water course protection
- proximity to private property.

4.2 Annual Operational Planning : detailed conceptual proposals for each mine pit should be prepared before rehabilitation. Each proposal should be jointly prepared by C.A.L.M., mining company staff and the Water Authority in water catchment areas and should consider the following specific factors:-

- pit identity
- dieback management, drainage, erosion control and water management, specifying measures to be used from initial drilling through to completed rehabilitation;
- treatment and management of land over non-ore bodies within and adjacent to ore i.e. "islands" of unmined forest;
- species to be used;
- any special features to be incorporated or retained (e.g. pit walls) as part of the rehabilitated landscape;
- internal access to pits for future forest management;
- location of mining facilities/structures;
- scheduling in sensitive areas;
- rock management;
- movement, stockpiling and replacement of top soil and overburden, in relation to dieback spread within and downslope of the pit.
- identification of features such as permeability, slope, waste islands, rocks, state of forest downslope, wetness of pit, thin overburden, sudden slope changes etc, which may require special handling;
- any research projects on the pit, including method and timing of decommissioning of the project at its conclusion.
- The long term management strategy for the rehabilitated area as planned by C.A.L.M.

The conceptual rehabilitation plans will be endorsed by the C.A.L.M. District Manager following discussions with other government agencies where appropriate.

Contentious or unusual areas will be referred to the Regional Manager or the Mining Operations Group.

Research proposals frequently will not be finalised until after the completion of conceptual plans. Such proposals, in the form of approved working plans, should be submitted no later than the 1st of December. Where the research project differs significantly from standard practice the means and time of decommissioning the project should be specified.

Research proposals, and other departures from the conceptual plan, should be jointly considered by the C.A.L.M. District Manager and the Company and interested Government departments.

4.3 Fire Protection Provisions

These are outlined in detail in Fire Protection Plans produced for each mine site. When conceptual plans are submitted to C.A.L.M., the District Manager should ensure they comply with the Fire Protection Plan for the relevant mine site.

5. DIEBACK MANAGEMENT

Bauxite mining and rehabilitation involves massive soil and vehicular movement under all weather conditions. Also mining can cause substantial modification to natural drainage patterns in the forest so close attention to dieback management is essential.

The two key management aims are:

i) to minimise the spread of infection into dieback-free forest and mine sites.

ii) to manage access and drainage so as not to expand areas which favour the survival and severity of the disease.

Dieback management practices are specified in detail in other prescriptions dealing with drilling, timber salvage and clearing. i.e., operations not dealt with in this prescription.

Dieback management practices following clearing are to be in accordance with the following:

5.1 Disease boundaries established during clearing are to be maintained and demarcated in the field with pegs. Pegs are to be painted green on one side, yellow on the other. The yellow side of the peg-line will indicate the infected area.

5.2 Stripping operations will segregate infected and uninfected soil. Stripping equipment should not access uninfected areas across unstripped infected areas.

5.3 Infected top soil and overburden should either be stockpiled in situ or transferred only to an immediately adjacent infected rehabilitation site. It should not be transported across uninfected areas.

5.4 Uninfected topsoil and overburden may be transferred to remote locations. Such material should be replaced with due consideration to the quality of native forest downslope of the mining area and the potential for restoration of jarrah within the rehabilitated mine pit.

5.5 Topsoil and overburden handling operations for uninfected material should be scheduled for dry soil conditions.

A categorisation process will be undertaken by C.A.L.M. District Managers and the mine sites within their jurisdiction, which will identify those areas of high quality forest where pre-mining operations should occur under dry soil conditions.

6. PREPARATION OF PITS FOR PLANTING

6.1 When mining is completed, the following earthworks will be carried out.

6.1.1 Deep ripping of compacted pit floors which may be covered with more than 0.5 metres of fill.

6.1.2 Landscaping.

6.1.3 Replacement of overburden, then top soil.

6.1.4 Deep or shallow ripping, or scarification as required. (See 6.6)

6.1.4 The construction of water management structures such as contour and grade banks, waterways and sumps.

6.2 Landscaping: Pit walls will be battered and smoothed. Waste islands, and pit floor will be shaped and filled. Occasionally pit walls may be retained if prescribed in a recreation plan. In this case visitor safety needs to be considered e.g. perched boulders, long-term stability of cliff wall.

6.3 Overburden and top soil will be evenly respread over all areas to be rehabilitated. The distribution of this material from pit to pit will be in accordance with the following requirements:

i) No transfer of infected material to dieback free sites which are above significant areas of dieback free vegetation.

ii) Endeavour to move soil under moisture conditions appropriate to its dieback status in accordance with arrangements agreed with the District Manager.

6.4 Unmined areas

Islands or inliers of low grade ore often occur within a pit. Clearing of these areas should be kept to an absolute minimum. However, there will be occasions when they are both cleared and stripped. When this need occurs, it will be justified to the satisfaction of the District Manager.

When this occurs, either the area will be completely landscaped or the unmined caprock will be 'popped' with explosives to provide planting sites and minimise surface runoff. The exception to this will be those areas, identified on conceptual plans as being within a noise restriction zone or inside safe blasting distance from private property. Blasted craters will be graded level before respreading overburden and top soil. Overburden/top soil should be at least 30 cm. deep and scarified, on contour as an aid to erosion control. Deep ripping in these areas should normally be avoided in order to reduce the appearance of surface rocks.

Vegetation establishment and growth on unmined areas have tended to be less successful than that of the adjacent rehabilitated mine pits.

In addition to the routine planting and/or seeding of these sites a supplementary seeding mix will be applied.

This mix will contain drought tolerant tree and understorey species. Seed of E. drummondii, E. sideroxylon and E. microcarpa will be applied to achieve a stocking rate of 625 trees per hectare. The understorey seed will be spread at 1 kilogram per hectare and contain only species endemic to the Darling Range.

6.5 Rock management

During the pit preparation work, care must be taken not to import, or bring to the surface, large boulders - which would make the future forest floor untrafficable. If boulders are brought to the surface enough rocks must be removed from the rehabilitated area to allow access for future management including fire control, silviculture, and other tending or harvesting operations. The removal of rocks may occur before or after planting provided the objective of avoidance of soil compaction and erosion control are not compromised and plants are not damaged.

6.6 Ripping

Deep ripping is required to fracture the compacted pit floor to allow root penetration and, water infiltration; to provide an "anchor" for the returned top soil; and to control the overland flow of water. Joint inspection by C.A.L.M. and Alcoa of pits prior to ripping will be carried out where appropriate to determine specific requirements.

In General

i) All of the rehabilitated areas require either contour or grade ripping,

ii) Deep ripping should be done using a winged tyne to maximise subsoil fracture; batters and banks need not be deep ripped, but must be scarified or shallow ripped. This avoids bringing up rocks, but still controls erosion and prepares a seed bed;

iii) The distance between parallel riplines will depend on soil conditions, but must ensure a continuous fracture of the compacted subsoil;

iv) Ripping should be as deep as possible and should not be less than 1.2 metres.

v) Where soil erosion control provisions will not be compromised, the ground surface should be levelled wherever possible during or after deep ripping. Any alternative techniques which ensure erosion control while producing a smoother surface are to be encouraged.

vi) To avoid bringing up rocks, cleared, unmined areas should be scarified on contour.

7. WATER MANAGEMENT

7.1 Careful water management must be considered in every phase of the operation from initial clearing and road construction through to completion of rehabilitation.

7.2 A variety of water management systems may be adopted, depending on land use priority, site, and the nature of the specific catchment or storage facility.

7.3 Criteria for Success: irrespective of the system which is used, it must satisfy the following basic criteria:

- there must be a minimum of top soil erosion within pits,

- on proclaimed catchments, the system must meet standards of stream turbidity, salinity and biological purity defined by the Water Authority. Off proclaimed catchments, streams draining an area influenced by mining must not increase unduly in turbidity, chemical or biological pollution,

- there must be no long-term ponds of water lying either within or below pits or roads unless planned.

- the need for long-term maintenance must be minimal,

- peak flood levels should not be increased by mining in catchments such that they endanger dams on the catchment;

- the system must be acceptable in terms of costs, aesthetics and the land use priority.

7.4 Water Management Systems

Pits may be designed and constructed so as to:-

i) retain and infiltrate water; or

ii) discharge water.

A combination of retention and discharge techniques may be used. A recurrence interval of once in twenty years will be used as the rainfall design period.

7.4.1 Water retention and infiltration will be achieved by:-

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

ii) collection of overland flow, either in a series of midslope contour banks and a pit bottom sump, or by a system of grade discharge banks directing overland flow to predetermined sump areas within the pit.

Where used, contour intercepter banks will be constructed at up to 10 metre vertical intervals. Such banks may not exceed 1 metre in height nor have steep sides which present an obstacle to future access. Where specified, contour interception banks must be provided with suitably constructed overflows and non-erodible spillways. Construction of these devices must be completed before the first Autumn rains.

Grade discharge banks will connect to a stabilised waterway.

Well drained sites may require no engineered drainage structures.

Sump and drain locations will be indicated on the conceptual rehabilitation plans.

7.4.2 Water Discharge: Where this is prescribed it will be achieved by:

i) infiltration and silt trapping in the contoured or grade rip lines, and

ii) control of overland flow by grade banks, waterways and slow release detention ponds or filter systems.

Grade banks should be constructed so as not to erode, and to be located with a maximum 10 metre vertical interval. Distance apart should depend upon site characteristics and should be such that any potential erosion is contained between two grade banks, and does not create serious management problems such as accessibility, safety and loss of top soil.

Waterways should collect discharge from grade banks and deliver water to the discharge system. The discharge system from the detention pond or filter system should provide a major passageway for water; avoid long-term detrimental effects of silt and water on forest or stream vegetation; minimise forest soil erosion, and not significantly increase turbidity levels in forest streams. In addition in water catchment areas any discharge into the stream shall comply with the requirements of the Water Authority.

7.5 Unless planned, drainage from mine access roads, haul roads, mine site facilities or from pits must not flow uncontrolled into unmined dieback-free forest, but must be channelled (via ponds or filters) directly into the lowest part of the landscape at agreed locations.

7.6 All erosion control earthworks other than deep ripping with the winged tyne must be completed and effective before the first Autumn rains (i.e., generally before 30th April each year).

Winged tyne ripping effectively shatters the clay zone all year round.

Standards will be monitored and remedial action specified as appropriate and as agreed to by Alcoa/C.A.L.M. officers.

8. PLANTING

8.1 Planting Layout and Design

8.1.1 As a general rule, tree species will be established as mixtures. Monocultures may occasionally be planted in localised portions of the landscape.

In order to fulfil the widest range of rehabilitation objectives, the emphasis will be on species indigenous to the Darling Range.

Every mixture must include species indigenous to the Darling Range. Species mixes will be determined in advance and specified in the rehabilitation plan by C.A.L.M.

8.1.2 Plant spacing will be varied according to the detailed site rehabilitation objectives. In some areas such as at prominent view points or vistas and along selected areas of road, areas may be left unplanted. In other instances, trees may be planted in small groups or clumps to minimise the rigid plantation effect created by row planting on a regular spacing.

8.1.3 Stocking rate should be sufficient to yield good tree form. A minimum stocking of about 625 planted trees per hectare must be used. An increase in stocking to 1,250 stems per hectare is favoured to be achieved by the most economic and appropriate method, either broadcast seeding or planting. Where seeding is selected, objective stocking rate should be 2,500 s.p.h..

8.1.4 Do not plant trees in drainage channels.

8.1.5 Start planting in June when the soil is wet to depth. Cease planting by the end of the second week in August.

8.1.6 Seedling specifications: plants in jiffy pots or paper pots, at least 5-30 cm. in height with a minimum of 2 true pairs of leaves. Pots and soil mix sterile. Exposed roots to be trimmed before planting.

8.2 Before planting all pits will be inspected by C.A.L.M. officers. Parts of pits which are deemed by C.A.L.M. to be inadequately prepared, may not be planted until they are adequately prepared.

8.3 Access for planting crews must be pre-planned and specified so as to minimise traffic through unmined forest to minimise disease spread; and across the prepared pit to minimise erosion.

8.4 The C.A.L.M. District Manager must ensure a detailed record of species planted and treatments applied is made at the completion of the job.

8.5 Selection of Tree Species for ~~Planting~~ Establishment: Criteria for selection of tree species are:

i) Compatible with land use objectives specified in Regional Management plan
ii) Site suitability index
iii) Tolerance to dieback
iv) Fire resistance
v) Capacity for roots to penetrate the compacted kaolin layer
vi) Useful timber
vii) Proven species longevity, growth to maturity and regeneration in the mine pit environment

vii) Visual compatibility with indigenous forest
viii) Useful food and nectar sources for fauna

Following are the species to be used in bauxite mine rehabilitation in the western, high rainfall area:

Eucalyptus marginata
Eucalyptus calophylla
Eucalyptus patens
Eucalyptus megacarpa
(E. drummondii may be incl. for revegt of waste islands)

The criteria for determining the distribution of the different species will be determined by position in the landscape and the risk and hazard of dieback disease. Risk and hazard will be determined by agreed procedures which are currently under development.

Alcoa staff and the C.A.L.M. District Manager will agree on a site by site application of the matrix when preparing conceptual plans.

Definitions of Risk and Hazard

Risk is an external force or agent that would bring Phytophthora cinnamomi (P.c.) to a site. Hazard is the degree to which conditions within the site favour the proliferation of the P.c. fungus once it has been introduced. The ability of plants to resist an infection is included as part of hazard rating.

8.5.1 Species Distribution Criteria

8.5.1.1 Assessing levels of dieback risk -

High - soil returned from moderate or high impact dieback area.

Moderate -

i) soil returned from low impact dieback area or high risk of dieback introduction.

ii) soil returned from non-dieback area, but little or no hygiene during soil handling.

Low - soil returned from non-dieback area and a high level of hygiene during soil handling.

8.5.1.2 Assessing levels of dieback hazard -

The dieback hazard of pits will be assessed by Alcoa and agreed with the C.A.L.M. District Manager. Hazard assessment will be according to a procedure to be agreed; based on ore depth, slope, aspect, soil type, pit location on the slope, position within the pit, ripping type, distance from the stream zone, etc., as appropriate. The system will be reviewed as required based on field experience.

EUCALYPTUS SPECIES FOR MINE PITS

8.5.1.3 Species Mix - Mine Pits (%)

Risk of P.c. Introduction	Dieback Hazard								
	Low			Moderate			High		
	Jarrah	Marri	Blackbutt	Jarrah	Marri	Blackbutt	Jarrah	Marri	Blackbutt
Low	80	20	0	60	20	20	20	20	60
Moderate	40	20	40	20	20	60	0	20	80
High	20	20	60	0	20	80	0	20	80

8.5.1.4 Species Mix - Significant Moisture Gaining Sites (e.g., stream crossings, pit sumps, pits with RL at level of adjacent Bullich zone).

Blackbutt - 50%
Bullich - 50%

8.6 Seed Sources for Seedlings

All seed to come from a range of provenances (locations to be approved by C.A.L.M.).

8.7 Fertilizer

Apply 200 grams of Diammonium phosphate per plant.

Fertilizer to be placed approximately 15 cms. from the base of the plant, in a spear hole or stamped depression.

8.8 Success Criterion for Planting/Fertilizer Operation

80% survival of planted species at 9 months after planting.

Areas of 0.5 hectares and above which fail to meet this criterion, to be rescheduled for replanting the next winter.

9. UNDERSTOREY ESTABLISHMENT

9.1 The aim of understorey establishment is to generate a diverse and vigorous understorey which will rapidly contribute to soil stabilization, erosion control and the build-up of soil nutrients and organic matter. At the same time, development of fuels and fire risks should be kept to tolerable levels.

9.2 Base species for the seed mix, comprising about 75% of the mixture, will include the major northern jarrah forest legume species. Jarrah seed is to be applied to all sites. The final mixture will be determined by agreement between Alcoa and the C.A.L.M. District Managers.

It will take into account such factors as seed availability and where the mixture will be used. A large diversity of minor jarrah forest species should make up the balance, including other nitrogen fixing species (Allocasuarina and Macrozamia spp.). Macrozamia seeds to be sown separately and pressed into the soil at a rate of 2 kilograms of seed per hectare.

9.3 Specific species and specific mixes should be applied to particular sites e.g., water logging tolerant species for sumps, wild flower species for roadsides and recreation areas (see Section 4.2), and species of low flammability and height for special fire management zones.

9.4 As a general rule, non-indigenous and high Phytophthora cinnamomi susceptible species should not be used. However, use of a low level of D.B. susceptible species (about 10 - 20 seeds) will provide for future dieback monitoring.

9.5 Understorey seed mixes will be determined in advance and specified in the rehabilitation plan for each pit and for specific sites within pits.

9.6 Fertilizer

Areas to be seeded will be broadcast fertilized with 450 kilograms per hectare of superphosphate.

9.7 Application Rate

Mixed understorey seed will be sown at the rate of 1 - 2 kilograms per hectare with the major legume seed mix no more than 1.0 kilograms per hectare.

Seeding is to be done after ripping by ground application and to be completed by 1st June each year.

9.8 Success Criterion

2 native plants established per square metre, 9 months after sowing, as determined by stocked quadrat survey of each pit.

Areas of 0.5 hectares or greater not stocked at this rate to be reseeded the following Autumn. Light scarification and control of insect predation may be necessary to promote seed germination in areas reseeded in Year 2.

10. ROADS

10.1 The road network which remains after rehabilitation must conform to a predetermined plan. The basic planning principle is to aim for the minimum number of well surfaced roads low in the landscape consistent with provision for public access and fire protection.

10.2 This plan will be drawn-up from approved 5 year mining plans, and will cater for -

i) access for mining

ii) access for rehabilitation

iii) access for future forest and catchment management including fire protection.

10.3 Unwanted roads will be rehabilitated by:

i) if possible and economical recovery of gravel for reuse elsewhere

ii) blasting of caprock and/or breakup of all compacted material

iii) overburden and top soil return

iv) ripping and erosion control

v) seeding and planting in harmony with surrounding forest

11. PRESCRIPTION REVIEW

Next date for review of this prescription : July, 1989.

FOREST IMPROVEMENT AND REHABILITATION SCHEME (F.I.R.S.)

PRESCRIPTION '89

1. INTRODUCTION

In the Wagerup E.R.M.P. Alcoa gave a commitment to finance the rehabilitation of dieback affected State Forests adjoining bauxite mines. This led to the initiation of the Forest Improvement and Rehabilitation Scheme (F.I.R.S.) in 1978.

The scheme is funded by Alcoa. Work is prescribed and implemented by the Department of Conservation and Land Management.

F.I.R.S. work is breaking new ground in the integration of site, land use and disease variables. Each annual prescription is therefore regarded as interim.

This prescription sets out objectives and guidelines for F.I.R.S. based on the best information available in July, 1988.

2. OBJECTIVES

The Forest Improvement and Rehabilitation Scheme is applied to unmined forest within the bauxite mining envelope. The objectives are:

- To treat the forest so as to render it less susceptible to dieback disease impact.
- To rehabilitate forest in which the overstorey has been extensively destroyed by disease.
- To prevent erosion which contributed to stream turbidity.
- To identify areas for improvement treatment, in healthy unmined forest.

The overall objective of F.I.R.S. is to maintain or improve the capacity of the unmined forest to produce water, timber, recreation, conservation and/or other forest values. Emphasis will vary according to the management priority for each area.

3. TREATMENT SELECTION

There are four basic F.I.R.S. treatments:

- Stream Zone Protection
- Dieback Protection via Understorey Manipulation
- Rehabilitation of Dieback Graveyards.
- Identification of and Implementation of Improvement Treatment for Healthy Forest.

When planning the F.I.R.S. treatment for a particular compartment of forest the stream zones are selected first. The remainder of the unmined forest is to be given either the Dieback Protection treatment (2), or the Graveyard Rehabilitation treatment (3), or a variation of these two treatments. Improvement treatments of Healthy Forest (4), are to be applied after mining and rehabilitation to some of the protected areas.

The choice between the Dieback Protection and the Graveyard Rehabilitation treatments depends on current dieback impact and on the likely consequences of treatment on dieback impact. Four situations are described below to illustrate how the choice might be made:

- The most simple situation is where the forest is dieback free with a dense population of B. grandis, and where infection from mining is possible. The Dieback Protection treatment (2), is then applied.

° The other simple situation is where the dieback impact is very high, with well over half the jarrah overstorey killed by dieback. The Graveyard Rehabilitation treatment (3), is then applied.

° Where disease impact is low (understorey only affected) the Dieback Protection treatment (2), should be chosen, but will need to be modified to suit the situation.

° Where the overstorey is affected by dieback, but not more than half of it has been killed, there is a risk that applying the Graveyard Rehabilitation treatment will further increase the disease impact. A conservative combination of the Dieback Protection and Graveyard Rehabilitation treatments is recommended. B. grandis numbers should be reduced, if applicable, and then understorey seed and seed of resistant eucalypts introduced. The disturbance to soil and to existing vegetation should be minimal.

The process of choosing the appropriate treatment is depicted in Figure 1. A treatment where little or nothing is done may be most appropriate in some areas where the disease is flourishing.

4. IMPLEMENTATION

A 5 year F.I.R.S. plan is to be developed for each mine site. This will be a rolling plan which must be updated in September of each year. At the same time an annual F.I.R.S. works programme will be drawn up in accordance with approved mining plans and available finance. The "F.I.R.S. Year" is regarded as running from the beginning of January to the end of December. Each plan will be subject to endorsement by Alcoa.

As soon as the areas to be treated are defined, each District Manager must ensure that:

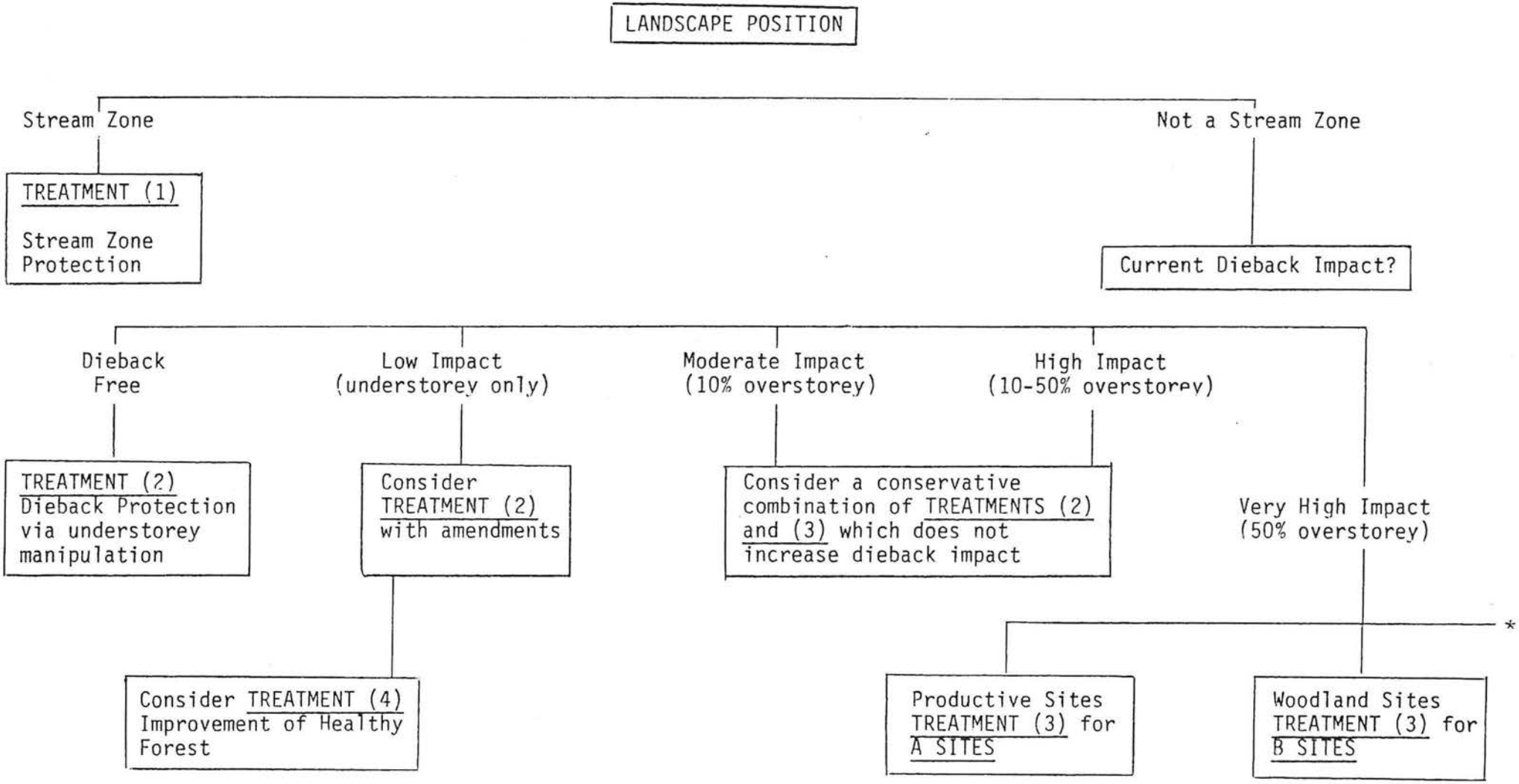

FIGURE 1: SELECTING THE APPROPRIATE F.I.R.S. TREATMENT

* Heath Sites Treatment (3) for C sites

° The appropriate prescription is chosen or written.

° A detailed plan of proposals is prepared.

° A works programme covering manpower, machinery and season is drawn up and priorities assigned.

° Staff responsibilities are made clear.

The following priorities apply:

° Carry-over areas from previous year.

° Banksia control, autumn burn and drainage improvements in DB Free or lightly affected stands.

° Rehabilitation of advanced dieback in pipe-head catchments.

The Regional Leader will review progress each quarter in each District to ensure that programmes are completed according to prescription and budgets not over-spent.

The Regional Leader will prepare a report for Alcoa at the completion of each financial year which will describe: areas treated, costs and treatments used.

Completed work is to be recorded on the Bauxite HOCS (1:10,000). The amended plans and Register are to be forwarded to Inventory in June each year.

District staff will maintain fortnightly records of costs and works progress and input this on the 097 report.

A joint Alcoa/C.A.L.M. inspection of works programmes will normally be made each 6 months and written comments exchanged.

5. REVIEW AND CONTROL

This prescription will be reviewed in July each year and updated as necessary, on the basis of:

° Changes in emphasis.

° New research findings.

° The need to correct inadequacies in the existing prescription.

It is acknowledged that the prescriptions contained in the following pages are guidelines only. Due to the nature of each mine site the prescriptions will vary to accommodate the needs of the particular site. However, major deviations from these prescriptions must be operationally trialled so that they can be assessed and input into the annual F.I.R.S. review.

Communication between the mine sites and Research Branch must be maintained so that trials are not duplicated where this is deemed inappropriate.

6. F.I.R.S. CHECK LIST

Prior to any F.I.R.S. work taking place the following information should be consulted or written. Some of this information may not, as yet, be available, but it should become the long term requirement for all F.I.R.S. work.

- land forms
- site vegetation types
- hygiene map
- predicted impact map
- 7-way test

7. F.I.R.S. PRESCRIPTIONS

Treatment (1) - Stream Zone Protection

Preamble

Stream Zones are to be selected so as to prevent turbid water from roads and bauxite pits entering streams. They need to be more extensive and secure in harnessed catchments than elsewhere.

Gravel pits, roads, earth dumps, etc., which may contribute to stream turbidity should be treated to prevent erosion. Treatment may include closure or relocation if appropriate, earthworks if necessary, and stabilising soil with vegetation.

Aim

To protect the existing vegetation in the stream zone so that it can filter sediment and provide a habitat refuge for fauna.

Method

1. Where necessary, and particularly in catchment areas, bare areas within stream zones should be seeded with understorey to enhance their ability to filter out sediment.

2. Where there is a recreation facility within or adjacent to a stream zone it may be necessary to:

    - Fall dead or dangerous overhanging trees.

    - Control erosion from car parks and access roads.

    - Do limited hazard reduction burning to prevent a dangerous hazard adjacent to picnic areas.

3. If adjacent treatment areas are to be burnt it may be necessary to protect the stream zone by either a burnt edge or a fuel reduction burn in cool conditions. Machine graded fire-lines are to be avoided if possible. It is recognised however that some stream zones may need to be hazard reduction burnt for protection management purposes. These burns must be programmed so as to avoid the possibility of erosion. They must also be broken up in both time and space to avoid disturbing an entire stream habitat.

   The W.A.W.A. must be notified of any burns which are to take place in stream zones.

4. Records of all stages of the treatment are to be kept in a central filing system in the District Office.

Treatment (2) - Dieback Protection via Understorey Manipulation

Preamble

Dieback research has shown that Banksia grandis is highly susceptible to Phytophthora cinnamomi as it is a host tissue from which the dieback fungus can readily sporulate and spread. Dieback research has also indicated that a legume understorey should disfavour the survival and spread of P. cinnamomi. The aim of the treatment, therefore is to reduce the population of B. grandis and increase the density of legumes in the understorey, thus tipping the balance in favour of the forest rather than the fungus. It is recognised that there are other factors, such as a highly susceptible site or increased drainage from roads and pits, which increase the likelihood of severe disease expression. However, B. grandis will be replaced by legumes unless it is clear that these other factors over-ride the likely benefits from the F.I.R.S. treatment.

A 3 year investigation into the effectiveness of understorey manipulation was commenced in 1988 by C.A.L.M. Research. Until results of this study are to hand, deferrment of treatment of sites having a high hazard rating may be appropriate.

Aim

To reduce (not eliminate) the B. grandis populations using a combination of machines, fire and herbicide. This treatment should be applied a minimum of 3 years, preferably 5 years, in advance of mining in adjacent areas. Priorities should be assigned accordingly.

Method

One method by which understorey manipulation takes place is currently is use. This is:

STRATEGY A - Manual kill of Banksia, burning, follow-up foliar spraying.

1. Select area of uniform treatment

2. Work through F.I.R.S. check list

3. Identify - dieback categories and B. grandis populations

   Assess - legume occurrence and site suitability for legume establishment and jarrah lignotubers occurrence, by carrying out a 25 m. x 10 m. diameter transect in each treatment 2 area.

   Note: Details of this assessment will be available during 1988 and will be included in next year's prescription.

4. Using rubber tyred machine or chain-saw, push or cut down all B. grandis greater than 4 cm. dbhob. Any mechanical work must be carried out in dry soil conditions.

5. Prepare tracks and edges for burn. Carry out falling of stags within 100 metres of burn boundary and where dangerous to F.I.R.S. operations.

6. Carry out erosion control works as required and close unwanted roads. Avoid draining water into dieback-free or lightly affected areas.

7. Burn at least 1 year after the above when banksia cones are dry and seeds have germinated. Burn in autumn or spring using the following guidelines:

   ° Forecast conditions
   SMC 10% - 15%

   ° Actual conditions at lighting
   SMC 14 - 15%

   ° Tower wind speed less than 15 kilometres per hour
   SDI as per standard prescribed burning conditions

   ° Autumn is preferred where acacia establishment is warranted. Autumn or spring conditions may be utilised where the burning objective is for fuel reduction only.

On sites determined from the results of the acacia occurrence and site suitability assessment, apply legume seed where necessary at 0.25 kg/ha, of major mix, the following winter after rain. Sites should be lightly scarified and seeds should be treated with a low toxicity ant repellent and scarified prior to application. The following is a guide to species which should be added to different sites, though it is probably best to have a basic mixture of local legumes and to add the following in greater proportions for the specific sites.

Site	Species
Moisture gaining	Acacia extensa, A. alata
Havel T & Q	A. urophylla, Bossiae aquifolium, Kennedia coccinea
Havel P & S	A. pulchella, A. lateriticola, Kennedia prostata (if seed available)

Where there are insufficient jarrah lignotubers (i.e. less than 1,000 spha), jarrah seeding will be done after burning with legume seeding.

8. Record the following details about the burn on the F.I.R.S. register.

- Date of burn
- SMC
- RH
- SDI
- Time of ignition
- Winds and temperature during the burn
- Rate of spread

9. In the spring-summer, 3 to 6 months following burning, use Round-up to poison any B. grandis coppice from cut stumps or lignotubers.

10. The timing of subsequent burning is dependent upon the objective of the burn:

i) Reduce fuel below 8 tonnes per hectare.

ii) Maintain B. grandis at a height that it doesn't seed i.e. 4 cm. dbhob.

iii) Regenerate legumes.

Further research on objective (ii) and (iii) will be necessary to determine just when is the appropriate time to carry out this burning so as not to affect jarrah establishment. Prior to any subsequent burning an assessment of banksia regeneration and the extent and quality of jarrah/marri regeneration should be carried out.

11. Records of all stages of the treatment are to be kept in a central filing system in the District Office.

12. Research/Operational Trials (T2)

Name: Minimising dieback impact in forest retained after mining.

Objective: To provide a scientific base from which prescriptions for the implementation of F.I.R.S. treatment (2), as a dieback control measure can be developed.

Description: The following questions will be addressed by appropriate field experiments:

- Will disease expression be intensified or controlled by treating sites in certain ways?

- Does removal of understorey and/or overstorey result in a 'wetter' or 'warmer' site of greater disease hazard?

Principal Investigator: Dr. Stuart Crombie, C.A.L.M.

Commencement: Autumn, 1988.

Duration: 3 years.

Treatment (3) - Rehabilitation of Dieback Graveyards

Preamble

Rehabilitation on advanced dieback areas should not be expected to grow fast, as the underlying causes of dieback disease also lead to less than ideal conditions for tree growth. In most areas intensive effort to establish fast growing trees is inappropriate.

Planting of eucalypts is suitable only on those advanced dieback sites where tree growth is expected to be good. On most sites planting and fertilising will encourage shoot growth at the expense of root development. Root development is considered the priority for survival and growth on infertile upland sites and to facilitate root development trees should be grown from seed on site. It is hoped that trees will develop their above ground parts only when they are capable of supporting that shoot growth.

Tree species for rehabilitation need to be selected to suit the particular advanced dieback sites so that long term growth is maximised. The success of different species beyond the establishment phase needs to be rigorously evaluated on different sites.

Aim

Rehabilitation should aim to increase the potential for recreation and fauna conservation, without compromising the primary land use of water production where applicable. Rehabilitation should also aim to improve the timber production potential, but the amount of effort should be appropriate to the expected tree growth. Where natural regeneration is occurring the treatment should aim to encourage the regeneration and supplement it if necessary.

Method

1. Select area to receive a rehabilitation treatment over one season.

2. Work through F.I.R.S. check list.

3. Identify
   - Advanced dieback boundary
   - Site types
   - Area of good natural regeneration
   - Areas of upslope or dieback-free or lightly affected forest
   - Areas where more than 50% of the original jarrah canopy remains

4. Subdivide area into -

   A Sites - potentially productive sites
   B Sites - woodland sites
   C Sites - heath sites

   Note: A definition of A as opposed to B sites will be quantified before the next review.

5. Site Preparation -

   A Sites - may undergo more intensive site preparation through the creation of ash-beds and the preparation of rip lines for planting. However, where trees are healthy and growing well, they are not to be fallen.

   B Sites - tree planting should be restricted to ash-beds. If there is little understorey, scarifying for seedling establishment is mandatory.

   C Sites - establish a comprehensive understorey if possible by application of seed and fertiliser together with comprehensive scarifying.

6. Carry out felling of stags within 100 metres of burn boundary and where dangerous to F.I.R.S. operation.

7. Carry out erosion control works as required and close unwanted roads especially when adjacent to stream zones. Avoid draining water into dieback-free or lightly affected forest.

8. Burn to reduce the hazard for young rehabilitation or to create ash-beds.

9. A Sites - spread 1 kg seed (F.I.R.S. mix) with 500 kg/ha. of Super No. 1 (including Copper) by tractor. Plant 625 spha and fertilise using 200g of DAP/plant, following the onset of winter rains.

   B Sites - plant on a 2 metre grid within ash-beds and fertilise with 200g DAP/plant. Seed with 1.5 kg/ha. understorey (Rehab major mix) and .4 kg/ha. eucalypt seed, bulked with 500 kg/ha. of Super No. 1 (including Copper) following winter rains.

   C Sites - seed understorey at 2 kg/ha. and fertilise with 1,000 kg/Super No. 1 per hectare.

   Note: All seed must be treated with a suitable low toxicity ant repellent. Understorey species mix to contain predominantly:

   A. pulchella
   A. saligna
   A. extensa

10. Tree species to be used on graveyard sites should include:

   E. calophylla
   E. patens
   E. megacarpa

where appropriate.

Eucalypt seed may be included in the seed mix for A sites at the rate of .4 kg/ha. This mix may include E. marginata at the discretion of the District Manager.

11. Records of all stages of the treatment are to be kept in a F.I.R.S. central filing system in the District Office.

12. Research/Operational Trials (T3)

Name: Dieback graveyard rehabilitation
Seeding/fertilising and planting legumes.

Objective: To determine whether rates of seed and fertiliser application and planting intensity are major determinants in the success of graveyard rehabilitation.

Description: A series of experimental sites have been treated with various rates ranging from:

- 0.5 - 2 kg/ha. understorey seed
- 0.5 - 1 tonne of broadcast superphosphate
- 625 - 1,250 spha trees

Site assessments have been carried out prior to treatment and will be assessed again 1 year after establishment.

Principal Investigator: John Day, Alcoa.

Commencement: June, 1987 at Jarrahdale mine site.

Treatment (4) - Identification and Implementation of Improvement Treatment for Healthy Forest

1. 3 to 5 years after a particular area has been mined and rehabilitated the remaining adjacent forest should be surveyed to identify areas for improvement treatment. This time scale is necessary to allow any new dieback infections time to express themselves.

2. Where thinning is proposed, it should be added to the District's J.S.I. programme. If there are additional costs to this treatment due to the mining operation, they should be borne by Alcoa.

3. In areas which are known to be protectable, a combined thinning and understorey manipulation treatment may be carried out prior to mining.

POST REHABILITATION MANAGEMENT

OBJECTIVE:

To provide guidelines for short term management of rehabilitated bauxite mining areas which will facilitate the long term management of these areas in accordance with standard forest management practices.

SUMMARY:

As at October, 1987, a number of trials have been instituted which address various aspects of rehabilitation which affect future management. These include:

- Long term nutrition
- General tree growth and vigour
- Ecological values
- Engineering structures
- Fire behaviour
- Understorey components
- Top soil quality

In general, it appears most areas established after 1977 are unlikely to require any major extraordinary management input. Some pre 1977 areas are likely to require such work.

Until the results of all trials are assessed and a set of guidelines formulated, management of rehabilitated areas will be on an 'as needed' basis determined jointly by C.A.L.M. and Alcoa