WORSLEY ALUMINA PROJECT
REYNOLDS AUSTRALIA ALUMINA LTD

REPORT AND RECOMMENDATIONS BY THE ENVIRONMENTAL PROTECTION AUTHORITY

MARCH 1979

DEPARTMENT OF CONSERVATION & ENVIRONMENT
WESTERN AUSTRALIA

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HON. MINISTER FOR INDUSTRIAL
DEVELOPMENT

Your Ref.
Our Ref.

The draft Environmental Review and Management Programme prepared by Reynolds Australia Alumina Ltd for its Worsley Alumina Project has been considered by the Environmental Protection Authority following submissions by the public and Government departments. Our assessment has been delayed by the several subsequent revisions the Company has made to its refinery waste disposal plans.

Please find attached the Authority's report and recommendations requested in your letter of 3 July, 1978.

C.F. Porter
CHAIRMAN

P.R. Adams, Q.C.

29 March, 1979

Enclosure

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1. INTRODUCTION

Much of the eastern margin of the Darling Range is covered by a mineral lease for bauxite mining held by Alwest Pty Limited and Dampier Mining Company Limited. These companies have entered into an arrangement with Reynolds Australia Alumina Ltd to examine the feasibility of the mining and refining of bauxite and export of alumina.

As part of the obligations of the joint venturers under the Alumina Refinery (Worsley) Agreement Act of 1973 and a subsequent amendment, Reynolds has prepared a draft Environmental Review and Management Programme (ERMP) which must be approved by the State before mining and construction of the project components can begin.

The draft ERMP has been submitted to the EPA for assessment in accordance with provisions of the Environmental Protection Act.

The draft has been made available for public and government comment and the subsequent responses, together with the information provided in the document, have been used in the preparation of our report. Additionally we have been able to refer to the EPA's recent Technical Advisory Group (TAG) report on bauxite mining in the Darling Range.

The process of evaluation has been aided by frequent discussions with the Company and Government departments.

Summaries of both Government and public comments appear as appendices to this report.

As a general comment we have found that our review of the draft ERMP together with discussions with the Company indicates that Reynolds has a considerable amount of planning and investigation to still complete. Our recommendations reflect this.

Again, we believe as a matter of course that the State's role in this project should take place within a framework for co-ordinated land use planning and research for the Darling Range as recommended previously by the EPA.

2. LAND USE AND THE DARLING RANGE ENVIRONMENT

In the south west of Western Australia there is a combination of factors which results in a delicately balanced and fragile environment and which presents considerable technical difficulties to its land use development. Geological history is such that old landscapes with low relief, poor drainage and deep and extreme weathering are widely preserved. The development of bauxite ores in the Darling Range is one result of this combination but it also means that the top ten metres or so of soils in this area are coarse textured and deficient in the major and many of the minor nutrient elements. The deep sub-soil clays are dense, acid and

very slowly permeable. Further, the regular inputs of sea salts with the winter rains into such a soil system has resulted in the retention at depth within it of considerable amounts of soluble salts, mainly sodium chloride. Summers are hot and almost rainless, and together with the intractable nature of the soil substrate the climatic conditions impose a severe environmental stress on plants and animals.

The natural ecosystems are specially adapted for survival in this environment. Many plants have extensive root systems deep in the permeable soils, enabling the utilisation of water remaining from winter rains. Removal of the forest results in a disturbance of the water balance so that water not used by the plants flows through the system, carrying stored salts into rivers and streams.

The low fertility level in the soils means that biological systems have evolved to minimise nutrient losses and maximise the efficiency of their use. One example is the fixation of nitrogen by legumes which are specially adapted to periodic intense fires. Another is where, in the litter layer on the forest floor, certain fungi growing around the fine roots of plants protect them from disease and help in the uptake of scarce nutrients such as phosphate. Small animals such as insects help breakdown debris so speeding up its decay and cycling of contained nutrients. These matters are only now being understood but it is known that the fragile ecosystems are easily disturbed. The rate that jarrah dieback (a fungus) disease has spread through the forest is an indication of how easily the system may be upset.

Within this scenario the many land uses of the Darling Range must be accommodated. Conservation of the natural ecosystems follows as a logical aim. However other land uses such as water catchment, forestry, agriculture, bauxite mining and recreation are all located within the area, are important to the community in one way or another and must be reconciled in regard to their effects on each other and on the ecosystem as a whole.

In broad terms the environmental issues associated with the various land uses arise because of their conflicting interactions. In the context of bauxite mining the EPA's TAG report examines these issues in detail under the headings of :

water resources and hydrology: where the relationship between bauxite mining and stream salinities and other effects on quality and run-off characteristics is discussed,

effects of bauxite mining on forest management: in which the objectives of forest management are brought into the sphere of bauxite mining and their interaction examined,

conservation, fauna and flora: the effects of bauxite mining on Nature Reserves, National Parks and particularly Conservation Management Priority Areas (MPAs) are discussed. The need for adequate surveys of biological communities in the project area is stressed.

jarrah dieback disease: the relationship of jarrah dieback spread and bauxite mining is discussed as are the effects of possible spread on other land uses,

recreation, aesthetics and other land uses: where primarily a case is made for greater recognition of recreation as a land use.

The rapidly increasing and competitive demands on the land, principally for timber production, mining, water supply, service and transport corridors and recreation must be reconciled with each other and with adequate provision for conservation reserves and environmental protection. This clearly calls for sound land use planning, and research to provide a technical basis for prediction, decision making and policy development. The area in which mining is proposed forms an enclave of forest surrounded by land already cleared for agriculture. Thus the major rivers draining the area, the Hotham and the Williams, are already saline. Nevertheless the tributaries arising from the forest are still fresh, and constitute a water resource which may be of great value in the future if the Murray River is developed, particularly if this involves diversion of the flow from saline tributaries. Integrated planning of mining and water supply development is clearly required. Further, it is in the State's long term interest to conserve the forest cover, or to replace it effectively if it is removed by mining. There are as yet no tested and proven techniques for reafforestation of low rainfall areas, and their development is an urgent research requirement.

In State Forest the principal objective of rehabilitation will, as in Alcoa's areas to the west, be the restoration of the forest. While this may still be desirable for privately owned forest land in the north of the Principal Mineralised Area (PMA) it may be harder to arrange. The State may not find it possible to require reafforestation of privately owned land when the owners are presently at liberty to clear for agricultural development. An alternative to clearing controls (such as those recently imposed on the catchments of the Helena, Wellington, Warren, Kent and Denmark catchments) is the modification of farming practices and systems so that more water is retained and used where it falls and salinity problems thus avoided. These problems clearly call for research. Since mining is unlikely to take place outside State Forest for a number of years there will be time to make some progress in investigations if the work is begun soon.

In our report on the Wagerup Alumina Project our recommendations 4 and 5 were that the State establish a means for developing land use policies and options and for coordinated land use planning, and that a single research coordinating committee be established.

These recommendations apply equally to the Worsley Alumina Project, and the arguments for them are outlined below.

3. LAND USE PLANNING AND RESEARCH

The foregoing brief outline of some of the land use and research problems reinforces our earlier concern that not only should mining take place in accordance with integrated planning between mining company and the State, but that the research required in support of it should be properly organised and coordinated. The need to ensure that coordinating arrangements are adequate is all the greater because of the likelihood of substantial funds becoming available from the mining companies. Alcoa has already agreed to contribute in its final ERMP on the Wagerup Refinery proposal.

Land use research is not concerned solely with the effects of bauxite mining or any other single land use, but with the complex interaction of many uses with the environment setting in which they take place. Three main areas of research are :

Salinity Control

This is concerned with the effects of complete or partial clearing of native vegetation on water and salt balances of catchments. The clearing may be permanent, as for agricultural development, temporary as for mining, woodchipping or pine plantations, or partial as in sylvicultural thinning. Yet in all of these the same or similar topics require investigation. They include, for example, the hydraulic properties of soil materials, the salt loads in the soils, water use by plant communities, native or established, and the effects of various engineering type treatments of the land surface.

Dieback Disease

The maintenance of the health and vigour of native forest under increasingly intensive management and use is the objective of the research, in particular those uses creating traffic activity, such as mining and logging. The responses of the fragile ecosystem to such impacts can only be understood and manipulated if we know how the system functions. This area of research offers the main hope of control of dieback, which must be investigated in terms of its ecological relationships.

Rehabilitation

> Revegetation of mined and diseased areas is required, primarily to control the water and salt balances of catchments, and secondarily to permit the restoration of such forest values as timber production, recreation and conservation of flora and fauna. Reafforestation of farmed land is a similar though not identical problem.

Seven State Government departments, CSIRO, the two Universities, WAIT and Alcoa are already involved in various ways in the research.

At present coordination is only partial, and is mainly carried out by the Hunt and Kelsall Steering Committees which oversee a total of 12 projects, often overlapping. The Western Australia Water Research Council is promoting research on water use by plant communities (evapotranspiration), and the "Dieback Research Foundation" is arranging to distribute funds contributed by Alcoa.

The Hunt and Kelsall Steering Committees are at a disadvantage in attempting overall coordination, confined by their terms of reference to the effects of one particular land use, bauxite mining and woodchipping respectively, and reporting to different agencies, one to the Bauxite Policy Committee and one to the Environmental Protection Authority. Few investigators can devote themselves full time to their projects, and they may be involved in similar studies, but in separate projects answering to different Steering Committees.

State funding is direct from Treasury to departments, which often carry hidden costs, so that it is difficult to determine or control the distribution of available finances in relation to research priorities. This difficulty will be even more awkward in future if funds from external sources are accepted.

The organisation is thus fragmented and inherently defective. Investigators and Steering Committee members are often trying to cope with the work in addition to many other duties, and those who can be single minded in their research are few. They are mainly in the Forests Department and the Department of Agriculture, which tend to have some research establishment, in contrast to operating organisations such as the water supply authorities or the Mines Department.

We therefore repeat here the relevant recommendations from our report on the Wagerup Alumina Refinery Proposal :

4. *that the State establish a means for developing land use policies and options for the Darling Range, and for co-ordinating land use planning by the several government agencies concerned*

5(a) that a single research co-ordinating committee be established; it should include adequate representation of the industries contributing funds, together with an equal number of representatives from the State; its function will be to draw up a budget and negotiate contributions from industry and from the State; it will also be responsible for assessing research priorities

(b) that in addition, there should be specialist committees of scientists responsible for directing and co-ordinating research in particular areas of concern, and for publishing the results.

4. THE WORSLEY PROPOSAL

Reynolds proposals fall into the three main operational phases of mining, ore transport and refining.

4.1 Mining

The mining operation is described as taking place in the Principal Mineralised Area (PMA) lying roughly between Mt. Wells in the north, and the Williams River in the south and bounded on the west by the limits of the lease. North of the Hotham River most of the PMA is occupied by privately owned forest held by Bunning Bros. The southern portion consists mainly of State Forest within the Marradong, Saddleback and Quindanning blocks. They are surrounded by cleared agricultural land.

The average annual rainfall in this area is in the order of 750 - 800 mm.

The initial mining operation will be centred in and around the Forest Timber Reserve at Mt. Saddleback. Here mineralisation occurs as deep as 19 metres with an average depth of 6.4 metres. From the Saddleback area mining would proceed east and north to the Quindanning and Marradong blocks respectively.

A production level of 1 million tonnes per year would require 3.17 million tonnes of bauxite with an estimated annual clearing rate of 60 hectares. At this rate the ore reserves of the PMA would last 63 years.

Bauxite mining and restoration procedures adopted elsewhere in the Darling Range are proposed for State Forest. Rehabilitation on private property is by agreement with the land owner subject to Ministerial approval.

4.2 The Ore Transport System

In the draft ERMP Reynolds discuss two alternative methods of ore transport from the crusher at the mine site to the refinery located about 50 kilometres to the south west.

4.2.1 The Railway

From the mine site the railway follows the Hotham and Murray River valleys to the Tumlo plantation. From here it climbs the valley of the Chalk Brook, passing through about 17 kilometres of the State Forest quarantine areas of Bell, Chalk and Ross blocks. Leaving the western edge of the quarantine area the rail passes a further 15 kilometres south west through non-quarantined State Forest to the refinery site. The rail route totals about 60 kilometres with roughly 20 kilometres through private agricultural land and 40 kilometres in State Forest; 20 kilometres of this is through quarantine area.

4.2.2 The Conveyor

Although it is said to be subject of further detailed engineering studies by Reynolds, the conveyor alternative is currently proposed in two straight sections. The first runs from Mt. Saddleback in a south west direction crossing the Hotham and Murray Rivers where they meet and passing immediately south of the Bell MPA. It finishes in State Forest at a point 2 kilometres north of Mt. Ross. From here the second leg proceeds south- south-west to the refinery site. The conveyor route totals approximately 50 kilometres of which about 46 kilometres passes through State Forest; 21 kilometres of its length is in quarantine area.

4.3 Refinery and Waste Disposal

These sites are located 8 kilometres north-east of the Worsley siding in the Hamilton forest block at the headwaters of the Augustus River. Reynolds require an area of approximately 2500 ha, of which approximately 1000 will be used for red mud disposal, 160 for the refinery and the balance as buffer zone.

The refinery site is located on a rise between two branches of the Augustus River, itself a major tributary of the Brunswick River system. The two main areas set aside for red mud disposal are situated in the two valleys of the Augustus River immediately north and south of the refinery site. The area is located towards the western edge of the Darling Scarp and is characterised by steep hills and sharply dissected valleys. Rainfall is high when compared to the drier more eastern parts of the Range and the average annual total is approximately 1300 mm.

The refining process proposed is the one currently used by all Australian producers and referred to as the Bayer process. Essentially it consists of mixing crushed bauxite with caustic soda under conditions of high temperature and pressure. The alumina hydrate goes into solution as sodium aluminate leaving behind the main impurities of iron oxide, silica and titanium. These impurities collectively form the caustic wastes commonly known as red mud. The alumina hydrate is crystallised from solution and calcined to anhydrous alumina.

At the refining capacity of 1 million tonnes of alumina per annum, a power station of 4 x 15 MW capacity, with one 15 MW set in reserve, will be built at the refinery. It will be fired with Collie coal. For a production of 2 million tonnes of alumina a further 3 x 15 MW set will be required. At a production level of 1 million tonnes of alumina, the following amounts of raw materials will be required.

Bauxite	3,170,000	tonnes
Coal	420,000	"
Fuel Oil	90,000	"
Caustic Soda (50% solution)	120,000	"
Lime	50,000	"
Synthetic Flocculants	900	"
Water	3,220,000	"

The Bayer process requires the disposal of large amounts of red mud. For every 1 million tonnes of alumina produced it is calculated that there will be 2.53 million tonnes of red mud consisting of 1.67 million tonnes of solids and 0.86 million tonnes of caustic liquor.

Reynolds proposes to use the two major valleys to the north west and south of the refinery site to store the red mud resulting from 63 years of continuous operation at an annual production rate of 2 million tonnes of alumina. It is proposed to sequentially construct small storage dams within the valleys, seal the floors and banks and progressively fill them with red mud. As each area is filled and dried out a vegetation programme would be carried out. Runoff from the refinery and unvegetated red mud slopes plus caustic drainage return collects in a waste water dam for recycling. A solar evaporation pond for neutralized acids and other refinery wastes such as boiler blowdown is proposed. Finally the Augustus River below all storage dams will be dammed to form a raw water storage area to supplement refinery water supplies.

5. CRITICAL ENVIRONMENTAL ISSUES ASSOCIATED WITH THE WORSLEY PROPOSAL.

Our brief outline of the major components of the Worsley project indicates that they are located within the Darling Range environment described by the EPA's TAG report. In land use terms the location of the main components adds new dimensions to existing bauxite mining operations and we outline these issues in some detail.

5.1 Refinery and Waste Disposal Site

We believe that the location of the refinery and waste disposal areas on the headwaters of the Augustus River, a major tributary of the Brunswick River, is the most critical environmental issue associated with the project.

The Brunswick River provides the largest undeveloped reserve of fresh, surface water supply north of the Collie River. If dammed at Olive Hill, just upstream from the townsite of Brunswick Junction, this river has an approximate annual yield of 50 million cubic metres. This puts it into the same category as the Serpentine and Canning dams which have annual yields of 57 and 46 million cubic metres respectively.

Furthermore the salinity of the Brunswick River is low by Western Australian standards with a weighted mean salinity of 230 mg/l TDS. The current desirable drinking water standard as set by the National Health and Medical Research Council is 500 mg/l TDS.

Clearly the Brunswick River and its tributaries form an important water resource for the populated south west of Western Australia, both as a water supply itself and as means of improving the deteriorating salinity of the Great Southern Towns Water Supply. Any reduction in its present quality would close off the future options for blending and must be avoided. It is noteworthy that the township of Brunswick Junction already receives its water supply from this river via a pipehead dam at Beela.

The high local rainfall and the nature of the Augustus River valleys will make it difficult to prevent contaminated runoff from the waste storage area entering the river systems. Extreme safety factors will be required in order to prevent any polluted overflow under normal and predicted major flood conditions. This in turn will require complex and expensive design criteria in order to ensure the maintenance of the present quality of the Brunswick River. Apart from the likely loss of a major fresh-water resource for human needs, physical and chemical pollution of this river system could have adverse biological impacts down to and including the Leschenault Estuary.

No engineering, geological nor hydrological data are provided for the refinery and associated works. As a consequence the Authority believes that the Company has not been able to show that waste disposal dams would not be subject to structural instability with consequent seepage of caustic red mud into the groundwater system.

The EPA is concerned that hydrostatic pressures in the form of confined water tables may build up beneath large masses of stored red mud and as a result rupture basement membranes.

The net effects could well be flow of polluted groundwater into the Augustus and Brunswick River systems even though a raw water dam is interposed between the two.

We believe that the Company must satisfy the PWD and EPA that pollution of the Brunswick River system by overflow of dams or seepage will not ever take place and our recommendations follow this view.

Reynolds has recently changed its plans for the disposal of red mud and currently proposes to stack it in the form of dumps having slopes of approximately 8^{o} (one in seven). The purpose of this change is to maximise the amount of red mud stored while minimising the surface area from which rainwater can be collected. This change resulted from water balance studies carried out since preparation of the Draft ERMP which showed that during periods of high rainfall water polluted by red mud could overflow from the red mud storage areas and the raw water dam.

The first disposal dump will have a final depth of approximately 50 metres of red mud to the valley floor, a final slope extending downhill about 600 metres, and the apex will be approximately 80 metres above the valley floor at the location of the pipehead dam. The dams are designed to contain water runoff from the dumps at times of extreme rainfall and to collect any red mud washed down the slope.

The uphill slopes of the dumps will be finished and revegetated first while downhill slopes will subsequently have red mud added until maximum size is reached.

Although the Authority is aware that the process of thickening red mud and stacking is used elsewhere, on the Island of St Croix in the Antilles for example, the disposal method proposed by Reynolds has not previously been used in Western Australia under the local conditions of climate and topography and with the residue which may result from the particular bauxite ore to be mined. The Company has not indicated deposition and rehabilitation methods appropriate to the proposal. In the case of Alcoa's red mud about 50% is a slimes fraction (a very fine

clay with less than 325 mesh particle size), a little less than 40% is coarse sand and the balance of material is of intermediate size. On deposition the sand and slimes fractions separate, water is retained in the slimes and potential structural instability results. The Company has not demonstrated that this problem will be overcome by thickening its red mud prior to deposition.

Representatives of the Mines Department have indicated their concern to us at the stability of the red mud stack, particularly if there is a high proportion of fine material, because of previous experience at Eneabba where massive movements occurred in a tailings dump. In that case the angle at which the tailings were disposed of was much less than that proposed for the red mud at Worsley.

In view of their concern and the lack of information currently before the Authority we believe the Company should engage consultants specialising in this field to study the feasibility and stability of stacking red mud in this manner, since any substantial movement of the stacked mud could carry it over the pipehead dam and down into the catchment of the raw water dam which is designed to overflow into the Brunswick River system. The consultant should be provided with particle size distribution data from red mud produced in early trials using bauxite mined at Mt Saddleback. This report should be made available to the EPA so that we can advise the Minister accordingly in due course.

5.2 Ore Transport System

Both transport alternatives pose issues of concern to the Authority and we believe that a brief comparison is necessary.

5.2.1 The Conveyor System

The conveyor has been designed to have one transfer point between two straight runs, each of which passes substantially through State Forest. In multiple land use terms the forest has a range of values related to timber resources, water catchment, conservation and recreation. The conveyor impinges on all these values.

Because corridors without major deviations are proposed the conveyor route does not have the flexibility to avoid areas which are presently free of dieback. It will pass in a relatively undeviating line over hills and valleys exposing forest to the spread of dieback during construction and operation. Downslope areas would be particularly at risk, while increased areas of dieback would add to the salinity of water resources in the area.

The Company's choice of conveyor, involving a physical barrier with few crossings, will result in severe disruption to the movement of forest firefighting equipment. Further, there will be obstruction to the normal movement of fauna particularly by relatively high levels of noise.

For those who use the forest for recreation the conveyor will have an adverse aesthetic impact, will be a physical barrier and be an unwanted intrusion from the continual noise it will generate.

5.2.2 The Rail System

The railway approximates the conveyor in length but has different characteristics. Because of the grades required for efficient haulage it follows valleys and water sheds wherever possible, so mainly traversing the Murray Valley, Chalk Brook and portion of the Harris River. As with the conveyor, the rail runs substantially within State Forest but has far less potential to affect those values of timber resources, water catchment, conservation and recreation previously noted. In terms of dieback spread the rail poses less of a risk and with appropriate management during construction protection of timber resources and water quality are possible. The rail passes through the Bell MPA, close to the Harvey - Quindanning road so that spread of dieback upslope into the southern portion is unlikely.

Because the railway will be principally located in valleys it will not introduce a new barrier to forest management, and will be no greater barrier than the rivers themselves.

Unlike the conveyor the rail will not impose a continual noise on the forest. Nor will it have the same adverse aesthetic impact.

The relative extent to which rail and conveyor affect forest values is the basis for our recommendations which follow later. We reiterate at this point that the conveyor has serious disadvantages because of the barrier it forms to forestry management practises, to fauna and recreation, in its very likely contribution to the spread of dieback particularly during construction and from the points of view of aesthetics and potential harm to water resources.

5.3 Mining

The area in which mining operations are proposed lies in the low rainfall portion of the Darling Range and is mostly uncleared land with a potential for the release of stored salts once forest cover is removed.

All of the PMA falls within the catchment of the Murray River, itself a saline water resource of salinity in excess of 1000 mg/l TDS in most parts.

Because forest cover will be removed, and taking into account the possible effects of dieback spread, rivers and streams in the PMA may receive increased salt loads at intervals. If the appropriate controls are not exercised by the State the net effect could be to limit its options for the use of these water resources and possibly add to their development costs.

Further, unless carefully researched and appropriate mining and rehabilitation techniques are used by the Company the streams in the area may also suffer from silt loads, and mined downslope areas from spread of dieback and upset water balances through seepage.

The Authority has carefully considered the circumstances under which a previous reference was made on the caution to be exercised in bauxite mining in low rainfall areas of the Darling Range. In that instance the areas gave rise to fresh water streams feeding into existing, harnessed water resources. In regard to State Forest within the PMA we believe the State has the opportunity to apply conditions for mining, rehabilitation and continued research which should ensure that fresh tributaries of the Murray system remain in their present condition.

Accordingly we are of the opinion that work should begin now on research into mining rehabilitation practices and that mining plans should be agreed to between the Company and the State before the Company begins its operations and from time to time thereafter.

5.4 Conservation

Finally each component of the project shares a common factor in that they all affect the natural environment of the forested areas. So far the Forests Department has broadly identified conservation areas and proposes to protect them by the establishment of special Management Priority Areas (MPAs). In regard to the detailed knowledge of ecosystems which may be affected by the project, including mining, transport and refining, little is known. The Authority notes that no biological surveys have been undertaken by the joint venturers and considers that before any mining begins these should be carried out in all areas of the project. As a general comment knowledge of the natural environment is important as it is not otherwise possible to monitor and assess many of the impacts of development. Furthermore the impact on flora and fauna is often a yardstick by which communities judge the acceptability of a project.

6. THE DRAFT ERMP

We believe that a detailed review of the draft ERMP including Government and public comment has shown it not to fulfil some basic expectations, especially in the areas which we have identified as being critical.

Normally an ERMP would be expected to describe the project proposed, the environment in which it is to be located, its effect on the environment and the measures which would be taken to successfully prevent damage to it.

As previously noted there is no description of the geology and hydrology of the proposed refinery site. Without this information we believe Reynolds is not in a position to state that its project will not cause pollution of the Brunswick River system. Nor can the Company guarantee that proposals are structurally sound on the basis of geomechanical criteria or extremes of climate. The Authority notes that since the publication of the draft ERMP the Company has altered the proposed configuration of red mud ponds, changed the location of the raw water lake, introduced a refinery catchment lake and altered the position of the refinery cooling pond. Additionally, a consultant study on soils has been completed and the Company has commissioned consultants to examine the feasibility of its new red mud and refinery waste disposal in terms of potential pollution of the Brunswick River system.

The Company points out that detailed mine planning is only currently being carried out and that a precise area development sequence is not yet available. Although it is said that mining will commence at a refinery production rate of 1 million tonnes of alumina per year, refinery waste disposal operations are described for twice this output. Mining at this latter rate would deplete presently known reserves within the PMA in approximately 30 years, and from information in the draft ERMP, remove all ore from the Mt. Saddleback forest block within 12 years. This is far too short a period in which to determine the success of rehabilitative techniques in re-establishing an acceptable water balance. Based on other bauxite mining operations in the Darling Range it is reasonable to assume a gradual increase in production to an optimal rate according to such factors as market and capital availability. This general programme and its likely effects in mining and rehabilitation terms needs to be described.

As a consequence, if the Company wishes to seek approval for plans for mining and refining at an alumina production rate of 2 million tonnes per year, it should satisfy the State in a new ERMP.

Where the draft ERMP is in the form of a consultant's review and recommendations there is no conclusion as to which transport route is favoured. In the managment section prepared by Reynolds a commitment is made to the conveyor route but no reasons are given. On the contrary,

previous discussion on the conveyor option identified the risks of dieback spread, and failed to resolve the issues of obstruction to forest management and to recreation.

Finally we have noted that no flora or fauna surveys have been carried out even though the consultant's report to the Company made this recommendation both in 1974 and 1978. Without this information being available we find difficulty in understanding how the relevant conceptual management commitments made by the Company relate to the existing environment.

Our inevitable conclusion is that the draft ERMP describes a project which is in the early planning stages and that a considerable amount of investigation, resulting in possible changes, needs to take place. We note here that because of this a number of recommendations have been included which may not have otherwise been necessary.

7. RECOMMENDATIONS

Our recommendations are :

1. *that, subject to the conditions contained in our further recommendations, mining and construction of an ore transport system and refinery should be allowed to proceed.*

2. *(a) that, the State should not approve the draft ERMP as submitted by the Company*

   (b) that, if the Company wishes to seek approval for plans for mining and refining at an alumina production rate of 2 million tonnes per year, it should satisfy the State in its new ERMP.

3. *that, the Company should satisfy the EPA and the Public Works Department that the design for red mud and refinery waste disposal will not ever cause, in any way, either during the life of the project or after decommissioning, pollution of the Brunswick River system or any other river system. To fulfil this recommendation the Company should carry out expert investigation of the hydrology, geology, soils and associated design criteria of the Augustus River refinery and waste disposal site including the current proposal for stacking red mud.*

4. *that, the State should require all mining plans by the Company to be agreed to from time to time between the Company and the State. This arrangement should give recognition both to the Company's need for a commercially viable mining operation to the extent of the production rate of alumina approved under the Agreement Act and the State's need to manage and conserve the forest, maintain water quality in the catchments, cater for the proper needs of the community for recreation and protect the flora and fauna of the forest. In the event of the Company and the State at any time failing*

5. *that, the Company should commit itself to a programme of research and monitoring and its implementation in all phases of the project.*

6. *that, because the eastern low rainfall zone is so different from the western areas presently being mined, the Company must begin its mining research and rehabilitation programmes as soon as possible.*

7. *that on the information available in the draft ERMP, and the severe impact that the conveyor would have on the forest, if undertaken as proposed, the Authority has no alternative but to recommend that the rail option be adopted unless the Company is able in its final ERMP to satisfy the Authority that the adverse environmental impacts of the conveyor system can be overcome.*

8. *that, prior to the commencement of mining the State should require the Company to carry out detailed flora and fauna surveys of the mining, refinery site and ore transport corridor to the satisfaction of the Minister for Fisheries and Wildlife.*

9. *that, relevant comments made by Government departments and noted in Appendix I, not included in the EPA's specific recommendations above, should be taken into account by the Company in the preparation of its final ERMP.*

APPENDIX I

REVIEW OF GOVERNMENT SUBMISSIONS

WORSLEY ALUMINA PROJECT

1. INTRODUCTION

Many Government departments commented on a broad range of issues covering all facets of the project including the presentation of the ERMP. This review addresses areas of concern to the EPA, setting them in the context of the different parts of the project and including the issues of land use in the Darling Range.

While Government departments are not specifically quoted it is considered important that the Company has the opportunity of seeing the submissions in full and discussing them with each contributor if necessary.

2. THE REFINERY

A number of departments noted that the Company had not undertaken geological and hydrological studies of the refinery area. Nor had the Company proven that the waste disposal ponds would not overflow and pollute the Brunswick River system.

A number of recommendations were made and they are listed in full below.

2.1 Design Philosophy, Approval of Concepts and Management

(a) It is recommended that the ERMP is not approved in relation to mud and waste disposal because of insufficient evidence that the design concepts are adequate to avoid pollution of the Brunswick River.

(b) It is recommended that any revised ERMP be required to include the following design philosophy:

"The design of the mud and waste chemical disposal system, together with refinery drainage shall be such that at all times and in all stages in the life of the operating and decommissioned system water shall not be discharged from the system into the river downstream either by flow over the spillway, by seepage underground, or by any other means unless it can be shown that pollutants introduced into downstream waters by the system will never exceed acceptable limits representative of a high quality water resource."

(c) It is recommended as a necessary precondition for approval that any revised ERMP should include sufficient evidence to demonstrate that the proposed design concept is feasible and meets the design philosophy defined.

(d) It is recommended that before approvals are finally agreed the Joint Venturers should undertake to regularly submit detailed development and management programmes for refinery development with respect to

red mud and waste disposal, operations, rehabilitation and subsequent landscaping. They should provide for monitoring and research, reporting on performance and subsequent adaptation and improvement in the design of the various mud and waste disposal systems. The programmes should be in the form of a five year rolling programme, submitted annually, and must require the approval of the Director of Engineering, Public Works Department.

2.2 Stabilisation and Decommissioning of Disposal Areas

(a) In submitting mud or waste disposal area designs and subsequent management programmes for approval, the Joint Venturers should be required to propose measures for the surface drainage of the disposal areas which achieve a substantial restoration of the resource potential of their catchments if these are significant and which will ensure protection against erosion after decommissioning of the refinery.

(b) The Joint Venturers should be required to submit sufficient information to adequately assess the magnitude of the problems of leachates.

(c) In submitting mud lake designs for approval the Joint Venturers should be required to propose methods for dealing with leachates from the refinery site during operations and after decommissioning of the refinery and until leaching is complete. Adopted measures should be such as to make these provisions within the life of the project if possible and the Joint Venturers should accept financial responsibility for decommissioning problems.

2.3 Alternatives for Mud Disposal

(a) It is recommended that unless the requirements of previous recommendations can be adequately satisfied the Joint Venturers be required to propose a viable alternative mud and waste disposal area.

(b) It is recommended that Clause 5(4)(d) should be stressed as an important commitment for the Joint Venturers in submitting proposals under the Agreement and that a revised ERMP should include consideration of alternative disposal methods.

2.4 Monitoring and Research (Waste Disposal)

Before approval of any revised ERMP the Joint Venturers should accept some flexible form of commitment to an adequate programme of monitoring and research and should undertake to fund any such activities which the State necessarily undertakes as a consequence of the Joint Venturers' activities.

Because the refinery site waste disposal problem is considered so important a further brief note is relevant: Following the expression of the "design philosophy" a number of meetings were held between the Company and the Public Works Department and in a subsequent letter the Company agreed to fulfil the requirements of that philosophy. Although the time scale for this has not been confirmed the Company has commissioned consultants to investigate the entire question of refinery waste disposal.

The refinery posed several other areas of concern to departments and the most relevant are:

(a) SO_2 emissions although likely to be easily controlled in relation to human health levels need to be controlled and monitored especially for their effect on the surrounding forest. Any appreciable degradation of plants may result in increased runoff in the catchments surrounding the refinery and impose consequent burdens on waste disposal ponds proposed.

(b) The requirement for additional water should be clearly defined.

(c) Detailed flora and fauna surveys should be undertaken and the Company commit itself to a continuous programme of investigation and monitoring.

(d) Specific chemicals which may become wastes should be considered:

- The Joint Venturers should be advised that the use of caustic soda produced from mercury cells will not be approved.

- The Joint Venturers should be advised that they will be required to seek approval from the State on the use of synthetic flocculants and any other chemicals or potentially toxic trace elements which can find their way into the residue ponds.

- The Joint Venturers should be required in any revised ERMP to provide data on the composition and quantities of wastes to be deposited in the various disposal and residue areas.

3. MINING

The principal issue raised was that of the effects of clearing and mining in the lower rainfall area of the Darling Range. While it was considered that it may have a small effect on the concentration of salts in the total Murray River flow, it would add measurably to the total mass of salts in the whole Murray system.

Furthermore mining could cause significant salinity increases in relatively fresh tributaries of the Murray and other streams rising in the Principal Mineralised Area. This could affect the future form of development of the Murray River and other sources.

Some departments considered that without details of the areas to be mined, mining rates and strategies, and control of salinity, and erosion, the acceptability or otherwise of the project could not be assessed.

Other departments considered that these aspects should be fully described and be a commitment in a management programme.

Further comments were made:

The areas of land in various present uses and which are to be affected by mining or associated aspects, including dieback, should be clearly identified for defined mining options and durations.

Approval of any revised ERMP should be conditional on the inclusion of an undertaking by the Joint Venturers to prepare rolling Mining and Management Programmes compatible with State planning and which will include consideration of location, research, investigation, development, management, rehabilitation and monitoring of the mining areas. These Mining and Management Programmes must require State approval.

Mining should not be approved in the 34 Mile Brook Catchment until it has been properly established that salinity can be adequately controlled.

The PMAs discussed in the ERMP have certain environmental features not present in other areas in the lease. The basic requirement and approval for mining on Crown land at Saddleback should not be considered as a general priority for mining on Crown land instead of on available private property. For instance mining within the lease on the Helena, Canning and Serpentine catchments should be prohibited except for research purposes, until all accessible private property has been used.

That the EPA require the Joint Venturers to -

(a) prepare two maps for approval by the State of an area containing sufficient bauxite to maintain refineries 1×10^6 and 2×10^6 tonnes/annum for a period of 30 years,

(b) indicate on the maps, apart from the initial Saddleback ore body, preference for mining cleared private property and to show tenure, areas to be mined and areas to be retained for conservation, timber production, aesthetics and other land uses,

(c) prepare a further ERMP for an extension of mining beyond 30 years or in excess of 2×10^6 tonnes/annum.

The Company should complete a detailed biological survey of the mine site before approval to go ahead is given.

4. ORE TRANSPORT

Many departments expressed concern that there had been an inadequate comparison of the two ore transport modes. While the rail option was able to be described in some detail (and some of this was claimed not to be factual) the conveyor option was not discussed in terms of an increased number of transfer points to provide greater flexibility.

Basic data on flora and fauna were not presented nor was there adequate discussion of the effects on recreation, water supplies and the spread of dieback.

Comments were made that:

(a) Any railway or conveyor constructed in the Murray Valley should be above RL 180 m.

(b) The Joint Venturers should not be given blanket approval of two transport concepts in the ERMP but that only one be approved within a revised ERMP and the decision should be based on consideration of least damage to forest catchments and forest environment.

(c) If a dam site was constructed at Olive Hill on the Brunswick River there may be a need for future relocation of a long part of the proposed rail route and that facilities should be constructed clear of recognised dam sites and agree to remove facilities if required.

5. LAND USE

Many submissions were related more directly to land use in the Darling Range and encompassed the whole project in concept.

For instance the use of the Darling Range for recreation was described in detail. There was a prediction of large future increases in demand for recreation resources and that these will be associated with an intensification of competition for land resources, especially the forest itself.

The ERMP was considered to inadequately address the impact on recreation, particularly with respect to the loss of the refinery site and buffer zone to public access, and the intrusion of ore transport systems along the upper Murray River valley. This section of the valley was already used for fishing, canoeing and hiking (including routes used for the Duke of Edinburgh Awards from Dwellingup via Harris Dam to Collie).

It was considered that a revised ERMP should consider the impact of the project on recreation in the context of other bauxite mining operations in the Darling Range as well as the matters outlined above. Further the Company should recognise the intrinsic value of the forest as a recreation resource, i.e. the importance of bushlands, valleys and waterways as recreation attractions and the social and economic value of recreation.

It was considered that the forested areas to be mined are important to apiculture and that, where possible, priority be given to the use of a balance of nectar and pollen producing species where revegetation is undertaken.

6. OTHER

6.1 Clean Air

Mining, crushing and transport of ore are associated with problems of nuisance due to dust generation. Clearly dust nuisance to properties or the township should be avoided by accepted methods of dust suppression. Regular watering (or other appropriate measures) of haul roads, etc. should be carried out to prevent dust nuisance, not after it becomes a nuisance. The Mines Regulation Act and the Ventilation Board operating under the Act will apply to mining employees. The crusher will be a particular source of dust.

The question of conveyor systems is dealt with in Section 6.7.2 of the ERMP. These should incorporate the most successful dust suppression systems, with particular attention to feeding points, and change-over points should be incorporated. The fail-safe controls are appreciated. Covering of the conveyors is also appreciated.

Operator exposure to dust could require airconditioned cabins in some of the trucks and ore-getting vehicles.

At the refinery, bauxite will be treated by the Bayer process and autoclaved at elevated temperature and pressure to form sodium aluminate, which is then calcined to anhydrous alumina by oilfired calciners. A coal-fired power station of 4 x 15 MW capacity and ultimately 7 x 15 KW capacity is envisaged at the refinery. The advantage of using Collie coal is obvious.

Stack emissions are expected to be principally sulphur dioxide, coal dust and alumina dust. Some steam may also be given off. It is claimed in Section 4.3 of the ERMP that the altitude of the refinery at Worsley will reduce the potential problem of stack emissions below the inversion layers.

Nevertheless the commitment required from the Joint Venturers will be to comply with the provisions of the Clean Air Act and with the relevant standards issued by the National Health and Medical Research Council.

6.2 Noise Abatement

This matter is dealt with in Section 6.3.5 of the ERMP. Reference is made to the problem of hard cap blasting, to which should be added the problem of vibration. It is quite acceptable that there will not be a health risk in the town of Boddington at the mine site 14 km distant or even probably at the minimum distance of 1.5 km. What is more to the point is the possibility of noise nuisance and specific reference should be made to avoiding contravention of the Community Noise Regulations under the Noise Abatement Act.

6.3 Aboriginal Sites

No mention has been made of possible aboriginal sites in the ERMP and there is no evidence of a survey having been undertaken by the developers. It is considered essential that this be carried out as a condition of approval.

6.4 Social

Further consideration should be given to the production of housing lots and services in Boddington.

APPENDIX II

REVIEW OF PUBLIC SUBMISSIONS

WORSLEY ALUMINA PROJECT

1. INTRODUCTION

Advertisements placedAustralia-wide calling for public comment on the Worsley Alumina Project ERMP attracted thirty-four responses from private individuals, conservation groups and professional bodies having a specialist interest in some aspect of the project. Other than one response which simply lodged a formal statement of opposition to the project all submissions commented on one or more aspects of the proposal, in detail ranging from a one page hand written response to a twenty-seven page typed submission treating a number of aspects of the proposal in depth.

In one instance a second submisison was received from an individual following the release by the State Government of the report on the Alcoa Wagerup ERMP by the EPA and Technical Advisory Group, and the approval by the Loans Council of funds for construction by the State Government of a rail link between the mine site and the proposed refinery at Worsley. For review purposes however, the two responses by this author have been treated as a single submission.

Of the thirty-four responses twenty-nine were received directly by the Department of Conservation and Environment while the remainder were transmitted to DCE by the Department of Environment, Housing and Community Development according to reciprocal arrangements made under the Commonwealth/State Agreement on Environmental Assessment Procedures.

Thirty submissions were transmitted to the Company for a formal response to questions raised in the submissions as required under Commonwealth Environmental Legislation. Submissions thirty-one to thirty-three (inclusive) however were received well after the nominated closing date for public submissions and consequently were not submitted either to EHCD or to the Company.

All thirty-two detailed public submissions have however been reviewed by DCE and the criticisms and recommendations contained therein have been considered by the EPA in the formulation of its recommendations on this project. A brief review of the major points made in the public submission is included in this report.

Of the detailed submissions the majority, 88%, considered specific aspects of the proposal while the remainder addressed their remarks to potential environmental problems associated generally with bauxite mining in the Darling Scarp.

Thirty-four percent of submissions were from recognised conservation groups, professional associations or land user groups affected directly by the proposal (e.g. Beekeepers Section of the Farmers Union of W.A.). The writers of 41% of submissions were identified as having either professional qualifications or employment experience relevant to the subject of their submissions.

Attitudes toward the proposal are shown in Table IV from which it can be seen that 66% of submissions opposed the Worsley Alumina Project while a further twenty-five percent sought deferral of the project pending the outcome of essential basic research, particularly into the subject of rehabilitation in low rainfall areas. An additional 13% of submissions were non-committal in their response. This latter group comprised mainly professional bodies offering comments on particular aspects of the proposal, related to their fields of expertise, rather than drawing conclusions on the project as a whole.

There were no submissions which stated support for the project. Twenty-five percent of submissions requested a full public inquiry at the Federal level into all aspects of bauxite mining in the Darling Scarp while 31% offered constructive recommendations and alternative strategies which, if fully implemented, could in the opinions of their authors allow the project to proceed with substantially reduced environmental impact.

A total of 291 comments on specific aspects of the environmental implications of the project and of its assessment were recognised in the 144 pages of written submissions. A detailed breakdown of the comments made in each submission appears in Table I - Environmental Aspects of the Worsley ERMP and Table II - Technical Aspects of the ERMP and the State's Environmental Assessment and Control Procedures. The following discussion expands upon the major areas of concern.

2. REVIEW

2.1 Conservation of the Jarrah Forest

The most widely expressed concern was for the preservation of the jarrah forest ecosystem, both because of its conservation value and for the various forms of land use that it supports. Eighty-eight percent of the submissions received reflected this concern, many claiming that the intrinsic value of the jarrah forest was great enough, and the area of forest presently uncommited sufficiently small to warrant preservation in its entirety.

Further comments related to:

(i) the possibility that the area of jarrah forest could be reduced to a critical level at which the integrity of the ecosystem would be threatened,

(ii) the area of forest affected by clearing would be compounded by dieback spread,

(iii) the further use of forest would threaten existing MPAs and preclude the establishment of further conservation and recreation reserves,

(iv) the recreational use of the forest would be impaired,

(v) the location of the refinery in the State Forest should have been avoided because it generated the use of a transport route through forest areas in addition to refinery waste problems. Further, no alternative sites were discussed in sufficient detail.

Specific comments were made on the refinery emissions and effluent storage problems leading to recommendations for resiting near the mine site.

2.2 Water Quality and Quantity

The probability that all or part of the Murray catchment may be used for public water supply purposes was widely accepted. Thus the Company's claim that the Murray was already saline and may become more so was criticised. This concern led to suggestions that the question of salinity and rehabilitation had been inadequatley dealt with.

It was said that increased salinity would initially result from the actual clearing associated with the mine sites and haulage roads and to a lesser extent with the ore transport corridor. Subsequently, and more significantly, the spread of dieback associated with this activity would potentially affect much greater areas and have far greater effects on salinity. The success of rehabilitation of both mine site and dieback affected areas with tree species having similar hydrological properties to jarrah was considered vital to the control of salinity in the catchment and that further investigation of rehabilitation techniques was required before the commencement of mining. It was considered that if rehabilitation was not successful then salinity increases could adversely affect the possible use of fresher subcatchments of the Murray River for water supply purposes and by increasing the total salt load of the river substantially increase the cost of future desalination.

It was generally concluded that the question of salinity had been inadequately dealt with because the river is presently not used for domestic water supplies and its potential for this purpose was not recognised in the ERMP.

The water quality of the Brunswick River was thought to be under threat by the red mud storage system proposed.

The supply of fresh water to the refinery and the overall impact of the project on existing and potential water supply catchments was considered in 34% of submissions.

Concern was expressed with regard to potential water supply problems by stating that the question of supply was not clearly defined and that the allocation of priorities for supply from Wellington Weir between the wheat belt towns, irrigation farmers and Alwest should be clearly stated. The fact that the refinery draw would be heaviest in drought years when other requirements were heaviest was evidence of the need for priorities to be allocated.

2.3 Dieback

The accelerated spread of dieback through the jarrah forest as a result of all facets of the project was a concern expressed in 69% of submissions.

Submissions stated that the mining area which was currently free of dieback would be unlikely to remain so following mining despite the hygiene precautions to be implemented.

Failure to control the spread of dieback from the mining area was seen as a major cause of future salinity problems and it was stated that the spread of dieback, as a result of mining, had not been considered in assessing the effect of mining on stream salinity.

In the mining area the location of the ore bodies on the high and middle slopes with wide interconnecting haul roads was considered to threaten the whole of the mining lease in the long term.

It was generally recommended that there should be no mining until it can be shown that the spread of dieback can be prevented.

2.4 Flora and Fauna

This section was the subject of wide ranging criticism because of the failure of the ERMP to present any information other than very broad general statements lacking in detail and supporting data. It was thus claimed that the Company has exhibited a lack of knowledge and appreciation of the biological environment.

In view of this failure to provide essential information it was recommended that comprehensive floral and faunal surveys be carried out before large scale mining commences.

The 56% of public responses concerned with the sections of the ERMP dealing with fauna were highly critical of the failure to provide essential information in the report. Comment on animals present in the area is limited to broad general comments on a few of the better known marsupials and no data at all is presented on other mammals, birds, reptiles or amphibians or on invertebrates which play an important part in mining rehabilitation and management. It was also deemed necessary to consider the individual species present as parts of functioning ecosystems rather than as isolated units.

2.5 Rehabilitation

A number of the public submissions emphasised the fact that rehabilitation of mined areas had not yet been attempted in the low rainfall, eastern areas of the jarrah forest and that the combination of steeper slopes, lower rainfall and harsher soil conditions present in the Saddleback area meant that direct comparisons based on Alcoa's rehabilitation experience were not valid.

The Company's claim with respect to rehabilitation were said therefore to be unjustifiably optimistic in view of the lack of supporting evidence and because of the existing uncertainty it was widely recommended that revegetation trials should be undertaken before approval for mining was given. The proposed 2 ha trial described in the ERMP was considered inadequate and not capable of providing essential data on rehabilitation necessary for broad scale application. It was noted that satisfactory techniques for establishing a permanently self-generating forest had not yet been established and it was therefore considered that more alternatives should have been presented in the management programme in case of failure of the techniques proposed.

Clarification of the Company's aims relating to rehabilitation were also sought as the stated aims of erosion control, maintenance of the hydrologic balance and development of commercial and aesthetic values were considered to be not necessarily reconcilable with restoration of the previously occurring flora and fauna. Recreation of the natural habitat was not discussed as a management policy.

2.6 Cost-Benefit Analysis

In the ERMP it was claimed that the project would contribute significantly to regional and national economic strength, however 44% of the submissions criticised these claims because of the absence of any substantiating economic review of the project.

Some of the information considered essential to such a review was said to be - the degree of Australian participation in the project and dividend repatriation to overseas shareholders; the present net value of the project to the Company, and to the State; the balance of payments as a result of both imports and exports; public expenditure on infrastructure; and royalty payments to the State.

Additional costs incurred by the project were seen as arising from the loss of timber and honey production, recreation and tourist potential, increased salinity of streams and rivers, the use of limited fossil fuel reserves and disruption to existing social structures in the region. It was recommended that any review of public expenditure on infrastructure for the project should include a comparison between the Worsley project and benefits to the State which could be derived from providing similar assistance to other projects.

2.7 Energy

The high energy usage and low labour requirement of the bauxite refining process was commented upon in 25% of the submissions and it was generally concluded that the use of a limited fossil fuel resource, Collie coal, could not be justified for this purpose. The depletion of existing reserves of coal well within the proposed 63 year lifespan of the project was noted and the failure to fully investigate alternative energy sources was criticised on this basis.

The reason for the reduction in the quantity of coal used in producing equivalent amounts of alumina as shown between the 1974 and 1978 reports was questioned. It was stated that the figures quoted in the 1978 report were not consistent with figures quoted by Alcoa in the Wagerup ERMP and that the process efficiency claimed was probably an under-estimate.

The question of the project's viability using alternative energy sources was also raised.

Submission recommendations included proposals that the remaining coal reserves should be set aside for power generation and for labour intensive industries.

3. DISCUSSION OF THE ERMP

As can be seen from Table II, 69% of the public submissions criticised the ERMP as an inadequate document from which it was impossible to fully assess the environmental consequences of the project. A substantial proportion of this criticism was directed toward matters related to the assessment of the existing environment and these issues have been discussed in the previous section.

Thirty-eight percent of submissions were critical of various aspects of the State's assessment procedures or of the EPA or State Government in the protection of the environment.

Criticism was mainly directed toward the State Government which was felt to be suppressing relevant information (the Stanford Research Institute Report was mentioned as an example) and pressing for the approval of the project because of the short term financial gains. It was claimed that the State has a poor record in considering environmental interests and that a Federal inquiry should be held to examine the whole question of bauxite mining in the Darling Range.

The EPA was criticised for not having rejected the ERMP because it failed to meet the requirements of the Act for an ERMP/Draft EIS. The ERMP was said to be unsuitable as a document for assessment because of the inadequacies of the Western Australian Environmental Procedures.

The fact that the Agreement Acts for this project were passed by Parliament before the presentation of the ERMP, was also criticised.

4. CONCLUSION

With minor exception public response to the ERMP has been highly critical of the failure of the document to provide essential data on which to make a full assessment of the project. However the review of public submissions emphasises that the two issues of greatest concern to the public are the conservation of the existing jarrah forest, for the variety of land uses presently associated with natural forest, and the protection of the State's existing and potential water supply catchments. This is a reflection of the limited area of surface catchment available to serve the coastal plain and of the small area of the State which presently supports native forest. The fact that the Worsley Alumina Project will to some degree further reduce the remaining area of jarrah forest and preclude some water supply options is seen as the major reason for the continued high level of public concern with bauxite mining in the Darling Range.

This report, the summaries of the public submissions and the analyses of the submissions have all been presented to the EPA, which has in turn taken this information into consideration in the preparation of its final report to the Government of Western Australia on the Worsley Alumina Project and ERMP.

TABLE I - DETAILED BREAKDOWN OF ENVIRONMENTAL ASPECTS OF THE WORSLEY ERMP

SUBMISSION NUMBER	1	2	3	4	5	6	7	8	9	10	11	12	13	14/33	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	Late 31	Late 32	Total
Conservation of Jarrah Forest	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X		X	X	X	X	X		X					25
Use of State Forest for Refinery Site	X			X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X								21
Red Mud Disposal	X		X	X			X	X	X	X						X	X	X	X	X		X	X		X		X						16
Air Pollution				X																					X								2
Dieback	X		X		X		X	X	X		X	X	X	X		X	X	X		X	X		X	X	X	X		X	X			X	22
Company Operating in Quarantine Areas			X											X		X	X	X										X					6
Dieback Spread Despite Precautions	X		X						X				X	X														X	X			X	8
Spread of Disease From Transport Route	X		X		X		X	X	X		X		X	X		X	X	X						X	X							X	15
Water Quality - Other Than Salinity	X			X	X						X				X		X	X	X				X		X		X						11
Salinity	X		X	X	X		X	X	X			X	X	X		X	X	X	X		X	X	X	X	X			X	X			X	22
Water Quantity - Inc. Supply to Ref.	X							X	X		X		X				X		X		X	X			X							X	11
Rehab. Not Proven or Not Attempted in East.	X		X			X		X	X		X		X	X						X	X	X	X	X	X	X			X			X	17
Further Research Required	X																					X	X				X		X			X	6
Flora - Data Inadequate			X				X	X	X			X	X			X	X	X		X			X		X								12
Fauna - Data Inadequate	X	X	X				X	X	X			X	X	X		X	X	X		X			X		X			X					16
Fauna - Effect of Conveyor, Clearing		X			X									X																		X	4
Conflict with Existing Land Use																							X		X					X			3
Recreation						X																	X	X	X	X		X					6
Concern for Existing/Additional Reserves												X			X		X	X					X		X								6
Alternative Strategies for Project Lay-out											X				X		X	X				X	X									X	7
Inadequate Data on Mining Plans	X													X					X			X	X									X	6
Impact Not Viewed on Regional Scale			X						X		X		X	X	X				X				X		X			X					10
Lack of Co-ordinated Land Use Planning																												X				X	2
ERMP Not Considered with System 6/SRI													X	X											X								3
Public Opinion Not Sought							X					X				X	X	X							X								6
No Cost/Benefit Analysis	X						X				X	X	X			X	X	X		X	X	X			X	X		X					14
Employment	X				X									X											X	X							5
Energy Consumption	X				X								X	X					X		X			X	X								8
Aboriginal Sites																														X			1

TABLE II - DETAILED BREAKDOWN OF THE TECHNICAL ASPECTS OF THE ERMP AND THE STATE'S ENVIRONMENTAL ASSESSMENT AND CONTROL PROCEDURES

SUBMISSION NUMBER		1	2	3	4	5	6	7	8	9	10	11	12	13	14/33	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	Late 31	Late 32	Total
Qualifications Relevant to Sub.		X	X	X	X										X	X							X	X				X		X	X	X	X	13
Group Affiliation - Inc. Cons.												X		X		X							X	X		X		X	X	X	X			11
Refers to Specific Aspects of ERMP	Submission Content	X	X	X	X	X		X	X	X		X	X	X	X	X	X	X	X	X	X		X	X	X	X		X	X	X	X	X	X	28
Not Based on Specific Aspects of ERMP	Submission Content						X				X											X					X							4
For	Attitude																																	0
Against	Attitude		X	X		X	X	X	X		X	X	X		X	X	X	X	X		X			X	X	X	X		X			X		21
Non-committal	Attitude																					X						X		X	X			4
Request Inquiry	Attitude									X	X	X	X				X	X								X			X					8
Defer Pending Further Research and Sumission of a Revised ERMP	Attitude	X			X									X	X			X		X			X										X	8
Proposes Constructive Recommendations	Criticisms of the Document											X			X	X			X				X	X		X		X				X	X	10
Document Inadequate	Criticisms of the Document	X	X	X				X	X	X		X	X	X	X		X	X	X	X	X		X	X		X		X	X		X		X	22
Inadequate Review Period	Criticisms of the Document											X																						1
Agreement Acts Premature	Criticisms of the Document																							X										1
Alternatives Not Adequately Considered	Criticisms of the Document													X		X		X					X	X		X			X				X	8
Critical of EPA or Government Environ. Control						X				X				X	X		X	X		X				X	X	X								10
EPA Report Should be made Public																						X												1
Length of Submission - Pages (Approx. A4)		15	2 1/8 +	4	2	2	3	2	2	5	1	5	2	3	9/4	1	1	5	2	4	1	3	4	9	1	27	2	2	3	1	1	2	6	

TABLE III

Background of Submissions

	% of Submissions
Author	
Relevant professional qualifications stated	41
Professional Association	19
Conservation Group	13
Lay persons (or qualifications unstated)	47
Submission	
Based on specific aspects of the ERMP	88
General submission	12

TABLE IV

Attitude Towards the Worsley Proposal

	% of Submissions
For	0
Against	66
Non-committal	13
Request Public Inquiry	25
Defer Pending Research	25
Proposes Constructive Recommendations	31

Note: A submission may have proposed two courses of action, e.g. Defer pending research and Request public inquiry, the total is therefore greater than 100%.

TABLE V

Major Areas of Environmental Concern to the Public

	% of Submissions
Conservation of the Jarrah Forest	78
Salinity	69
Dieback	69
Location of the refinery in State Forest	66
Rehabilitation not proven	53
Red Mud Disposal	50
Fauna	50
Spread of disease along transport routes	47
Flora	38
Water quality - other than salinity	34

TABLE VI

Technical Inadequacies of the ERMP Itself and/or the State's Environmental Process

	% of Submissions
Document inadequate	69
Lack of Cost/Benefit analyis in ERMP	44
Critical of EPA or Govt. environmental control	31
Alternatives not adequately considered	25
Agreement Acts premature or inadequate	3
Inadequate review period	3

TABLE VII

Broader Issues of the Worsley Proposal

	% of Submissions
Impact not viewed on Regional Scale	31
Conflict with existing land use	10
ERMP not considered in relation to System 6 and SRI reports	10
Lack of co-ordinated land use planning	6