Expansion of alumina production from 2.0 million tonnes per annum to 3.5 million tonnes per annum at Worsley refinery, and associated bauxite mining activities at Boddington

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Worsley Alumina Pty Ltd

Report and recommendations
of the Environmental Protection Authority

Environmental Protection Authority
Perth, Western Australia
Bulletin 823
June 1996

THE PURPOSE OF THIS REPORT

This report contains the Environmental Protection Authority's environmental assessment and recommendations to the Minister for the Environment on the environmental acceptability of the proposal.

Immediately following the release of the report there is a 14-day period when anyone may appeal to the Minister against the Environmental Protection Authority's report.

After the appeal period, and determination of any appeals, the Minister consults with the other relevant ministers and agencies and then issues his decision about whether the proposal may or may not proceed. The Minister also announces the legally binding Environmental Conditions which might apply to any approval.

APPEALS

If you disagree with any of the contents of the assessment report or recommendations you may appeal in writing to the Minister for the Environment outlining the environmental reasons for your concern and enclosing the appeal fee of $10.

It is important that you clearly indicate the part of the report you disagree with and the reasons for your concern so that the grounds of your appeal can be properly considered by the Minister for the Environment.

ADDRESS

Hon Minister for the Environment
12th Floor, Dumas House
2 Havelock Street
WEST PERTH WA 6005

CLOSING DATE

Your appeal (with the $10 fee) must reach the Minister's office no later than 5 00 pm on 28 June 1996

Environmental Impact Assessment (EIA)

Process Timelines in weeks

Date	Timeline commences from receipt of full details of proposal by proponent	Time (weeks)
27/12/95	Proponent Document Released for Public Comment	
7/2/96	Public Comment Period Closed	6
5/3/96	Issues Raised During Public Comment Period Summarised by DEP and Forwarded to the Proponent	4
15/3/96	Proponent response to the issues raised received	2
14/6/96	EPA reported to the Minister for the Environment	12

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Summary and recommendations

This report and recommendations provides the Environmental Protection Authority's advice to the Minister for the Environment on the environmental factors relevant to the proposal by Worsley Alumina Pty Ltd to expand alumina production from 2.0 million tonnes per annum to 3.5 million tonnes per annum at its Worsley refinery, in conjunction with associated bauxite mining activities at Boddington.

This proposal has been assessed by the Environmental Protection Authority (EPA) at the level of Consultative Environmental Review (CER).

A number of environmental topics generated by the proposal were considered by the EPA. From these the EPA has identified the major environmental issues requiring detailed evaluation as:

- Environmental Management Systems;
- impact of clearing on forest ecosystems;
- rehabilitation of mined areas;
- forest disease management;
- impact on other users of State Forest;
- water resource management and protection - mining;
- noise impacts from mining and overland conveyor;
- rehabilitation of bauxite residue areas;
- atmospheric emissions including greenhouse gases;
- water resource management and protection - refinery; and
- management of rail noise.

The EPA considers that the major environmental issues identified during the assessment could be adequately managed through the proposal design, the proponent's environmental management commitments, and licensing requirements administered by the Department of Environmental Protection, in conjunction with approvals required from other agencies such as the Department of Conservation and Land Management, the Department of Minerals and Energy and the Water and Rivers Commission.

In reaching this conclusion, the EPA has acknowledged the results of monitoring undertaken by the proponent since the original project approval was granted in 1980.

The EPA has also acknowledged the role of the Environmental Management Liaison Group as a forum for interaction between State Government agencies and the proponent, thereby facilitating the development of best practice environmental management for the operation.

Following evaluation of the environmental issues, the EPA has concluded that the proposal can be managed to meet the EPA's objectives, subject to the successful implementation of the proponent's environmental management commitments, and the conditions and procedures recommended in this assessment report.

Recommendation No.	Summary of recommendations
1	That the Minister notes the environmental issues, and that the proposal can be managed to meet the EPA's objectives, subject to the successful implementation of the proponent's commitments and the EPA's recommended conditions and procedures.
2	That, if the Minister for the Environment approves the implementation of this proposal, then the proposal be subject to the recommended conditions set out in Section 6 of this report.
3	That in addition to recommendation 1, the following procedures should apply if the proposal is to be implemented: • the State Government formalises the role of the Environmental Management Liaison Group in reviewing and reporting the environmental performance of the proponent; • the proponent formalises its environmental management commitments in an environmental management plan; and • the Environmental Management Liaison Group should review the proponent's performance in accordance with the plan, and, where appropriate advise the Minister for the Environment through the Minister for Resources Development on the proponent's compliance with the environmental conditions.
3	That Westrail, in conjunction with the users of its service, and in consultation with the Department of Environmental Protection, the Ministry for Planning and relevant local government authorities, undertake a study into the current and future impacts of rail noise in the vicinity of its freight operations between Collie and Bunbury, Wagerup and Bunbury, and around the Picton Marshalling Yards. The study should include, but not be limited to: • identification of residences within the likely affected corridors around these areas; • identification of any land use zonings which may be incompatible with predicted noise levels, including potential residential developments within or adjacent to the corridors; • establishment of a model for prediction of noise emissions from freight operations, taking into account variables such as locomotive type, number and notch setting, and wagon speed and number; • adoption of a model for propagation of railway noise across the corridors; • consideration of accepted standards for noise emissions from freight operations; and • identification of appropriate ameliorative measures for any residences for which such measures may be warranted. Westrail should substantially complete the study and submit a report to the EPA prior to the commissioning of the Worsley refinery expansion.

1. Introduction and background

1.1 Purpose of this report

This report and recommendations provide the Environmental Protection Authority's advice and recommendations to the Minister for the Environment on the environmental factors applicable to the proposal to expand alumina production from 2.0 million tonnes per annum to 3.5 million tonnes per annum at Worsley and associated bauxite mining activities at Boddington in Western Australia. The location of the project is shown in Figure 1.

1.2 Background

The proponent, Worsley Alumina Pty Ltd (Worsley), is a management company for the Worsley Bauxite/Alumina Joint Venture. The current participants in the Worsley Alumina Joint Venture are Reynolds Australia Alumina Pty Ltd, Billiton Australia Pty Ltd, Kobe Alumina Associates (Australia) Pty Ltd, and Nissho Iwai Alumina Pty Ltd.

Since 1980, the proponent has managed the construction and operation of the existing alumina refinery near the Worsley siding and the associated bauxite mining near Boddington, bauxite transport, alumina shipping from Bunbury and related facilities on behalf of the Joint Venturers.

The Alumina Refinery (Worsley) Agreement Act 1973 provided the basis for the Worsley Project to proceed. This Agreement required the Joint Venturers to submit an Environmental Review and Management Program (ERMP) in order to begin project operations. The final ERMP for the Worsley Alumina Project was submitted in October 1979. The Worsley Joint Venturers received environmental approval to proceed with the project in 1980.

The bauxite mine and refinery were commissioned in 1983 and 1984 respectively. Production of alumina reached 1.0 million tonnes per annum (Mt/a) in 1985. Refinement of operating procedures and a "debottlenecking" of the project subsequently increased annual production to 1.5 million tonnes.

Worsley, acting on behalf of the Joint Venturers, propose to expand the refinery's production capacity from the current 1.75 to 3.5 Mt/a of alumina in two stages. The Stage 1 development will involve an increase in production of alumina from 1.75 Mt/a to 2 Mt/a with minor modifications to refinery plant and the construction of Berth B loading facilities in the Bunbury inner harbour, in addition to an increase in the rate of bauxite mining within the existing leases. Stage 2 of the expansion involves an increase in alumina production from 2.0 Mt/a to 3.5 Mt/a by a major upgrade of existing plant facilities and the introduction of new process technology to increase efficiency.

The EPA determined in October 1995 that Stage 1 of the expansion could be managed under Part V of the Environmental Protection Act. A Works Approval was subsequently issued by the Department of Environmental Protection for Stage 1.

In October 1995, Worsley referred Stage 2 of the proposed expansion to the EPA for assessment. The EPA set the level of assessment at Consultative Environmental Review.

1.3 Structure of this report

This document has been divided into seven Sections.

Section 1 describes the historical background to the proposal and its assessment and explains the structure of this report. Section 2 briefly describes the proposal. The proposal is described in more detail in the proponent's Consultative Environmental Review (Worsley, 1995).

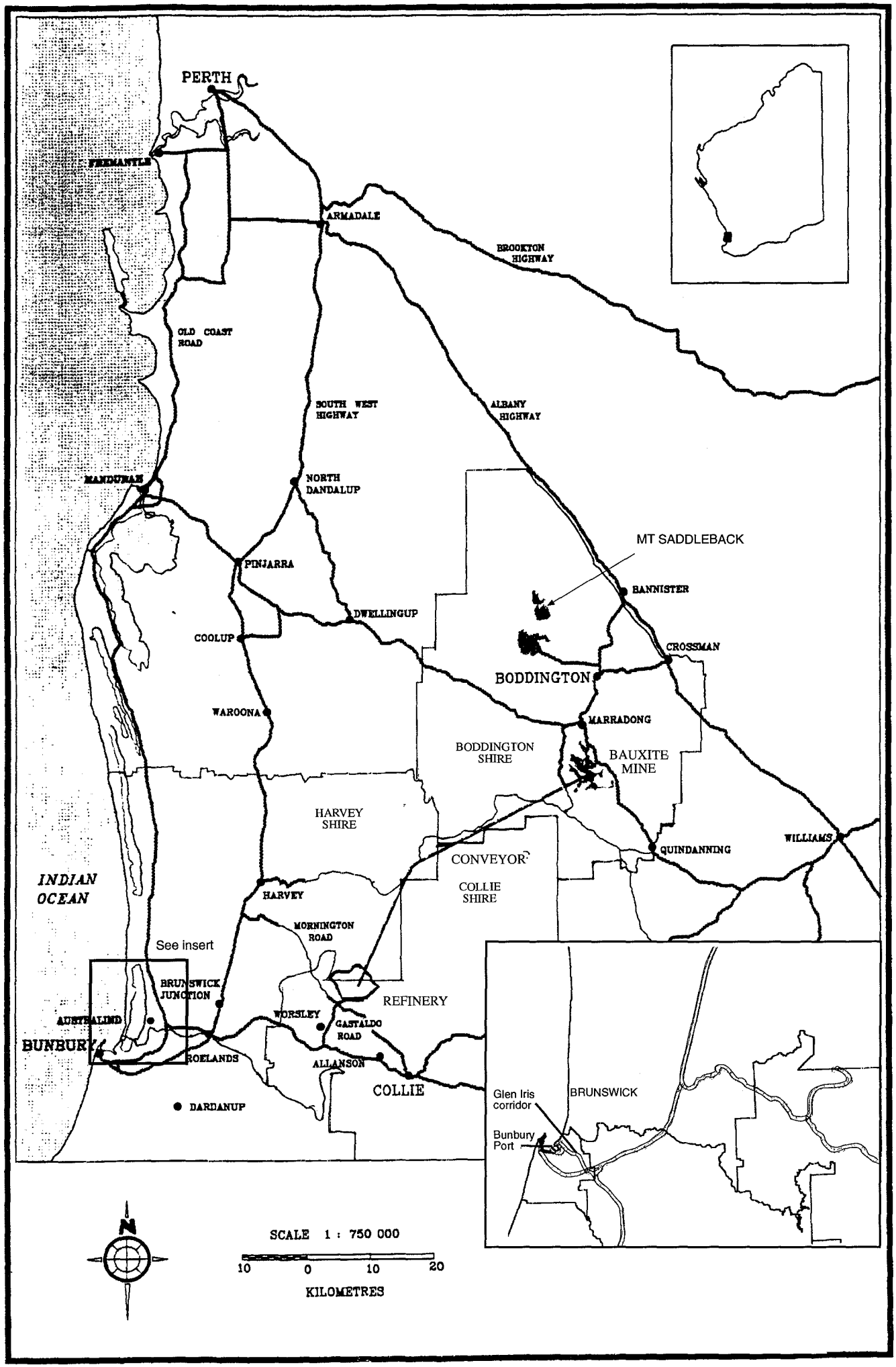

Figure 1. Project locations (modified from Figure 1 of the CER).

Section 3 explains the method of assessment and provides a summary of the topics raised through the setting of guidelines and in public submissions. From these topics and others raised during the assessment process, those considered issues that require further evaluation by the Environmental Protection Authority are identified. A table summarising this process is provided (Table 1).

Section 4 details the evaluation of the environmental issues associated with the proposal. Each issue is discussed in its own subsection, which initially states the objectives of the assessment for that issue. The relevant Environmental Protection Authority policy is stated and any technical information is provided. Comments from key agencies/interest groups are summarised, and the proponent response is presented. The subsection on each issue is concluded with the Environmental Protection Authority's evaluation in terms of achieving the stated objectives. The evaluation of the key environmental issues is summarised in Table 5.

Section 5 summarises the conclusions and recommendations. Section 6 describes the recommended environmental conditions. References cited in this report are provided in Section 7.

2. Summary description of the proposal

The Worsley Project is situated in the south west of Western Australia and involves the mining of bauxite in the Mt. Saddleback area, transport of bauxite via a 51 kilometre overland conveyor to the Worsley refinery where alumina is extracted from the bauxite by the Bayer process (see Figure 1). Bauxite residue ('red mud') is a by-product of the Bayer process and is disposed of onsite, in contained impoundment areas.

Bauxite mining presently occurs in the Primary Bauxite Area (PBA) near the town of Boddington within mining leases granted under the *Mining Act* and the Alumina Refinery (Worsley) Agreement Act. As a result of the proposed expansion, mining will proceed at an accelerated rate within these leases and in approximately 30-35 years time, mining will go beyond the PBA and into southern and northern parts of mining lease ML 258SA . Based on current proven bauxite reserves, up to 65% of the forested area in the PBA will be left uncleared during mining. Figure 2 provides a comparison of the extent of forest areas with the mining area.

To accommodate the increased output of bauxite from the mine, the overland conveyor will be operated for longer hours.

The expansion of refinery capacity will be achieved through the introduction of improved efficiency and by retrofitting existing equipment and installing new process facilities. New plant will include:

- a liquor purification facility to improve the efficiency of the Bayer process;
- either a coal or gas-fired boiler to provide for the additional energy demand of the expansion; and
- two additional gas-fired calciners to remove chemically combined water to form alumina product.

Production of bauxite residue will increase proportionally and will require an acceleration of the construction program for residue disposal areas. No extension of the area originally approved for residue disposal will be required to accommodate the expansion for present proven bauxite reserves within the PBA. The refinery and residue disposal areas are designed so that contaminated water does not escape from the refinery lease area. Contaminated runoff waters and seepage from the residue disposal areas are captured by pipehead dams and the refinery catchment lake for use in the refinery process. Fresh water on the refinery lease is directed to the freshwater lake for potable uses in the refinery and as make up water to the refinery process.

An extensive network of monitoring bores and sites around the refinery has been established to monitor any affects on the quality of groundwater and surface waters.

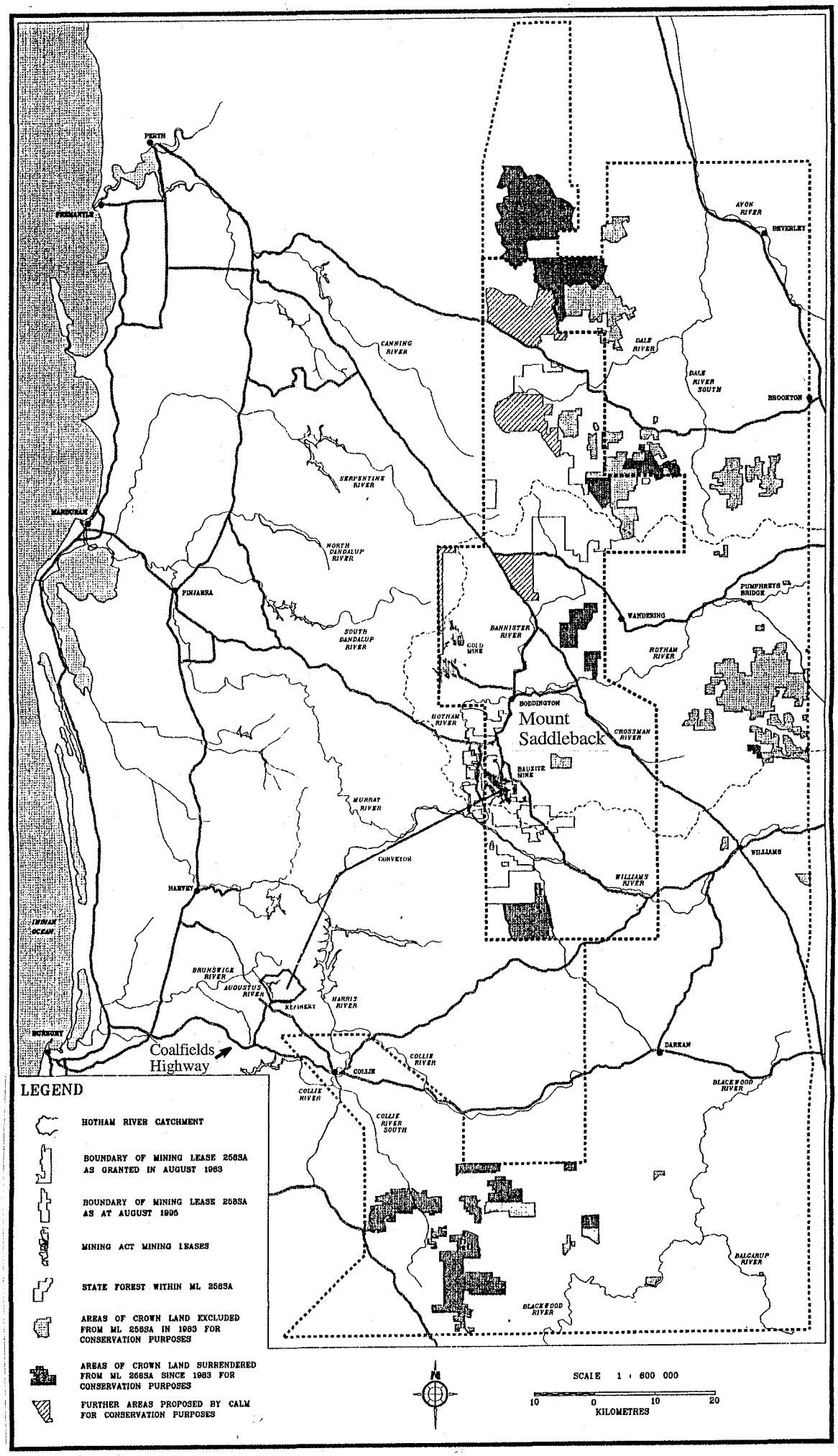

Figure 2. Project mining leases (modified from Figure 6 of the CER).

The anticipated annual increase in mining, atmospheric emissions, and bauxite residue associated with the expansion, are as follows:

	2 Mt/a Production	3.5 Mt/a Production	Increase	% Increase
bauxite mined (million tonnes)	7.3	12.6	5.3	72.6
forest clearing (hectares per annum)	70	140	70	100
bauxite residue (million wet tonnes)	6.8	11.9	5.1	75
Mine water supply (ML per annum)	200	300	100	50
conveyor operation (hours per week)	85	140	55	64.7
sulphur dioxide (tonnes (with coal as fuel))	10,610	16,370	5760	54.3
oxides of nitrogen (tonnes)	4,310	6,650	2340	54.3
particulates (tonnes)	293	512	219	74.7
carbon dioxide (million tonnes (with coal as fuel))	1.96	3.15	1.19	60.7
trains to Bunbury Port (trains per week)	30	65	35	116.7

Source: Worsley, 1995

No additional land would be required for residue disposal areas, although the rate of residue disposal within the previously approved area would increase.

Increased water consumption in the refinery will be met in the medium and longer term by the increased yield from the refinery catchment and the increased recovery of recycled water from the residue disposal areas. The basal flow from the freshwater lake following the expansion is expected to remain the same as current levels, and the increased recovery of process liquors should result in a decreased need for supplementation from the lake.

A small amount of native vegetation (3 hectares) within the refinery lease area will be cleared to accommodate the expansion of the refinery.

3. Identification of environmental issues

3.1 Method of assessment

The purpose of environmental impact assessment is to determine whether a proposal is environmentally acceptable, or under what conditions it could be environmentally acceptable.

A set of administrative procedures has been defined (refer to Appendix 1) in order to implement this method of assessment.

The first step in the method is to identify the environmental topics to be considered.

For this proposal, an extensive scoping exercise was undertaken by the proponent to determine environmental issues of potential concern or importance to the public, community organisations, local authorities, and government agencies. This consultative process included an independent survey of residents in the vicinity of the mine and refinery.

A list of topics was identified by the Department of Environmental Protection (DEP), on behalf of the Environmental Protection Authority (EPA) through the preparation of guidelines. These guidelines were referred to the proponent, relevant agencies and interest groups, prior to being given to the proponent in a final form.

These topics were then considered by the proponent in the preparation of the Consultative Environmental Review (CER) through the identification of potential impacts and making project modifications or devising environmental management strategies.

The CER was then reviewed to ensure that each topic has been discussed in sufficient detail prior to release for government agency and public comment. Worsley's CER was available for public review for six weeks between 27 December 1995 and 7 February 1996, during which time 21 submissions were received.

Following completion of the public review period, the responses received were summarised by the DEP. This process can raise additional environmental topics to be considered by the proponent.

Worsley was invited to respond to matters raised in the summary of submissions. Appendix 2 contains the summary of the submissions and the proponent's response to those submissions. The list of submitters is included in Appendix 3.

By this stage in the assessment, 23 topics had been identified, of varying environmental significance. The EPA considered all the topics and identified those that were not environmentally significant or did not require further evaluation. Often these topics can be addressed by other agencies or have been adequately addressed by the proponent's commitments. The remaining topics were considered to be issues of environmental significance that required further evaluation by the EPA.

For each environmental issue, the environmental impacts of the proposal, and the proponent's environmental management commitments were evaluated in the context of the EPA's assessment objective and relevant policy and technical information. The complete list of the proponent's consolidated environmental management commitments is included in Appendix 4 of this report. If the commitments achieve the assessment objectives, there is no need for the EPA to make recommendations to the Minister for the Environment on that issue. Otherwise, the EPA may recommend conditions and procedures necessary to achieve the EPA's objectives. Where the proposal has unacceptable environmental impacts, the EPA can advise the Minister for the Environment. The Minister for the Environment determines whether the proposal should proceed and under what conditions.

Limitation

This evaluation has been undertaken using information currently available. The information has been provided by the proponent in the CER and supplementary documentation, by DEP officers utilising their own expertise and reference material, by utilising expertise and information from other State government agencies, information provided by members of the public, and by contributions from EPA members.

The EPA recognises that further studies and research may affect the conclusions. Accordingly, the EPA considers that if the proposal has not been substantially commenced within five years of the date of this report, then such approval should lapse. After that time, further consideration of the proposal should occur only following a new referral to the EPA.

3.2 Public and agency submissions

Comments were sought on the proposal from the public, interest groups and local and state government agencies. During the public review period 21 submissions were received. A summary of these submissions was forwarded to the proponent for their response, as included in Appendix 2. Of the 21 submissions received, 13 were from government agencies (local, state and federal), 2 were from conservation groups and 6 were public submissions.

The principal topics of concern raised in the submissions were:

Mining Impacts

Biophysical Impacts

- impact of clearing on forest ecosystems
- rehabilitation management
- forest disease management

Pollution Potential

- water resource management and protection
- noise and blast vibration management

Refinery Impacts

Pollution Potential

- atmospheric emissions including greenhouse gases
- water resource management and protection
- management of rail noise

The EPA has considered the submissions received and the proponent's response as part of the assessment of this proposal.

3.3 Review of topics

3.3.1 Identification of topics

23 topics were raised during the environmental impact assessment process, including those topics identified in the EPA guidelines, subsequent consultations with the proponent and relevant government agencies and in public and government agency submissions. The topics are as follows:

- Environmental Management Systems

Mining Impacts

Biophysical Impacts

- impact of clearing on forest ecosystems
- rehabilitation management
- forest disease management
- impacts on other users of State forests

Pollution Potential

- water resource management and protection
- noise and blast vibration management
- dust management
- waste management

Refinery Impacts

Biophysical Impacts

- management of bauxite residue
- decommissioning and return of refinery land

Pollution Potential

- atmospheric emissions, including greenhouse gases
- water resource management and protection

- management of solid and liquid waste
- noise management
- management of rail noise

Social Surroundings - Refinery & Minesite

- hazard management
- road traffic impacts
- community consultation
- maintenance of separation distances
- impacts on available residential lots and accommodation
- Aboriginal heritage
- control of public access and safety

The EPA has evaluated the above topics and considers that a number of them can be managed by the proponent in accordance with their environmental management commitments and in compliance with DEP regulations and guidelines (see Table 1). Each topic is discussed below in order to identify those requiring further evaluation by the EPA.

3.3.2 Identification of issues requiring EPA evaluation

Environmental Management Systems

The EPA recognises the importance of best practice with regard to environmental management. Worsley has indicated it intends to further develop its Environmental Management System in accordance with the principles of the Standards Australia ISO 9000 series.

An important element of Worsley's Environmental Management System involves liaison with, and reporting to, the State Government through the Environmental Management Liaison Group (EMLG). This group consists of representatives of the Departments of Environmental Protection (DEP), Conservation and Land Management (CALM), Minerals and Energy (DME) and Resources Development (DRD). The Water and Rivers Commission (previously the Water Authority of Western Australia) is also a member. The role and composition of the EMLG should be formalised.

The EMLG should advise government on the acceptability of the proponent's environmental performance including management plans, performance audit, and review of the management plan.

Further, the submission from CALM reiterated that it has specific statutory responsibilities under the Agreement Act, and that these would remain unaltered by the development of the EMLG. The submission from the Conservation Council requested that it also be included on the EMLG.

This topic has been identified as an issue requiring evaluation by the EPA.

Mining Impacts - Biophysical

Impact of clearing on forest ecosystems

Worsley's bauxite mining operations occur on the eastern edge of the Darling Range. Most of the bauxite is under jarrah forest, with some small areas having been cleared for agriculture.

Clearing of native vegetation prior to mining has the potential to impact on the jarrah forest ecosystem and impair the long term viability of populations of species known to be rare and endangered or geographically restricted.

The rate of clearing in State forest will increase from the current rate of 70 ha per annum to an estimated 140 ha per annum.

No rare and endangered flora have been located, but 15 priority species from CALM's Declared Rare and Priority Flora List have been identified within the project area. A number of fauna species protected by the Commonwealth *Endangered Species Protection Act, 1992* and the *Wildlife Conservation Act, 1950* are also known to occur.

Worsley has an established flora and fauna conservation strategy that has been developed and is implemented in consultation with CALM.

The submission from CALM indicates it has worked closely with Worsley since it commenced operations and is pleased with the comprehensive list of commitments contained within the CER.

A number of public submissions commented on this issue. Submitters suggested that bauxite mining should occur only over cleared land to prevent additional clearing of forest areas, and requested clarification regarding the incremental impacts of disturbance, and the potential disturbance to areas of high conservation value.

This topic has been identified as an issue requiring evaluation by the EPA.

Rehabilitation of mined areas

The EPA has in past assessments recognised that rehabilitation management should not impose short or long term costs on the community of Western Australia.

Under the Alumina Refinery (Worsley) Agreement Act, 1973, Worsley is required to develop completion criteria for the rehabilitation of the site in consultation with CALM, and also enter an 'Consent, Compensation, and Restoration Agreement' with private landowners.

Clearing of forested areas has the potential to directly affect the ecosystem, as well as contributing to rising groundwater levels and the mobilisation of salts stored in the soil profile.

Disturbance to agricultural land requires a rehabilitation prescription that is designed to restore the pre-existing productivity qualities and mitigates other potential impacts such as rising groundwater levels, mobilisation of stored salt, and wind and water erosion that could affect the land capability of the rehabilitated area.

Worsley has implemented the rehabilitation program that it committed to in the 1979 ERMP, in consultation with CALM. The prescription is evolving and is reviewed with CALM in response to information from monitoring and research programs.

The Department of Minerals and Energy considered that the proponent should also make a commitment towards 'maximising the direct return of topsoil'. Submissions also requested clarification regarding whether Worsley's target of 35% coverage of rehabilitated areas with fresh topsoil has been achieved in recent years, and also asked to what extent Worsley coordinates and shares information with other major users of the jarrah forest.

This topic has been identified as an issue requiring evaluation by the EPA.

Forest disease management

Bauxite mining and associated activities such as forest clearing and exploration drilling have the potential to introduce and spread jarrah dieback and other forest diseases. *Phytophthora cinnamomi* which causes jarrah dieback is spread through the movement of soil on vehicles and equipment and by surface water runoff.

Worsley has an existing forest disease management strategy which has been developed and is implemented in consultation with CALM. This strategy includes dieback mapping of all areas prior to mining. The mining plan is then developed in accordance with forest hygiene procedures and is based on a disease risk minimisation objective.

Since 1979, no new dieback infections have been recorded on the Saddleback Timber Reserve (shown on Figure 3) where mining has occurred. In 1992 a dieback infection (less than one hectare) was discovered on Worsley Joint Venture owned land.

Monitoring of infections over the past two years has revealed the absence of an "active dieback front" with plant deaths near the infection being sporadic.

Public submissions suggested there is a need for the proponent to address the potential for the spread of dieback disease as a consequence of mining operations, and that there has been little progress made in the understanding of dieback prevention and elimination.

This topic has been identified as an issue requiring evaluation by the EPA.

Impacts on other users of State Forest

The management of the Saddleback, Marradong and Quindanning Timber Reserves is based on the Forest Management Plan 1994-2003 (Lands & Forest Commission, 1994).

Bauxite mining and forest clearing for mining has the potential to impact on other users of State Forest. Uses include conservation, recreation, water resources, timber production and bee keeping.

The co-ordination of bauxite mining and forest management planning has been developed by Worsley in conjunction with CALM and is subject to annual review by the Environmental Management Liaison Group through Worsley's 10 Year Mining Plan and Environmental Management Report both of which are submitted to government.

One submission suggested that any approval for the proposal should be conditional upon full implementation of all the conservation reserve recommendations in the 1983 System 6 report, as updated by CALM in 1987 and 1994, and supplemented by the recommendations in the *Central wandoo woodlands: Botanical Survey.*

This topic has been identified as an issue requiring evaluation by the EPA.

Mining Impacts - Pollution Potential

Water resource management and protection - Mining

The bauxite mine is within the intermediate rainfall zone (740 mm per year) of the eastern Darling Range, and within the catchment of the Hotham River.

Abstraction from the Tunnell Road borefield (shown on Figure 3) currently meets 85% of the minesite's annual water requirements.

The clearing of native vegetation prior to bauxite mining together with groundwater abstraction from the Tunnell Road heathland area has the potential to alter the hydrology and stream water quality in and around the mining area. The significance of this impact is affected by the rate of clearing and groundwater abstraction and the time between clearing and rehabilitation.

Fuelling facilities, if not properly designed have the potential to contaminate ground and surface waters, particularly in the event of a major storm event.

Water demand at the mine is expected to increase by 50%, from 200 to 300 ML/annum as a result of the expansion.

To meet future increased water demand, Worsley proposes to seek supply from other sources. A number of options are being investigated to reduce water consumption and reduce the draw upon the shallow aquifer.

The Water and Rivers Commission has requested that monitoring parameters for the Hotham River be discussed with that agency and that fuelling facilities should include impervious bunding and be designed to cope with storm events without overtopping.

Other submissions requested comments on the potential impacts of mining operations on water quality (particularly salinity) of ground and surface waters, and whether the proponent is prepared to contribute to the development and implementation of a Salinity Strategy for the State.

The design and operation of fuelling depots could be managed under Works Approval and Licence Conditions, as required under Part V of the Environmental Protection Act.

The potential for mining operations to impact on the water quality, particularly salinity, and the quantity of ground and surface waters has been identified as an issue requiring evaluation by the EPA.

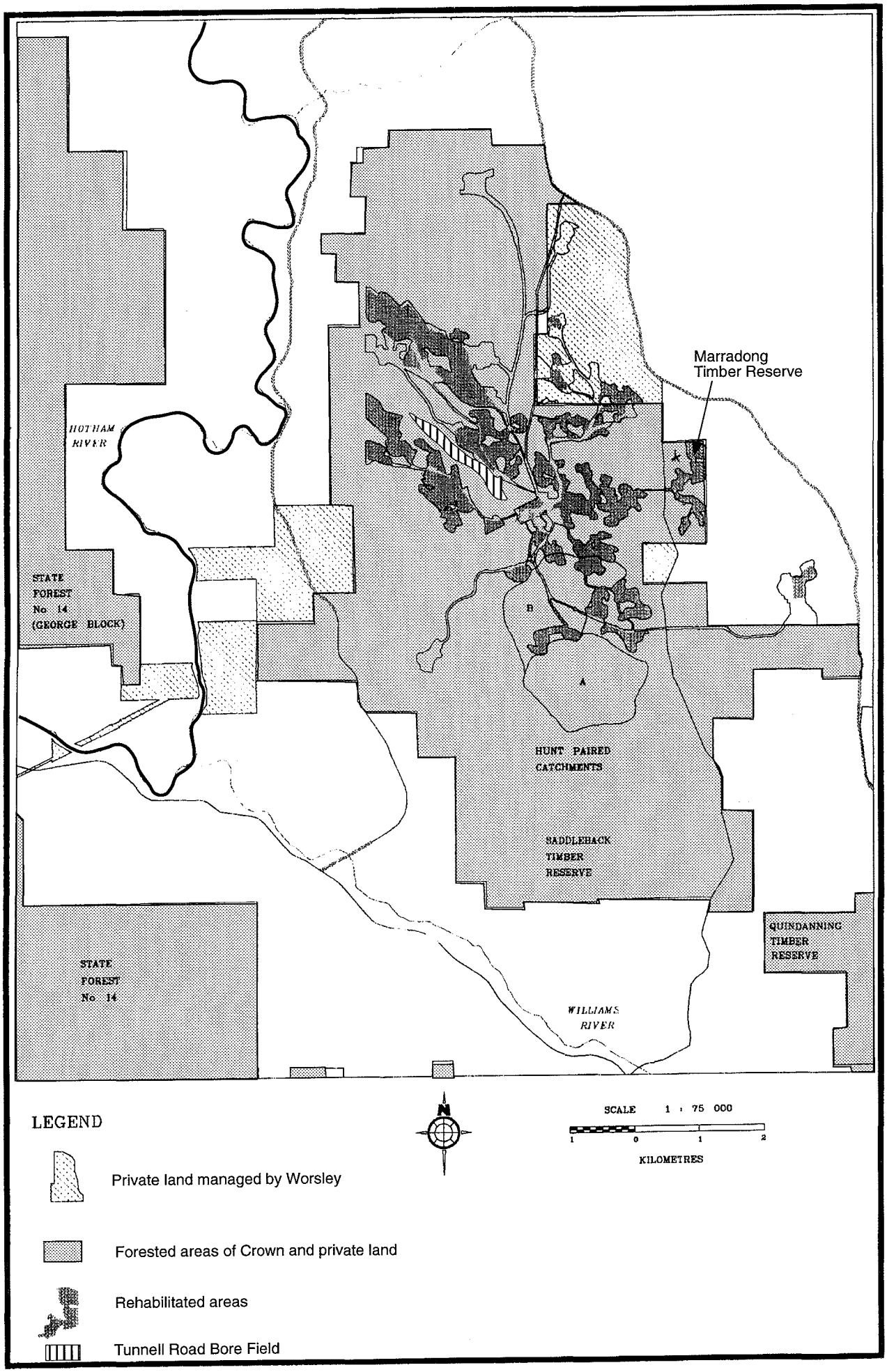

Figure 3. Forested areas, timber reserves and the Tunnell Road borefield. (Source: Figure 7 of the CER.)

Noise and blast vibration management

Noise impacts and blast vibration as a result of mining operations may affect the health and amenity of residents in close proximity to the mine. The increase in the hours of operation of the overland conveyor might also cause noise impacts on neighbouring residents.

The proponent is required to ensure compliance with noise control regulations under the Environmental Protection Act. Airblast overpressure emissions from the minesite have been regulated under Part V licence conditions since 1989.

The DEP has stated that 99.9% compliance with the proposed regulations is required, and that future monitoring should verify the effects of operational modifications and assess tonal, modulation or impulsive noise characteristics.

This topic has been identified as an issue requiring evaluation by the EPA.

Dust Management

Activities such as vehicular transport of mined bauxite, blasting, the operation of mining equipment, crushing and stockpiling all have the potential to generate fugitive dust emissions.

Mining operations are subject to licence conditions under the pollution prevention provisions of the Environmental Protection Act. The proponent has also made commitments regarding the control of dust emissions from the minesite, and to ensure that statutory requirements relating to the protection of the amenity of nearby residents are met (Commitments 41 and 42).

Further evaluation of this topic by the EPA is not required.

Waste Management

Wastes generated on the minesite are either collected and recycled on the site, or deposited in an offsite landfill.

The Shire of Boddington has requested that the proponent provide assistance with costs towards a suitable landfill site to meet the future waste disposal needs of the local community.

The Waste Management Division of the DEP recommended that it be consulted for assistance in locating an additional landfill site, and that the proponent comply with Environmental Protection Act regulations regarding the storage and disposal of tyres.

The management of waste from the mine is subject to licence conditions under the pollution prevention provisions of the Environmental Protection Act. In addition to these requirements, and the requirements of the local government authority, Worsley has committed to investigate methods for on-site reuse and recycling of wastes and to assist the Shire of Boddington in locating an alternative landfill site (Commitments 47 and 48).

Further evaluation of this topic by the EPA is not required.

Refinery Impacts - Biophysical

Management of bauxite residue

The increase in alumina production would also lead to an increase in the rate of generation of bauxite residue, thereby increasing the potential for impact on water resources and the generation of dust.

Public submissions suggested that the closure criteria and long term management strategies for residue areas should be finalised and agreed to before approval for the expansion is granted.

The design and construction aspects of the residue areas are managed under DEP Part V Works Approval. Dust and water quality parameters are also established under Part V Licence Conditions.

The issue of a closure and rehabilitation strategy to be agreed with the State requires further evaluation by the EPA.

Decommissioning and return of refinery land

The expansion of the refinery to cater for an increase in production to 3.5 million tonnes per annum would require clearing of an additional 3 hectares of vegetation.

At the end of the project life, the refinery operations will require appropriate decommissioning and rehabilitation to restore the attributes of the site as they existed prior to disturbance.

Within the existing requirements of the Alumina Refinery (Worsley) Agreement Act, 1973, the proponent is required to develop completion criteria and to ensure the successful and sustainable rehabilitation of the site. CALM must approve the standard of rehabilitation, prior to the return of any rehabilitated land to the State.

In addition to these statutory requirements, Worsley has also committed to prepare decommissioning and closure plans and completion criteria for the refinery area, in consultation with the EMLG (Commitments 101 to 104).

As this topic is addressed by the statutory requirements of other agencies, further evaluation by the EPA is not required.

Refinery Impacts - Pollution Potential

Atmospheric emissions, including greenhouse gases

The ecological values of offsite areas, and the amenity and health of nearby residents could potentially be affected by gaseous emissions (eg NOx, SOx, odours) discharged as a result of refinery operations.

Expanded operations would significantly add to greenhouse gas emissions in Western Australia. These emissions could contribute to climate change.

Submissions suggested that the proponent should be encouraged to use gas rather than coal as fuel in the powerhouse, to reduce greenhouse gas and sulphur dioxide emissions.

The potential impact of increased gaseous emissions as a result of increased alumina production requires further evaluation by the EPA.

Water resource management and protection

The refinery operations have the potential to impact upon the environmental values of water resources, particularly the water quality and quantity of potable water resources.

The Water and Rivers Commission commented that all chemical and oil tanks and process vessels will require adequate perimeter bunding to control spills and minimise overtopping.

Submissions identified that the security of on-site dam design needs to be examined to ensure the protection of local water catchments. Submissions also queried the potential for dam overflow during extreme storm events.

The design details for the refinery process water circuit and its operation are subject to Part V Works Approval and Licence Conditions administered by the DEP.

The potential for refinery operations to impact upon environmental values of water resources requires further evaluation by the EPA.

Management of solid and liquid waste

An increase in the scale of operations at the refinery has the potential to increase the production of liquid and solid wastes.

The DEP suggested that Worsley should liaise with the DEP regarding the possible options for the long term management of on-site disposal of fibrous materials, spent acids and all aspects of the reuse and recycling of wastes.

During the construction and implementation of expanded operations at the refinery, the proponent will be required to comply with conditions imposed through the pollution prevention provisions of the Environmental Protection Act.

In addition to these requirements, the proponent has made a commitment to waste minimisation and to reuse or recycle wastes where practicable. The refinery landfill will be operated to prevent impacts on surface and ground waters (Commitments 79 to 81).

Further evaluation of this topic by the EPA is not required.

Noise management

The expansion of the refinery may result in an increase in noise emissions.

Advice from noise assessment officers within the DEP suggests that as the refinery is located more than 8 kilometres from the nearest residence, noise is not expected to be an issue, and the proponent's monitoring has confirmed this.

The proponent is required to comply with noise control regulations under the Environmental Protection Act. The proponent has committed to conduct periodic acoustic assessments at the nearest sensitive residence to the refinery, to ensure continued compliance with the statutory requirements (Commitment 82).

The EPA considers that as a result of the substantial buffer zone provided by areas of State Forest around the refinery, adequate controls exist under the Environmental Protection Act to control noise associated with the refinery operations.

Further evaluation of this topic by the EPA is not required.

Management of rail noise

Currently 30 trains per week deliver coal, and other products to the refinery, and transport alumina to the Port of Bunbury. The proposed expansion may result in train movements increasing to 65 per week, with consequent effects on residents in close proximity to the railway line. Further increases in train traffic may be anticipated as a result of other proposed developments in the region.

The DEP has received a number of complaints regarding noise emissions from the Picton marshalling yards. The impact of future increases in rolling stock needs to be considered in the management of noise emissions from this centre.

The issue of rail noise, particularly shunting noise at the Picton marshalling yards and noise arising from additional rail traffic associated with the proposed expansion requires further evaluation by the EPA.

Social Surroundings - Refinery and Minesite

Hazard management

Potential hazards at the refinery site include the presence of large volumes of caustic soda at elevated pressures and temperatures, in addition to acids and flammable substances.

The management of hazardous materials is regulated through the Explosives and Dangerous Goods Act, administered by the Department of Minerals and Energy. In addition to meeting these requirements, the proponent has committed to implementing a comprehensive program for the identification and prevention of hazards at the refinery as well as the preparation and implementation of an emergency response plan (Commitments 77 and 78).

Further evaluation of this topic by the EPA is not required.

Road traffic impacts

The expansion in mining activity and alumina production rates will result in an increase in mining/refinery related traffic, and as a consequence, road upgrades may be necessary.

The Shire of Collie has indicated that Coalfields Highway is its preferred route for access to the refinery. The City of Bunbury's submission recognised that increases in train movements may require the construction of the Glen Iris Service Corridor between Glen Iris and the Port of Bunbury to reduce potential road delays.

This matter should be addressed by the local government authorities and relevant State Government agencies such as Main Roads Western Australia (MRWA) in conjunction with the proponent. Worsley has also committed to participate in any Government working party to address issues of road safety and the upgrading of main transport routes to the refinery (Commitment 95).

Further evaluation of this topic by the EPA is not required.

Community consultation

The environmental issues of concern to the community from this proposal need to be adequately addressed.

Public submissions suggested that private landowners should be compensated if mining occurs on their properties.

Community consultation has been initiated by the proponent as part of the public review of its proposal. The issue of compensation is a matter for negotiation between private landowners and the proponent. Further evaluation of this topic by the EPA is not required.

Maintenance of separation distances

The expanded mining and refinery operations have the potential to affect the amenity of residences in close proximity.

The potential for the proposal to affect the amenity of neighbours through noise impacts and impacts on water resources has been considered as separate topics which are discussed in Section 4.

Worsley has also committed to retaining existing buffer areas and, if required, will establish buffer areas around project locations through local town planning schemes in consultation with the State (Commitments 98 and 99). Further evaluation of this topic by the EPA is not required.

Impact on available residential lots and accommodation

The proposed expansion will result in an increase in the population of Boddington by approximately 10%. This has the potential to affect existing town facilities.

The Shire of Boddington suggested that the proponent should assist in improving the Boddington town business centre, residential, school, medical, and recreational facilities and existing road infrastructure. The Shire of Collie also suggested that workers be accommodated within close proximity to the Collie township.

Worsley has committed to construct additional accommodation in Boddington and/or near the refinery, and to participate in any Government coordinated forum to address issues of workforce accommodation (Commitments 89, 91 and 92).

This topic should be addressed through other processes. Further evaluation of this topic by the EPA is not required.

Aboriginal heritage

Mining operations could potentially affect sites identified as having potential archaeological and ethnographic significance.

Worsley has made a commitment to ensure that mining operations do not adversely affect sites having potential archaeological significance (Commitment 100).

The EPA considers that the predicted impacts of the proposal on Aboriginal heritage values can be adequately managed through processes outside the Environmental Protection Act, 1986, notably the Aboriginal Heritage Act, 1972. Further evaluation of this topic by the EPA is not required.

Control of public access and safety

Blasting and mine traffic activities are potential hazards to the community. These issues are managed through legislation administered by the Department of Minerals and Energy.

The proponent has also made a number of commitments to ensure that public access to mine areas is restricted and that public safety is maintained through the use of security fencing, signs and safe blasting procedures (Commitments 43 to 46).

This topic should be addressed through other processes. Further evaluation of this topic by the EPA is not required.

3.3.3 Summary

Table 1 summarises the process used by the EPA to evaluate the topics raised during the environmental impact assessment process. The table identifies the topics, the relevant characteristics of the proposal, and comments received from specialist government agencies and the public. If a topic is considered environmentally significant it becomes an issue and is further evaluated by the EPA (as summarised in Table 5). Section 4 of this report provides the detail of this evaluation.

The issues identified in Table 1 as requiring further evaluation by the EPA are:

- Environmental Management Systems;
- impact of clearing on forest ecosystems;
- rehabilitation of mined areas;
- forest disease management;
- impact on other users of State Forest;
- water resource management and protection - mining;
- noise impacts from mining and overland conveyor;
- rehabilitation of bauxite residue areas;
- atmospheric emissions including greenhouse gases;
- water resource management and protection - refinery; and
- management of rail noise.

4. Evaluation of key environmental issues

4.1 Environmental Management Systems

Objective

To apply the principles of best practice environmental management.

Technical Information

Worsley carries out its activities in accordance with best practice environmental management where best practice implies the use of the best practicable equipment, process or systems and techniques (Worsley, 1995).

Environmental Management Systems

To facilitate the planning and implementation of environmental management, Worsley has implemented an environmental management system which comprises five programs. These programs are education, services, environmental studies, monitoring and reporting. Implementation of these programs is facilitated through Worsley's environmental compliance system.

The primary purpose of Worsley's environmental monitoring is to provide feedback on performance to enable continuous improvement of Worsley's environmental management programs. In conjunction with its existing monitoring, Worsley is commencing a program of environmental audits to improve environmental performance and determine compliance with environmental management procedures.

TOPICS	PROPOSAL CHARACTERISTICS	COMMENTS FROM GOVERNMENT AGENCIES	PUBLIC COMMENTS	IDENTIFIED ISSUES
ENVIRONMENTAL MANAGEMENT				
Environmental Management Systems	The proponent is developing an Environmental Management System that applies the principles of Best Practice Environmental Management. The EMLG involves representatives of government, and annually reviews the project.	CALM's statutory role under S. 16 of the Agreement Act stands. Advice from other agencies is welcomed but final decisions regarding land use objectives for State forest and completion criteria for CALM-managed lands should rest with CALM (CALM).	The Conservation Council should be included in the EMLG.	*The role of the EMLG in advising Government on the proponent's environmental performance requires further evaluation by the EPA.*
MINING IMPACTS - Biophysical				
Impact of clearing on forest ecosystems	The project will involve clearing jarrah forest at twice current rates, ie 140 ha/year rather than 70 ha/year. Clearing of native vegetation could impact on the jarrah forest ecosystem and impair the long term viability of populations of species known to be rare and endangered or geographically restricted.	CALM and Worsley have co-operated on mine planning, data on declared rare flora and fauna, and identifying areas of high conservation value within the PBA and the lease area. CALM has liaised closely with Worsley in the preparation of the CER. CALM is pleased with the comprehensive list of proponent commitments (CALM).	Mining should only occur over cleared land to prevent forest clearing. An environmental tax should be imposed if mining proceeds in native forests. Forest areas should be assessed for conservation value and high conservation value areas protected. The incremental and interactive impacts of disturbance to ecosystems, and the potential noise, dust and emission impacts on flora and fauna need to be addressed. The extent of establishment of species in rehabilitated areas should be determined.	*The impact of bauxite mining on jarrah forest, and the associated incremental, cumulative and interactive impacts require further evaluation by the EPA.*
Rehabilitation management	Rehabilitation of mined areas in State forests could potentially be unsustainable and may fall behind due to increased clearing rates. Rehabilitation of mined areas on private land could potentially leave the land in an unstable and unsustainable condition.	Worsley should consult with Agriculture WA regarding rehabilitation of pasture land on private property (Agriculture WA). Proponent to commit to maximising the direct return of topsoil (DME).	Need continued research into the re-establishment of agricultural productivity following mining on agricultural land. Achievements of current rehabilitation queried.	*The issues of sustainability, timeliness and completion criteria for rehabilitation of mined areas in State forest and private land requires further evaluation by the EPA.*
Forest disease management	Mining and associated activities such as clearing and exploration have the potential to introduce and spread jarrah dieback.	No comments received.	The potential for spread of dieback as a result of mining operations should be addressed.	*The potential spread of dieback as a consequence of mining operations requires further evaluation by the EPA.*
Impact on other users of State forests.	Mining and forest clearing could impact on other users of the State forest such as conservation, recreation, water resources, timber production and bee keeping.	No comments received.	Project approval should be conditional upon full implementation of all conservation reserve recommendations in the System 6 report as updated, and supplemented by the recommendations in the *Central wandoo woodlands: Botanical Survey.*	*The potential for bauxite mining activities to impact upon other users of the State forest in the context of multiple land management requires further evaluation by the EPA.*
MINING IMPACTS - Pollution potential				
Water resource management and protection	Clearing of native vegetation before mining and increased groundwater abstraction could alter surface and ground water quality and quantity in and around the mining area. Additional water demand of 100 ML/annum may require supply from a new source. Fuelling facilities have the potential to contaminate ground and surface waters, particularly following storm events.	Monitoring parameters for the Hotham River should be discussed with the WRC. Fuelling facilities should include impervious bunding and be designed to cope with storm events without overtopping (WRC).	The impacts of mining operations on the quality (including salinity) of ground and surface waters should be addressed.	The design and operation of fuelling depots is to be managed under Part V Works Approval and Licence Conditions. *The potential for expanded mining operations to impact on the quality and quantity of ground and surface waters requires further evaluation by the EPA.*
Noise and blast vibration management	Noise and blast vibration associated with mining operations may affect the health and amenity of residents in close proximity. The increased hours of operation of the overland conveyor may also cause noise impacts.	Need for relevant, accurate and precise data prior to noise modelling (DME). Modelling for noise prediction is accepted. 99.9% compliance with proposed regulations required. Future monitoring to verify effects of operational modifications, and assess tonal, modulation or impulsive noise characteristics. Commitments to be converted to noise management plans (DEP).	Need to address potential for noise emission from operation of conveyor.	*The potential for noise impacts from mining and associated activities to affect the amenity of residents requires further evaluation by the EPA.*
Dust management	Truck movements for the transportation of mined bauxite, blasting, mining equipment operation, crushing and stockpiling have the potential to generate dust.	No comments received.	No comments received.	Mining activities subject to DEP's works approval and licensing. Worsley has committed to control dust emissions to meet statutory requirements protecting the amenity of nearby residents. Further EPA evaluation not required.
Waste management	Wastes produced at the minesite are collected and recycled or disposed offsite into landfill.	Worsley should assist with costs towards a suitable landfill site for the future waste disposal needs (Shire of Boddington). Proponent should liaise with DEP in locating an additional landfill site. Use of treated wastewater on haul roads may require DEP approval. Worsley to comply with regulations for storage and disposal of tyres (DEP).	No comments received.	Management of waste from the mine is subject to DEP's Licence Conditions. The proponent has made several commitments regarding on-site re-use and recycling of wastes, and to assist the Shire of Boddington in locating an alternative landfill site. Further EPA evaluation not required.
REFINERY IMPACTS -Biophysical				
Management of bauxite residue	Increased alumina production will result in an increase in the rate of production of bauxite residues, thereby increasing the potential for impact on water resources and dust emissions.	No comments received.	Closure criteria and long term management strategies for residue areas should be agreed before approval is granted. If this is not done, then criteria and accompanying agreements should be reviewed in a separate public review process (WA Forest Alliance).	Design and construction aspects of residue areas are managed under DEP's Works Approval. Dust and water quality impacts are managed under DEP's Licence Conditions. *The requirement for a closure and rehabilitation strategy to be agreed to with the State requires further evaluation by the EPA.*
Decommissioning and return of refinery land	Refinery operations will require appropriate decommissioning and rehabilitation to restore the pre-existing qualities of the site.	No comments received.	No comments received.	Completion criteria and closure plans are a requirement of the Agreement Act. Worsley has committed to prepare decommissioning & closure plans and develop completion criteria for the refinery area, in consultation with the EMLG. Further EPA evaluation not required.

Table 1. Identification of issues environmental requiring EPA evaluation

TOPICS	PROPOSAL CHARACTERISTICS	COMMENTS FROM GOVERNMENT AGENCIES	PUBLIC COMMENTS	IDENTIFIED ISSUES
REFINERY IMPACTS -Biophysical (continued)				
Atmospheric emissions, including greenhouse gases	Ecological values of off-site areas and the amenity and health of nearby residents may be affected by gaseous emissions (NOx, SOx, odours). Increased operations would add to greenhouse gas emissions which could contribute to climate change.	No comments received from other agencies.	Proponent should be encouraged to use gas rather than coal for power-house fuel to reduce greenhouse gas and SO_2 emissions.	*The potential impact of increased gaseous emissions as a result of the expansion requires further evaluation by the EPA.*
Water resource management and protection	Refinery operations could impact upon environmental values of water resources, including the quality and quantity of potable water resources.	Security of on-site dams design needs to be examined, to ensure protection of local water catchments (Shire of Harvey). Monitoring parameters to be discussed with WRC. Increase draw from surface catchments must not significantly diminish inflow to Beela Dam. Plan showing monitoring and recovery bores required (WRC).	Potential for run-off or dam overflow resulting from extreme storm events.	Design details for process water management are subject to works approval and licensing administered by DEP. The integrity of the dam structure is also investigated as part of the DEP's works approval and licensing procedures. *The potential for refinery operations to affect water resources (including quality and quantity of potable water resources) requires further evaluation by the EPA.*
Management of solid and liquid waste	Refinery expansion has the potential to increase the production of solid and liquid wastes.	Chemical and oil tanks and process vessels to have adequate bunding to control spills and minimise overtopping (WRC). Proponent should liaise with DEP on long term management of on-site disposal of fibrous materials, spent acids and sodium oxalate extraction, and reuse/recycling of wastes where practicable (DEP).	No comments received.	DEP Works Approval and Licence Conditions apply to the construction and operation of the expanded refinery facilities. Worsley has committed to waste minimisation and to reuse / recycle wastes. The refinery sanitary landfill will be operated to prevent impacts on surface and groundwaters. Further EPA evaluation not required.
Noise management	Expansion of refinery operations may result in an increase in noise emissions.	As the refinery is located more than eight kilometres from the nearest residence, noise is not expected to be an issue and monitoring by the proponent confirms this (DEP).	No comments received.	Worsley's operations must comply with the draft Environmental Protection (Noise) Regulations 1995. Worsley has committed to conduct periodic acoustic assessments to ensure continued compliance with statutory requirements administered by DEP. Further EPA evaluation is not required.
Management of rail noise	Cumulative rail noise impacts associated with proposed expansions in the alumina industry may further affect residents in close proximity to the railway line.	DEP has received noise complaints from the Picton marshalling yards. The impact of future increases in rolling stock needs to be considered in the management of noise emissions from this centre (DEP).	No written comments received.	*The issue of rail noise, particularly shunting noise at the Picton marshalling yards and cumulative noise impacts arising from additional rail traffic requires further evaluation by the EPA.*
REFINERY & MINESITE - Social surroundings				
Hazard management	Potential hazards at the refinery include the presence of large volumes of caustic soda at elevated pressures and temperatures, acids and flammable substances.	No comments received.	No comments received.	Hazardous materials management is regulated under the Explosives and Dangerous Goods Act administered by DME. The proponent has committed to implement a comprehensive program for the identification and prevention of hazards at the refinery and the preparation and implementation of an emergency response plan. Further EPA evaluation is not required.
Road traffic impacts	Expansion will result in an increase in mining/refinery related traffic and road upgrades may be necessary	Coalfields Highway is the preferred route to refinery. If Mornington Road used, Worsley should assist with costs in upgrading this road (Shire of Collie). Due to extra train movements to Bunbury Port, the Glen Iris Service Corridor needs to be constructed to reduce potential road delays (City of Bunbury).	Impacts of additional train transport should be carried out before approval for the expansion is given.	This topic should be addressed by local government authorities and MRWA. Worsley has committed to participate in any Government working party to address issues of road safety and the upgrading of main transport routes to/from the refinery. Further EPA evaluation is not required.
Community consultation	Environmental issues of community concern arising from the proposal need to be adequately addressed.	No comments received.	Private landowners should be compensated if mining occurs on their properties.	Compensation is a matter of negotiation between private landowners and the proponent. Community consultation regarding environmental issues has been facilitated through the public review of this proposal. Further EPA evaluation is not required.
Maintenance of separation distances	Expanded mining and refinery operations have the potential to affect the amenity of residences in close proximity.	No comments received.	No comments received.	Potential impacts on amenity as a result of noise and impacts on water resources have been considered as separate topics. Worsley has committed to retain existing buffer areas and will establish buffer areas around project locations in consultation with the State. Further EPA evaluation is not required.
Impact on available residential lots and accommodation	Expansion will result in an increase in Boddington population by approximately 10% which may affect existing town facilities.	Worsley should assist in improving Boddington town facilities and road infrastructure (Shire of Boddington). Workers should be accommodated within close proximity to the Collie townsite (Shire of Collie).	No comments received.	This topic should be addressed through other processes. Further EPA evaluation is not required.
Aboriginal heritage	Mining operations may affect sites identified as having potential archaeological and ethnographic significance.	No comments received.	No comments received.	This topic is most appropriately managed through the Aboriginal Heritage Act, 1972. Further EPA evaluation is not required.
Control of public access and safety	Blasting and mine traffic activities are potential hazards to the community.	No comments received.	No comments received.	Matters of public safety relating to mining activity are managed by the DME. Worsley has also committed to ensure that public access to mine areas is restricted. Further EPA evaluation is not required.

Table 1. Identification of environmental issues requiring EPA evaluation (cont'd)

Current activities of this program aim to:

- monitor the establishment and development of vegetation structure, flora diversity, and the fauna recolonisation of mine pit rehabilitation;
- demonstrate compliance with statutory controls and corporate environmental objectives;
- evaluate the accuracy of environmental impact assessment predictions and the effectiveness of Worsley's environmental management program; and
- prepare environmental audit plans for the bauxite mine and the refinery (Worsley, 1995).

In order to audit the effectiveness of Worsley's environmental programs, Worsley has devised an environmental compliance system.

Government Liaison

Worsley's environmental planning, monitoring, auditing and investigative activities are developed and reported in accordance with Worsley's commitments. In meeting statutory requirements these activities are facilitated through consultation with the various regulatory agencies.

The Worsley Environmental Management Liaison Group (EMLG) was established to fulfill Agreement Act objectives to advise on mining and environmental matters. The group undertakes annual inspections of the environmental aspects of the Worsley operation and provides advice to the Minister for Resources Development.

The liaison group is comprised of representatives from:

- Department of Environmental Protection
- Department of Conservation and Land Management
- Water and Rivers Commission (previously the Water Authority of Western Australia)
- Department of Minerals & Energy
- Department of Resources Development.

The EMLG provides for coordinated statutory reporting and life-of-project environmental considerations, such as completion criteria and closure strategies.

Worsley supports the further development and formalisation of the existing arrangements for the EMLG to review, audit and advise Government on environmental requirements of the project together with the development of life-of-project environmental strategies where appropriate (Worsley, 1995).

Worsley also conducts annual briefings and meetings with local land owners situated in the vicinity of the mining operations, to discuss the rolling ten year mining plans and related environmental matters. Given the relative isolation of the refinery from the nearest neighbours (8 km), community liaison at the Worsley site has historically been intermittent and issue driven. Periodic briefing representations are undertaken by Worsley at the local government level.

Comments from key agencies / interest groups

The only submission received regarding this issue requested the inclusion of a representative from a community based conservation movement on the EMLG.

Response from the proponent

Worsley considers that the EMLG was established in order to fulfill Agreement objectives and to advise on mining and environmental matters as well as to provide for the coordination of Government review of environmental management of the project. The group undertakes periodic inspections of the environmental aspects of the Worsley Project and provides advice to the Minister for Resources Development.

The EMLG is comprised of scientific and technical experts from Government authorities which have some statutory responsibility in relation to the Worsley Project.

Environmental Protection Authority evaluation

The Environmental Protection Authority (EPA) supports the application of the principles of best practice environmental management in relation to the day to day management of this operation. The EPA considers that the proponent has commenced the implementation of these principles at its Worsley operation in its development of an Environmental Management System in accordance with the principles of the Standards Australia (Interim) ISO 14001 series. These principles may be further established through the implementation of 'Best Practice Licensing' which is planned to be introduced by the DEP in 1996.

The development of an Environmental Management System would also detail the procedures for the implementation of the extensive environmental management commitments made by the proponent as part of this proposal. Prior to the finalisation of Worsley's Environmental Management System, the EPA considers that the proponent should formalise its commitments within an environmental management plan to facilitate audit and reviews of the proponent's compliance and performance.

The EPA recognises that the continual review of environmental performance is an important component of ongoing environmental protection of proposals, and that the EMLG can perform an important role in facilitating this. The EPA considers that the role of the EMLG should be formalised to allow the review of the environmental performance of the proponent, and where appropriate, to determine Worsley's compliance with environmental conditions. The consolidated environmental management commitments, as formalised within an environmental management plan, should be regularly reviewed on a five year cycle (see Recommendation 3, Section 5).

Given the role of the EMLG in determining compliance, the EPA considers it important that there is appropriate private and government representation within the group. The EPA considers that at such time that the EMLG is reviewing closure strategies for the project area, community consultation and public review of the proposed strategy should be facilitated (see Section 4.8).

The EPA should receive the EMLG's review, including public comments, for consideration, and subsequently advise the Minister for the Environment on its acceptability.

4.2 Impact of clearing on forest ecosystems

Objective

To ensure that the biodiversity and sustainability of the eastern Darling Range forest ecosystems are maintained.

To ensure that rare and endangered flora and fauna are protected.

Policy Information

The protection of rare or threatened flora and fauna is legislated for in the *Wildlife Conservation Act*, 1950, the *Conservation and Land Management Act*, 1984 and the *Commonwealth Endangered Species Protection Act,* 1992. Australia is a signatory to the international Convention on Biodiversity, and Western Australia is also a signatory to the National Strategy for the Conservation of Australia's Biological Diversity (Commonwealth of Australia, 1996).

Technical Information

Clearing of native vegetation prior to mining has the potential to impact on the jarrah forest ecosystem and impair the long term viability of populations of species known to be rare and endangered or geographically restricted.

Worsley's bauxite mining operations occur on State and private land on the eastern edge of the Darling Range. Most of the bauxite is under jarrah forest, with some small areas having been cleared for agriculture.

The primary bauxite resource lies within the Agreement mining lease (ML 258SA) and nearby 1978 Mining Act mining leases (over private land) in the Lower Hotham Valley. The Primary Bauxite Area (PBA) includes parts of three key areas of Crown land - the Saddleback, Marradong and Quindanning Timber Reserves. The northern part of the PBA is forested private land owned by the Boddington Gold Mine Joint Venturers and managed by Worsley.

Based on current proven bauxite reserves, up to 65% of the forest area in the PBA will be left uncleared. On the basis of current knowledge of the bauxite resource a similar proportion of native vegetation will remain undisturbed in the Marradong and Hotham north areas. A higher proportion of vegetation (approximately 80%) in the Quindanning Timber Reserve area will remain undisturbed.

The rate of clearing in State forest will increase from a present rate of 70 ha per annum to an estimated 140 ha per annum in the Saddleback and Marradong areas and Hotham north areas. Approximately 95% of the Hotham North area is privately owned land (Worsley, 1995).

The Primary Bauxite Area lies within the Darling Botanical District of the South Western Botanical Province.

Flora

The Tunnell Road heathland is recognised as having conservation values of local and regional significance because of its biodiversity, habitat value and size (Mattiske Consulting, 1995, Ninox Wildlife Consulting, 1995).

Four communities within the Saddleback area are considered by the proponent to have conservation values not found in other areas to date. Mining in these areas will not occur until an assessment is made in consultation with CALM as to the conservation significance of these areas in a local and regional context.

No rare and endangered flora have been located, but 15 priority species from CALM's Declared Rare and Priority Flora List have been located in the Saddleback and Marradong areas (Worsley, 1995).

Of these 15 priority species:

- twelve were located in communities which have been deferred from mining;
- three have been located in Wandoo Woodland, of which an estimated 90% is likely to remain undisturbed by mining;
- recruitment (recolonisation) of seven of the 15 priority species have so far been recorded in mine rehabilitation areas; and
- seven of the 15 priority species known to occur in jarrah type vegetation have been recorded in other forested areas outside the Saddleback and Marradong Timber Reserves (Worsley, 1995).

Fauna

Fauna species of particular conservation significance that have previously been recorded in the project area include:

- the chuditch, which is listed under the Commonwealth *Endangered Species Protection Act, 1992* and is known to occur in low densities in the PBA;
- the peregrine falcon, Carnaby's black-cockatoo and Baudin's black-cockatoo which are declared rare under the *Wildlife Conservation Act (1950)* and have been recorded in the Saddleback area; and
- the carpet python which is listed as rare under the *Wildlife Conservation Act (1950)* and has been recorded on several occasions in the PBA (Worsley, 1995).

All of the fauna located in the Saddleback area requiring statutory or special protection have a geographical home range that extends beyond the PBA and eastern Darling Range forest.

The proponent's fauna protection strategies include:

- the retention of approximately 65% of the native vegetation in the mining area;
- minimising the area disturbed by mining operations;
- revegetation of mined areas with locally sourced eastern Darling Range type vegetation;
- re-creation of fauna habitats; and
- feral animal control programs in conjunction with CALM.

Worsley has an established flora and fauna conservation strategy developed and implemented in consultation with CALM.

Comments from key agencies / interest groups

The submission from CALM noted that CALM has worked closely with Worsley since the company was given approval to proceed with the project in 1980. During that time, CALM and Worsley have cooperated on a number of aspects, including data on declared rare flora and fauna, and identification of areas with potentially high conservation values within the Primary Bauxite Area (PBA) and the Lease Area. CALM and Worsley have liaised closely during the preparation of the CER, and CALM advises it is particularly pleased with the comprehensive list of commitments contained within the CER.

A number of public and action group submissions commented on this issue. Submitters suggested that bauxite mining should only occur over cleared land to prevent additional clearing of forest areas, and that the company should incur an environmental tax if mining was to proceed in State Forests.

Unlogged and old growth forests should be assessed for conservation values and high conservation value areas should be protected. Submissions asked what priority was given by the company to protect the conservation values associated with these areas.

Submissions perceived a need to address the incremental, cumulative and interactive impacts of disturbance to native vegetation and ecosystems, and the potential for noise, dust and gaseous emissions resulting from the project, from impacting on flora and fauna.

A number of submissions suggested that the extent to which all flora species are at risk from the operation, and the extent of establishment of these species in rehabilitated areas needs to be better defined.

One submitter also asked, of the priority species that occur in heathland communities within Worsley's mining lease, what proportion of their local population does this represent?

Response from the proponent

In its response to the suggestion of an environmental tax, Worsley stated that in accordance with the provisions of the Agreement, the Worsley Joint Venturers have always made direct payment to the State in the forms of royalty on minerals and compensation for forest clearing. How the State decides to apportion this money is a matter for the elected government.

Worsley's response noted that the company is currently addressing the conservation values of old growth forest. Old growth areas in ML 258SA are currently being determined by CALM. Worsley will consider this information when developing and implementing its mining plans.

The proponent considers that the CER has addressed the incremental, cumulative and interactive impacts of disturbance to native vegetation and ecosystems.

Monitoring programs in undisturbed vegetation indicated that no species of flora appears to be threatened by local extinction due to mining activities. Similarly fauna surveys indicate no apparent decline in the number of fauna species or their population densities.

As stated in the CER, monitoring in rehabilitation areas has shown that 61 of the 72 most commonly occurring flora species from baseline studies have been recorded and that 74% of the vertebrate fauna located during baseline studies have been recorded in rehabilitation areas; the

oldest of which was revegetated in 1986. As rehabilitation areas mature, the number of flora and fauna species recolonising can be expected to increase. Based on monitoring information to date and the flora and fauna conservation strategy outlined in the CER, Worsley does not expect that an increase in the rate of clearing of vegetation will have an adverse impact on the biodiversity and sustainability of eastern Darling Range ecosystems.

Negligible impacts are expected on flora and fauna from noise, dust and gaseous emissions. The proponent recognises that fugitive dust emissions from haulroads, mining operation areas and bauxite residue areas can result in dust coatings on adjacent vegetation, and considers that dust suppression measures have been successful in minimising impacts on vegetation. Fauna monitoring near haulroads has shown no detectable reduction in species richness and abundance.

The proponent's preliminary study of bird breeding on the verge of the Northern Conveyor Corridor in 1987 indicated that noise and light levels in addition to regular traffic, did not appear to be unduly inhibiting the breeding activity of birds. An additional study of approximately 23 kilometres of the Conveyor Corridor was also assessed in 1991.

The survey results indicated that breeding activity in the dense vegetation adjacent to the conveyor was much higher than that previously recorded in forested sites throughout the bauxite mine and was at a level similar to that observed in heath or older rehabilitation areas. The level of breeding activity indicated that birds are not unduly disturbed by noise and light. A large number of reptiles and several species of native mammals (including the rare Chuditch) were also captured within 10 metres of the conveyor. So far no discernible impact from noise, light or traffic has been detected in study sites adjacent to mining activity.

The proponent considers that current monitoring has not shown any loss of fauna or flora in the Saddleback area. Given the rate of return of fauna and flora to rehabilitation areas and the current flora and fauna conservation and rehabilitation strategies, the proponent believes that no loss of species is likely to occur with current environmental management techniques.

In its response Worsley has clarified that, based on information from flora baseline and monitoring programs, seven of the 13 priority flora species recorded in heathland communities have local populations that are confined to these communities.

The remaining six priority flora species have local populations in heathland and jarrah vegetation units. Three of these species - *Acacia gemina, Calytrix simplex sp. simplex and Dryandra subpinnatifida* are thought to have a reasonable proportion of their local population in jarrah vegetation units. The other three species - *Lasiopetalum cardiophyllum, Senecio leucoglossus and Templetonia drummondi* are widely distributed in other jarrah vegetation units which indicates that a significant proportion of the local population of these species occurs in jarrah vegetation units.

Environmental Protection Authority evaluation

The EPA notes that the proponent had made extensive commitments regarding the protection of flora and fauna, and biodiversity within the area of its mining operations within the eastern Darling Range (Commitments 5 to 11, Appendix 4). These include conducting baseline flora and fauna surveys in areas prior to mining, deferring mining in areas of potentially high conservation significance within the PBA until it can be shown that the biodiversity and sustainability of the ecosystem will not be adversely affected.

As part of the response to submissions, Worsley has made additional commitments including a commitment to individually assess unlogged areas in Saddleback Timber Reserve during mine planning to minimise unavoidable disturbance (Commitment 105, Appendix 4).

On the basis of the current understanding of flora and fauna in the PBA and the continued updating of the flora and fauna conservation strategy, the EPA considers that the clearing of native vegetation for mining as a result of advanced rates of development, will not significantly affect biodiversity or threaten rare flora and fauna. The EPA concludes that the proposal could be managed to achieve the objectives for this issue.

4.3 Rehabilitation of mined areas

Objective

To ensure that rehabilitation of mined areas in State Forest is timely, sustainable and meets completion criteria agreed by the State.

To ensure that rehabilitation of mined areas on private property leaves the land in an environmentally stable and sustainable condition and meets the requirements of the private property owner.

Policy Information

Past assessments by the EPA of similar mining proposals provide a policy framework for consideration of the rehabilitation scenarios proposed, and the expectations of the EPA.

The EPA has recognised that for rehabilitation to be most effective it must be integrated into the mining plans early on in the project's development, and not be left to the conclusion of mining (EPA, 1991 Bulletin 574).

It is of paramount importance to the State that rehabilitation management does not impose short or long term costs on the community of Western Australia. This is particularly relevant when the success of rehabilitation cannot be evaluated in the short to medium term (EPA, 1994 Bulletin 766).

Under the Alumina Refinery (Worsley) Agreement Act, 1973, Worsley is required to develop completion criteria for the rehabilitation of the site in consultation with CALM. That agency has a defined statutory role to ensure the successful and sustainable rehabilitation of crown land, prior to its return to the State.

Under the Agreement Act the proponent is also required to enter into a 'Consent, Compensation, and Restoration Agreement' with private landowners. Within these agreements Worsley and the owner are required to discuss and agree on terms of the restoration program including the purpose for which the owner's land will be used at the termination of the restoration program and the types and quantities of vegetation that will be planted on the owner's land (Worsley, 1995).

Technical Information

Clearing of forested areas has the potential to directly affect the ecosystem, as well as contributing to rising groundwater levels and the mobilisation of stored salt in the soil profile.

The existing land use objectives of the Saddleback, Marradong and Quindanning Timber Reserves areas include conservation, recreation, timber production and beekeeping.

Disturbance to agricultural land requires a rehabilitation prescription that is designed to restore the pre-existing productivity qualities and mitigates other potential impacts such as rising groundwater levels, mobilisation of stored salt, and wind and water erosion that could affect the land capability of the rehabilitated area.

Worsley has implemented the rehabilitation program that it committed to in the 1979 ERMP, in consultation with the Department of Conservation and Land Management. The principal elements of the original program were:

- shaping mined areas to facilitate surface drainage;
- replacement of topsoil from stockpiles, or direct stripping of the soil surface during overburden removal;
- ripping the pit floor; and
- liaison with CALM (previously the Forest Department) to determine appropriate tree species for rehabilitation by establishing a two hectare trial (Worsley, 1995).

The program was further refined following research trials and in 1984, Worsley Alumina's bauxite mine-pit rehabilitation prescription was developed in consultation with CALM. The prescription is evolving and is reviewed with CALM in response to information from monitoring and research programs.

State Forest

Worsley has implemented a program of rehabilitation in accordance with the rehabilitation prescription developed in consultation with CALM. The broad objective of rehabilitation is to regenerate a forest ecosystem with flora and fauna characteristics comparable to the eastern Darling Range forest that existed prior to mining.

Specific goals include the maintenance of recreation, conservation, landscape and hydrology forest values.

To date 862 ha has been cleared for mining operations of which 66% (568 ha) is being rehabilitated.

The techniques used for rehabilitation have been described in detail in the CER. The mix of species and revegetation methods have also been modified since 1986 in response to monitoring and research programs.

This is illustrated in Table 2 below.

Table 2. Comparison of revegetation techniques between 1986 and 1995

Process	1986	1995
Topsoil Replacement	Direct return of topsoil to 10 - 20% of mined area	Targets developed to achieve up to 35% direct return of topsoil
Tree Species	18% eastern states eucalypts, 50% powderbark, wandoo 18%, jarrah 14% and other WA eucalypts	66% jarrah, 24% sheoak, 10% marri
Tree Establishment	Hand planting at 500 stems per hectare	75% hand planting at 500 stems per hectare. 25% direct seeding of 600 - 1,000 trees per hectare
Understorey	Up to 50 species native to the area	Up to 90 species native to the area and local provenance specific
Understorey Application	Seed broadcast in mid - June to July	Seed broadcast immediately following scarification, from March to July

Current revegetation strategies aim to establish a vegetation type that reflects the pre-mining vegetation. Most of the mined area (approximately 95%) was originally jarrah-type vegetation and is revegetated with this type of vegetation. Areas that were previously wandoo or heath type vegetation are also revegetated with wandoo and heath-type vegetation respectively.

Rehabilitation of agricultural land

Worsley began mining on private land not owned by the Worsley Joint Venturers adjacent and east of the Saddleback Timber Reserve in 1993. A rehabilitation prescription has been developed with the owner in consultation with the Department of Agriculture. A catchment management approach has been adopted for the rehabilitation of previously cleared mined land, with a long term objective to restore a sustainable agricultural system. Other rehabilitation goals include the maintenance of landscape, hydrology, conservation and agricultural productivity values.

The rehabilitation methods proposed and already implemented as part of existing operations in forested areas are applicable to mined private land in areas that are to be revegetated with Eastern Darling Range type vegetation. Where pasture is to be re-established the soil surface is smoothed and lightly scarified to facilitate seeding by farm machinery.

The revegetation strategy on private land incorporates the following principles:

- re-establishment of eastern jarrah forest type vegetation in pre-existing forested areas;
- establishment of high yielding pasture on pre-existing pastoral areas; and
- strategically placed alleys of trees to combat groundwater level rise and erosion.

Monitoring and Past Performance

Criteria have been developed in consultation with CALM to measure initial revegetation performance. Monitoring data reported to date indicates that criteria have been achieved in terms of survival rates and plant densities. Of the 374 native species that have been recorded in the Saddleback Timber Reserve area during baseline studies, 282 species have been recorded in rehabilitation areas. Of the 72 most commonly recorded species from baseline studies, 61 species have been recorded in rehabilitation (Worsley, 1995).

Fauna recolonisation is monitored in all mine pit rehabilitation areas. As reported on in the CER the most recent fauna survey has shown that vertebrate fauna is beginning to recolonise mine pit areas that were revegetated between seven and nine years ago (Worsley, 1995). The recolonisation rate currently stands at 53% of all known native vertebrates in the Saddleback area (Worsley, 1995).

Comments from key agencies / interest groups

The Department of Minerals and Energy considered that the proponent should also make a commitment towards 'maximising the direct return of topsoil'. Submissions also requested clarification regarding whether Worsley's target of 35% coverage of rehabilitated areas with fresh topsoil has been achieved in recent years.

Submissions also asked to what extent Worsley coordinates and shares information on its rehabilitation research, monitoring and development programs, with other major users of the jarrah forest. The difference in fauna recolonisation of rehabilitated areas between Worsley (53%) and Alcoa (75 - 90%) was also queried.

One submission requested evidence that trees planted in mined areas would grow to the maturity of trees existing prior to mining, and queried what action Worsley has implemented to address the eleven most commonly recorded species from baseline studies that have not been recorded in rehabilitation to date.

Agriculture Western Australia stated that through its Narrogin District Office, that agency would continue to consult with Worsley on the rehabilitation of pasture land on private property where it has been affected by mining operations. Other submissions suggested that Worsley needs to continue to research methods for rehabilitation to re-establish agricultural productivity following mining of agricultural land.

Submitters expressed concern that some of the mined agricultural areas may have a saline sub-soil, and asked what vegetational and hydrological impacts (local and down-stream) are anticipated after the areas are rehabilitated?

Response from the proponent

In recent years the coverage of rehabilitated areas with direct return of fresh topsoil has varied between 15 - 20%. The proponent's current strategy provides for the direct return of fresh topsoil to as many of the larger rehabilitation areas (greater than 3 ha) that are not surrounded with native vegetation as is practicable. Worsley's current target is to spread fresh topsoil or topsoil that has been stockpiled for less than six months over a minimum 35% of the rehabilitated mine pit area. Worsley will continue to work to find ways to increase direct return of topsoil.

Worsley has commented that it and other major users of the jarrah forest freely share relevant environmental information. Worsley regularly prepares reports on ongoing biological monitoring and investigations for Government agencies including CALM. In addition, Worsley is actively involved in industry forums, designed to exchange information with fellow practitioners, on scientific developments and advances in environmental monitoring and

research including rehabilitation. Worsley meets regularly with other company's environmental staff to share information from research, monitoring and development programs. Worsley and Alcoa are currently involved in a collaborative research and development program which is investigating methods for the propagation of recalcitrant species common to both companies. Since 1992, Worsley has been constructing fauna habitats in rehabilitation areas specifically designed to provide habitat for chuditch. The present methods of habitat construction are currently being reviewed in consultation with CALM.

Worsley has long standing involvement with recalcitrant species research. The current collaborative Alcoa-Worsley recalcitrant species program is the culmination of previously sponsored research in this area and the findings from this work are expected to greatly assist in re-establishing these species. Results of rehabilitation monitoring programs confirm that the recruitment of species into rehabilitation is still continuing. Worsley is currently assessing monitoring records which indicate that 11 of the 72 most common jarrah vegetation species have not been recorded. The cause of this apparent absence of these 11 species is being investigated.

The proponent also states that while Worsley's mine rehabilitation is relatively young in an ecological time frame, there is ample evidence within the industry of sustained healthy revegetation of mined areas. Prior to mining commencing, rehabilitation trials were conducted on a variety of tree species. Since that time, this site has been monitored on a regular basis for tree survival, growth rate, form and health. There is no reason to believe these trees will not grow to maturity.

Worsley in collaboration with Agriculture WA and the land owners is currently planning to conduct a pasture trial on mined agricultural land adjacent to the eastern boundary of the Saddleback Reserve. The purpose of the trial will be to determine what are the appropriate land restoration techniques and pastoral species consistent with restoring agricultural productivity.

On the basis of Worsley's current investigative procedures and rehabilitation programs, adverse impacts on vegetation or hydrology are not anticipated following mine rehabilitation. Environmental assessment of agricultural land is carried out before mining commences. This involves a survey of the vegetation, landforms, soils, hydrology and salt storage. Rehabilitation prescriptions are then designed to restore agricultural productivity and to minimise impacts to vegetation and water resources (Worsley, 1996).

Environmental Protection Authority evaluation

The EPA notes the requirements of the Alumina Refinery (Worsley) Agreement Act, 1973 regarding rehabilitation, particularly the role of CALM in developing completion criteria for the company, and the requirements on the proponent that it enter into agreements regarding rehabilitation with private landholders.

Worsley has made extensive commitments regarding this issue, particularly the trial recreation of fauna habitats in rehabilitated areas and the further development of rehabilitation enhancement techniques in consultation with CALM (Commitments 12 to 17). The use of direct seeding and cutting techniques may be important for the establishment of recalcitrant species in rehabilitated areas. The EPA notes that 11 of the 72 most common jarrah vegetation species are yet to be recorded in Worsley's rehabilitation, and expects that the development of improved rehabilitation techniques to encourage the return of these species would be reported to the EMLG.

As part of its response to issues raised in public submissions, Worsley has made an additional commitment that it will set inhouse targets (completion criteria) to facilitate the achievement of the objectives on which this assessment is based, in consultation with the EMLG (Commitment 106). Additionally, Worsley has indicated it will advise the EMLG if the agreed objectives for this issue are not being met, and is committed to make appropriate changes to its environmental management strategies in order to achieve these objectives.

The EPA considers that the proponent's past monitoring provides evidence that species present prior to mining are re-establishing following mining, and that research has commenced into recalcitrant species in collaboration with Alcoa. The commitments made by the proponent, and the existing management measures and statutory requirements of the Agreement Act, achieve the EPA's objectives for the assessment of this issue.

4.4 Forest disease management

Objective

To minimise the risk of bauxite mining activities introducing or spreading jarrah dieback or other forest diseases into areas of State and private forest.

Technical Information

Bauxite mining and associated activities such as forest clearing and exploration drilling have the potential to introduce and spread jarrah dieback. *Phytophthora cinnamomi* which causes jarrah dieback is spread through the movement of soil on vehicles and equipment and by surface water runoff.

An estimated 14.2% of the jarrah forest is affected by *P. cinnamomi* (Davison and Shearer, 1989 reported in Worsley, 1995). The greatest incidence of *P. cinnamomi* occurs in the northern jarrah forest on the western edge of the Darling Scarp, however, a decrease in expression is observed towards the drier eastern edge of the jarrah forest (Worsley, 1995).

The potential impact of *Armillaria luteobublina* is most significant on coastal dune vegetation and wandoo forest where dead and dying host plants occur frequently in patches. In the jarrah forest, infections occur infrequently and affect individual plants or small patches of vegetation (Shearer, 1994). *A. luteobublina* can be spread by movement of infected root material and by airborne spores.

Worsley has an existing forest disease management strategy which has been developed and is implemented in consultation with CALM. This strategy includes dieback mapping of all areas prior to mining. In the event that the expression of dieback or some other forest disease is identified or where the risk of dieback is considered high, these sites are isolated from routine clearing operations and managed separately.

The mining plan is developed in accordance with forest hygiene procedures and is based on a disease risk minimisation objective.

Minimising the risk of introduction of forest disease to the mining area is facilitated through the application of forest hygiene procedures which restrict access to the mining area and require vehicles and equipment to be hygienically clean prior to gaining access.

The risk of spreading jarrah dieback and other forest diseases within the mining area is minimised by the classification of the mining area into appropriate dieback status categories, and the application of disease prevention measures developed in consultation with CALM. The classification of areas is based on standard operating practices and the results of routine dieback detection surveys.

In small areas of jarrah dieback infection, vegetation affected by jarrah dieback is treated with a dilute phosphoric acid solution (Fos-jet 200). The effectiveness of this method over time is being evaluated by the proponent.

Worsley is currently co-sponsoring research aimed at improving and expediting the techniques available for the identification of *P. cinnamomi.* This research project is coordinated by the Minerals and Energy Research Institute of WA.

Monitoring and Past Performance

The rate and extent of spread of the only two *P. cinnamomi* infections identified in the Saddleback Timber Reserve since project commencement, is monitored in accordance with procedures developed in consultation with CALM. If further *P. cinnamomi* infections are identified, the area affected is to be recorded, monitored, and reported to Government.

Since 1979, no new dieback infections have been recorded on the Saddleback Timber Reserve where mining has occurred. In 1992 a dieback infection (less than one hectare) was discovered on Worsley Joint Venture owned land.

Monitoring of infections over the past two years has revealed the absence of an "active dieback front" with plant deaths near the infection being sporadic and more likely caused by drought (Worsley, 1995).

Several *A. luteobublina* infections have been recorded in the current mining area. These infections are localised and affect a small proportion (approximately 10 ha) of the current mining area. Movement of a disease front has not been observed (Worsley, 1995).

Comments from key agencies / interest groups

The submission from CALM mentioned that CALM has worked closely with Worsley since 1980. CALM and Worsley have liaised closely during the preparation of the CER, and CALM has advised it is particularly pleased with the comprehensive list of commitments contained within the CER.

Public submissions suggested there is a need for the proponent to address the potential for the spread of dieback disease as a consequences of mining operations. One submission suggested that there has been little progress made in the understanding of dieback prevention and elimination.

Response from the proponent

Worsley has responded that there have been considerable advances made in the understanding of the jarrah dieback disease and its treatment, and that much of the research funding for this work has been contributed by industry. In the area of Worsley's mining operations, two dieback infections which predate mining and affect approximately five hectares occur in the 6000 hectare Saddleback Timber Reserve. There is no evidence from monitoring to date that mining has caused any significant spread of dieback in the mining area (Worsley, 1996).

Worsley considers that the current strategy has been successful in minimising the risk of spread and introduction of dieback in association with mining activities. Continued implementation of Worsley's current strategy (detailed in section 5.2.3 of the CER) should ensure that the spread and introduction of dieback into the area is prevented. Worsley has also committed (Commitment 19) to continue to, "Support research relevant to forest disease management and Worsley's operations."

Environmental Protection Authority evaluation

The EPA notes the small area of known dieback infection within the mining area, and that the proponent has an existing dieback management strategy developed and implemented in consultation with CALM. The EPA also notes the substantial contribution to dieback research undertaken by the company and made available to CALM and other relevant government agencies, and the commitments made by the company regarding the management of this issue (Commitments No. 18 - 21, as shown in Appendix 4). The EPA considers that the management measures already implemented by the proponent, and the proponent's environmental management commitments achieve the EPA's objective regarding the issue of forest hygiene management.

4.5 Impacts on other users of State Forest

Objective

To minimise the impacts of bauxite mining and related activities on other users of the State forest, by integrating as far as practicable Worsley's activities with CALM's forest management.

Policy Information

In accordance with the *Conservation and Land Management Act*, 1984, the management of the Saddleback, Marradong and Quindanning Timber Reserves is based on the Forest Management Plan 1994-2003 (Lands & Forest Commission, 1994). Multiple use management principles are applied to these areas and the recognised uses of the State Forest include bauxite mining, recreation, timber production and bee keeping.

Technical Information

Bauxite mining and forest clearing for mining has the potential to impact on other users of the state forest areas. Those uses include conservation, recreation, water resources, timber production and bee keeping.

The co-ordination of bauxite mining and forest management planning has been developed by Worsley in conjunction with CALM and is subject to annual review by the Environmental Management Liaison Group through Worsley's 10 Year Mining Plan and Environmental Management Report both of which are submitted to the State Government.

The CER has recognised that the forest management activities requiring an integrated management approach include:

- fire protection;
- forest salvage;
- feral animal control; and
- relinquishment by Worsley of parts of its mining lease for incorporation into conservation reserves by CALM.

Worsley and CALM have developed a fire protection strategy through the Worsley - CALM Hazard Reduction Burning and Wildfire Suppression Agreement. This agreement includes the planning and implementation of prescribed burning on a rotation basis. Provision is also made for emergency procedures in the event of a wildfire. Prior to mining any area it is first cleared of vegetation and any salvageable material is recovered prior to clearing. The remaining forest material is heaped into piles and burnt.

The use of the forest for conservation includes the preservation of habitat, which is particularly important for rare or regionally restricted species. The chuditch (protected under the *Commonwealth Endangered Species Protection Act*, 1992) is known to occur in low densities in the PBA. Competition for food resources and predation by foxes is thought to have contributed to the contraction of its home range and population decline. Baseline surveys in the Saddleback area have recently being carried out to ascertain the distribution and abundance of the chuditch. The results from these surveys will be used to monitor the chuditch population in response to fox control programs that may be implemented in the future.

Since the granting of Mining Lease ML 258SA in August 1983, the Worsley Alumina Joint Venturers have progressively relinquished parts of the lease. Relinquishments have been for conservation purposes or after confirmation that areas were not prospective for bauxite. The lease area remaining now is broadly prospective for bauxite. The total area initially excluded or subsequently relinquished from the lease for conservation is 551 km^2 (Worsley, 1995). The evaluation of the remaining parts of ML 258SA proposed by CALM for conservation reservation is on-going.

Any exploration drilling to be undertaken in areas remote from the current mining operations is specifically discussed with CALM prior to field-work being carried out.

Comments from key agencies / interest groups

The submission from CALM mentioned that CALM has worked closely with Worsley since 1980. Over a decade, CALM and Worsley have cooperated regarding the identification of areas with potentially high conservation values within the Primary Bauxite Area (PBA) and the Lease Area. CALM and Worsley have liaised closely during the preparation of the CER, and CALM

has advised it is particularly pleased with the comprehensive list of commitments contained within the CER.

One submission suggested that any approval for the proposal should be conditional upon full implementation of all of conservation reserve recommendations in the 1983 System 6 report, as updated by CALM in 1987 and 1994, and supplemented by the recommendations in the *Central wandoo woodlands: Botanical Survey.*

Response from the proponent

Worsley has responded that it does not necessarily believe that all the recommendations contained in the aforementioned reports represent the best balance between conservation and resource utilisation objectives.

Since the granting of mining lease ML 258SA in August 1983, the Worsley Alumina Joint Venturers have progressively relinquished parts of the lease. Relinquishments have been, in some cases consistent with the recommendations from some of the above reports, for conservation purposes or have been following confirmation that areas were not prospective for bauxite.

The evaluation of the remaining parts of ML 258SA proposed by CALM for conservation reservation is an ongoing process. Worsley expects to work closely with CALM to assess forest areas within ML 258SA during the Regional Forest Agreement processes established by the State and Federal Governments, and expects that a balanced outcome, meeting conservation and economic development objectives can be achieved.

To date, Worsley has relinquished 551 square kilometres from its mining lease and has committed (Commitment No. 26) to work with the state to identify areas of ML 258SA outside the PBA with potentially high conservation value that can be precluded from mining without significant impact on the life of the project.

Environmental Protection Authority evaluation

The EPA recognises that areas of jarrah forest held by the crown are an important resource, and have uses to all residents of the State beyond that of mineral development. The EPA also recognises the Department of Conservation and Land Management is the lead agency regarding the management of these areas, and that the protection of other uses should be addressed through the implementation of the Forest Management Plan prepared by CALM. The EPA notes that CALM is satisfied with the level of consultation it has with Worsley, and that there are existing consultative procedures between both parties.

The EPA also notes the proponent's environmental management commitments (Commitments 22 to 25), particularly the commitment to work with the State to identify areas outside the PBA but within Worsley's mining lease with potentially high conservation value that could be precluded from mining. The EPA concludes that these commitments and the existing protocols with CALM achieve the EPA's objective of minimising the impacts of bauxite mining on other users of the State Forest by integrating Worsley's activities with CALM's forest management.

4.6 Water resource management and protection — Mining

Objective

To ensure that environmental values of water resources including water quality and quantity of potable resources, are maintained from adverse impacts of bauxite mining activities.

Technical Information

The Boddington mine is within the intermediate rainfall zone (740 mm per year) of the eastern Darling Range, and within the catchment for the Hotham River.

Abstraction from the Tunnell Road borefield currently meets 85% of the of the minesite's annual water requirements.

The clearing of native vegetation prior to bauxite mining together with groundwater abstraction from the Tunnell Road heathland area has the potential to alter the hydrology in and around the mining area. The significance of this impact is affected by the rate of clearing and groundwater abstraction and the time between clearing and rehabilitation.

Fuelling facilities, if not properly designed have the potential to contaminate ground and surface waters, particularly in the event of a major storm event.

Water demand at the mine is expected to increase by 50%, from 200 to 300 ML/annum. Increased haul road distances and longer operating hours require a greater amount of water to suppress dust emissions. Night shift road watering requires proportionally less water compared to daytime operations due to lower evaporation rates. Water supply is currently being sourced from the:

- shallow aquifer (50% of water needs) of the Tunnell Road borefield;
- deep fractured rock aquifer (35% of water needs) of the Tunnell Road borefield; and
- a single shallow bore in the eastern Saddleback area and a surface run-off collection sump adjacent to the crushing plant in central Saddleback Timber Reserve.

To meet future increased water demand, Worsley proposes to seek supply from other sources in order not to increase draw on the shallow Tunnell Road aquifer. A number of options are being investigated to reduce water consumption and reduce the draw upon the shallow aquifer. These options include further development of the deep rock aquifer in the Tunnell Road borefield, the development of an alternative borefield, and trials of wetting agents to improve the effectiveness of dust suppression techniques (Worsley, 1995). These options are to be further investigated prior to the construction of the expansion in consultation with the Water and Rivers Commission (Commitment 26).

Worsley has an existing water resource management strategy that has been developed, implemented and modified to ensure the clearing of vegetation and groundwater abstraction do not adversely affect the environmental values of water resources or significantly impair the health of overlying vegetation (Worsley, 1995). The key elements of this program include:

- minimising the operating area of mine;
- containing stormwater runoff from operations area;
- the provision of settling ponds to avoid dispersal of turbid flow;
- the rehabilitation of mined areas with deep-rooted vegetation; and
- the collection of solid and liquid wastes with appropriate treatment and disposal (Worsley, 1995).

Monitoring and Past Performance

The water resources management program includes routine monitoring of surface waters, ground waters, and flora of the Tunnell Road heathland.

In September 1995, 52 sites in the Hotham River catchment were monitored. The CER suggests that the monitoring results indicate elevated salt levels in the Hotham River which could be due to diffuse run-off from farming regions north east of the PBA around Pingelly. Salinity levels in the Hotham River decrease as it flows past the forested catchments of the Hotham North, Marradong and Saddleback areas where the river is diluted by the input of fresher tributaries (Worsley, 1995).

The monitoring of surface waters in the Saddleback area has been carried out by Worsley on a monthly basis since 1978. Salinity levels in the River from monitoring locations during 1995 are comparable to the pre-mining levels in 1983 (Worsley, 1995).

Groundwater levels in four monitoring bores at the Tunnell Road borefield have been monitored since 1991. An apparent downward trend in groundwater levels commencing in 1994 and ending in the first half of 1995 corresponds to a period of increased groundwater abstraction and well below average rainfall. In this period the rainfall was 235 mm less than that the

average rainfall normally anticipated. Groundwater levels recovered in the period May - October 1995, when average rainfall was experienced (Worsley, 1995).

The groundwater levels under the Tunnell Road heathland may be expected to decline for short periods but the levels begin to recover when normal rainfall resumes. This is also reflected in other sub-catchments.

The potential impact of groundwater abstraction on the heathland vegetation was examined during a systematic flora survey which compared the species richness and abundance of the area with pre-mining baseline studies.

This investigation noted significant changes in the floristic composition, but suggested these changes may be due to variable climatic factors and the dynamic nature of heathland communities. Plant stress observed was attributed to inter-plant competition, senescence and natural moisture variations and could not be attributed to fluctuating groundwater levels (Mattiske, 1995 reported in Worsley, 1995).

The effects of mining on catchment hydrology and salinity have been studied by the Water Authority of Western Australia (now the Water and Rivers Commission), as part of an established program in the high, intermediate and low rainfall zones of the Darling Range. Their study of the Hunt A and B paired catchments has demonstrated the variability in changing groundwater levels in response to mining, and the potential for change to stream salinity. Changes in stream salinity have also been shown to be a result of changes in rainfall, as well as changes in landuse.

Comments from key agencies / interest groups

The submission from the Water and Rivers Commission (WRC) requested that monitoring parameters for the Hotham River be discussed with the Bunbury office of the WRC, and noted that any increase in water drawn from the Murray River would require licensing. The WRC also noted that fuelling facilities should include impervious bunding and be designed to cope with storm events without overtopping (WRC).

The Department of Minerals and Energy (DME) endorsed Worsley's commitments to monitoring but stated that there is also a need for relevant, accurate and precise data prior to modelling of water parameters.

Other submissions requested comments on the potential impacts of mining operations on water quality (particularly salinity) of ground and surface waters, and whether the proponent is prepared to contribute to the development and implementation of a Salinity Strategy for the State.

One submission stated that water quality in the vicinity of some farms around the current and proposed mining areas is at critical levels for stock purposes, and asked what management procedures, safeguard measures and commitments are proposed by Worsley to ensure that bauxite mining activities do not exacerbate this position in local streams, particularly on the water quality of Marradong Brook.

Response from the proponent

The proponent has responded that the results from local and catchment monitoring programs indicate that bauxite mining operations have had no measurable adverse impact on salinity levels of the local water resource.

Worsley commenced mining in the Saddleback Timber reserve area in 1983. By the end of 1995, 862 hectares of native vegetation had been cleared for mining operations, of which 66% (568 ha) is being rehabilitated. The rate of clearing is currently 70 hectares per annum and is expected to increase to 140 under the proposed expansion.

As indicated in section 5.2.5 of the CER, the impact from bauxite mining on the local water resources has been monitored by Worsley through monthly measurements of salinity levels in rivers, streams and dams in the Boddington region since 1977. There has been no measurable increase in salinity levels since mining began in 1983.

In a recent water quality survey of the Hotham Catchment by Streamtec, it was noted that the Hotham river receives most of its salt as diffuse run-off from farming regions east of the PBA. Run-off from the forested areas of Hotham North, Saddleback and Marradong Timber Reserve areas dilutes the overall salinity related to historic broadscale clearing before the Hotham River discharges into the Murray River.

Worsley also commented that the Hotham Catchment Group has recently been commissioned through the National Soil and Conservation Landcare Program. Worsley will be working with other parties to develop strategies in the local area to ameliorate the impacts of salinity and other land degradation problems.

Worsley's position is that bauxite mining has had no measurable impact on salinity levels of the local water resource. This suggests that bauxite mining is not working contrary to the gains of farmers who are retaining native vegetation to counter salinity. Native vegetation on Worsley Joint Venture agricultural land has been retained and programs to expand the extent of these native vegetation remnants are being developed. The proponent notes that these initiatives have included the return of some areas of pasture to forest in association with mine rehabilitation activities on private property. This has included some twenty hectares of Worsley Joint Venture land which has been planted with trees.

Worsley has responded that its monitoring programs will continue and if mining causes salinity increases which adversely affect the use of surface water, immediate action will be undertaken to mitigate such impacts. Monitoring programs during the past 20 years have not detected a measurable increase in salinity levels of the local water resources from bauxite mining activities.

Worsley has recently commissioned a geophysical survey through World Geoscience using aerial electromagnetic techniques to map the PBA. The interpretation of this information is expected to help identify areas that may be at risk from the impacts of salinity. Areas identified with a potential salinity risk will be drilled to determine the salt storage and its proximity to the surface and groundwater. This information will be used to make an assessment as to how to best manage the area if it is likely to be mined.

Environmental Protection Authority evaluation

The design and operation of fuelling depots, is controlled under Part V of the Environmental Protection Act, through the application of Works Approval and Licence Conditions. These conditions would specifically require appropriate bunding of all fuel and chemical storage areas.

The EPA notes the proponent's existing water resources management program, particularly the elements of investigating alternative water supply sources, and seeking greater efficiency in the applications of that water (Commitments 26 and 27). As dust suppression is a major use of water on the minesite, the EPA strongly supports investigations towards improving the efficiency of that application and the consideration of alternatives.

The EPA also notes that the CER has not precisely defined the manner in which the additional water requirements 100 ML/annum might be obtained, although a number of options have been suggested. Should the increase in water demand at the minesite require the extension of existing borefields, or the establishment of a new borefield, such changes would require approval from the Water and Rivers Commission. If that agency considers that the consequences of that development are likely to be environmentally significant, then the proposed borefield development should be referred to the Environmental Protection Authority.

The EPA also notes that the proponent's monitoring suggests that the impact of mining on stream water quality has not resulted in significant changes. It is recognised that the most probable effect of mining on water quality is increasing salinity, as a result of the mobilisation of subsoil stored salts following clearing. The proponent has made a specific commitment to investigate stored salts in the Marradong and Hotham North areas prior to mining (Commitment No. 29). Once the potential for impact has been characterised, appropriate ameliorative measures can be implemented in advance of clearing as discussed by the proponent in their response to submissions (see response to Question 6.4, Appendix 4).

On the basis of the proponent's environmental management commitments, the existing program for water resource protection implemented by Worsley, and the advice of the Water and Rivers Commission, the EPA considers that this issue can be managed to achieve the assessment objective.

4.7 Noise impacts from mining and the overland conveyor

Objective

To protect the amenity of nearby residents from noise impacts resulting from bauxite mining activities and overland conveyor, by ensuring that noise levels comply with statutory requirements.

Policy Information

Noise levels for projects within Western Australia are subject to the Noise Abatement (Neighbourhood Annoyance) Regulations 1979 (existing noise regulations), which are currently the prescribed standard for noise under the *Environmental Protection Act 1986*. These regulations specify the Assigned Outdoor Neighbourhood Noise Levels for various types of noise-receiving premises for different times of the day. In the case of rural residences and residential areas, such as Boddington, the Assigned Noise Levels are 30-35 dB(A) at night (10.00 pm - 7.00 am); 35-40 dB(A) during the evening (7.00 pm - 10.00 pm) and on weekends/public holidays (7.00 am - 7.00 pm); and 40-45 dB(A) during weekdays (7.00 am - 7.00 pm).

The EPA will shortly be considering the draft Environmental Protection (Noise) Regulations 1995, currently being prepared by the DEP. The EPA's evaluation of noise impacts from the bauxite mining operations considered the draft regulations, since these are likely to be in force by the time the expanded operations of the project commence. The draft regulations specify a method for determining the Maximum Allowable Noise Level for a noise-receiving location, based on the land use zonings and the presence of major roads around the receiving point. For a residence with no commercial or industrial zonings and with no major roads within 450 metres, the lowest of the Maximum Allowable Noise Levels would apply. These levels would be 35 dB(A) at night, 40 dB(A) during the evening and on Sundays and public holidays, and 45 dB(A) during the day on Monday to Saturday.

Air-blast over-pressure emissions from the minesite have been regulated under Part V licence conditions since 1989. Air-blast over-pressures are subject to certain limits, including not to exceed 125 dB peak linear, not to exceed 120 dB peak linear more than 4 times per year, and not to exceed 115 dB peak linear more than 12 times per year, when measured on the curtilage of the most affected noise sensitive premises. Monitoring reports are to be submitted annually to the Department of Environmental Protection.

The noise management strategy to which Worsley committed in the ERMP includes fitting appropriate sound power suppression to mining equipment and investigating air-blast overpressure and operational sound emissions to ensure compliance with regulations.

An amendment to the *Alumina Refinery (Worsley) Agreement Act 1973* in July 1995 prescribes the noise and compliance monitoring standards for the overland bauxite conveyor. The Agreement provides for 24 hour operation of the bauxite conveyor subject to compliance with prescribed noise standards. Noise emissions from the conveyor are required to be continuously monitored at a reference point 900 m from the conveyor to ensure compliance with an upper limit of 60 dB(A). Results of the monitoring program are to be reported to the State annually.

Technical information

Mining operations are and will be conducted in proximity to some residences, which will be exposed to mining equipment noise, air-blast over-pressure and conveyor noise.

Mobile mining operations
Mobile mining operations will be extended and will be routinely scheduled during the 10.00 pm to 7.00 am (night shift) period. Significant noise generating mobile equipment includes drills, scrapers, front-end loaders, excavators and trucks.

The proponent's noise management strategy is documented in the CER and includes the use of computer modelling, noise reduction initiatives and mine pit flexibility.

Worsley uses the computer software, Environmental Noise Model (ENM), which allows the input of equipment sound power, topography, terrain and meteorological data, to generate sound level contours surrounding the operation or detailed sound level information at a selected location. The output from ENM is cross-referenced with Worsley's weather database to predict the probable occurrence of a particular level of mining sound at a nominated receival point. The model is validated by conducting field measurements of mining sound levels.

The CER presented the results from the modelling of three typical operating situations. The model predicted L10 sound level at each of 10 key residences under a variety of wind speed and direction conditions for these operations.

Under typical mining operations during the night shift period the model predicts that sound level output will be within compliance conditions for 64% of the time. By modifying the mining operation and retracting to the core mining area, the model has shown that compliance conditions can be achieved during all day shifts and during 87% of the time during night shift. Further modification to the mining operation by limiting operations to reclaiming from stockpiles near the crusher plant enable compliance conditions to be met 96% of the time during night shift. Sound power reduction initiatives on the current mining equipment and plant will enable the mining operation to meet compliance conditions more than 96% of the time during night shift. Where required, mining operations can be contracted further to meet noise limits.

The CER stated that Worsley has received eight complaints relating to mining noise since July 1989. Reversing alarms on mining vehicles have been identified as the most intrusive. Worsley has recently fitted quieter alarms to reduce their impact on neighbours while maintaining mine safety standards.

Blasting
Blasting currently takes place two to three days per week. It is expected that at expanded production rates blasting activities will be required five days per week.

To comply with its internal air-blast over-pressure target of less than 110 dB (lin) peak, the proponent modifies the charge weight per delay, initiation management and blast design for each individual blast. Blasting is scheduled to take into account prevailing and likely weather conditions at the time of the blast. The air-blast overpressure from each blast is monitored at the most sensitive premises, as determined by distance, topography, meteorological factors and local experience. Worsley is currently reviewing the potential for developing computer software that can be used for predicting air-blast overpressure.

Air-blast over-pressure levels have been in compliance with licence conditions since blasting operations were subject to Environmental Protection Act in 1989.

Comments from key agencies / interest groups

In its assessment of mining-related noise impacts, the DEP made the following points:

- the modelling work and predicted noise levels were accepted;
- the proponent should make available any monitoring results that are used to adjust the noise model;
- the DEP will be seeking 99.9% compliance with the proposed new noise regulations;
- the proponent should give details on how compliance is to be achieved in subsequent noise management plans;
- a reduction in noise emissions is crucial to the achievement of compliance with the proposed new regulations;

- documentation on how noise reductions are achieved with existing equipment and methods for determining sound power levels of any new equipment should be documented in noise management plans;
- future monitoring proposed by Worsley should include verifying the effects of the various modifications to mining operations that are carried out on a daily basis, and assessing the effects of any tonal, modulation or impulsive noise characteristics;
- the proponent's approach of adopting an internal target of 110 dB (lin) peak for air-blast over-pressure is commendable and should minimise complaints;
- the proposed monitoring of each blast and the intention to develop computer software for the prediction of air-blast over-pressure is supported;
- Commitments 31 to 40 relating to mining noise and blasting, while they are acceptable in addressing the issues satisfactorily, are of a general nature and need to be converted into a noise management plan at the appropriate stage;
- wear and tear on conveyor parts and the speed of the conveyor are regarded as key influences in the ability to maintain compliance with the 60 dB (A) limit in the Agreement Act; and
- Commitments 54 and 55, relating to noise mitigation measures and monitoring of noise emissions, appear to address potential noise impacts associated with the extended use of the overland conveyor.

One public submission expressed concern that noise from the future conveyor extension would affect them. The conveyor is currently located more than 7 km from the residence, where noise is said to be noticeable but not too loud to be a problem. The submission indicated that the extended conveyor would be about 1 km from the residence, possibly in direct line of sight.

Response from the proponent

In response to the comments made by the DEP regarding compliance with the noise regulations, the proponent indicated that it will strive for 100% compliance with the proposed noise regulations.

In relation to a noise management strategy, the proponent responded that it has developed and implemented such a strategy with the objective of meeting noise limits at noise sensitive premises. If other noise sensitive areas are identified, appropriate noise management strategies will be developed.

In relation to monitoring noise levels to verify the effects of the various modifications to mining operations in sensitive areas, Worsley stated that it will routinely monitor noise levels to determine the effects of modifications to mining operations and verification of noise modelling sound level predictions. This will also involve an assessment of tonal, modulation and impulsive noise characteristics within the vicinity of noise sensitive areas. The results will be made available through the annual environmental management reporting to Government agencies and EMLG.

In response to concerns that noise from the future conveyor extension would affect a private residence, the proponent has stated that the indicative conveyor extension route has not been finalised and appropriate access provisions would need to be agreed to with private land-owners in advance. Route selection and design specifications for the conveyor will be developed in consultation with relevant Government agencies to ensure that the environmental management plans are appropriate to the extensions.

Furthermore, no decision has been made at this stage by Worsley in regard to the specific design or technology to be used in any extension of the conveyor system. However, noise mitigation will be a major consideration in the eventual decision on conveyor design and technology, as will issues such as, minimising impact on noise sensitive premises, and taking into account heritage and aesthetic values.

Environmental Protection Authority evaluation

The EPA notes the comprehensive commitments made by the proponent to manage noise emissions associated with the mining operation and the overland conveyor (Commitments 31 to 40, 54 and 55), and the proponent's response to the DEP submission and the public. The EPA also notes the performance of the proponent to date in complying with licence conditions and managing complaints from the public.

The EPA acknowledges the advice of the DEP on mining-related noise impacts, specifically its acceptance of the commitments provided by the proponent. The EPA supports the specialist role that the DEP has, as part of the EMLG, in providing advice to the State Government on mining related noise impacts.

The EPA considers it important that the proponent further documents its noise management strategy and proposed initiatives as part of its environmental management plan. This would provide a valuable basis in auditing the proponent's performance in meeting the environmental objective relating to mining-related noise impacts (Recommendation 3, Section 5).

The EPA concludes, based on the proponent's performance to date, the modelling data demonstrated in the CER, and its noise management strategy and commitments, that the proposed expansion of operations can achieve the EPA's objective of protecting the amenity of nearby residents from noise impacts resulting from bauxite mining activities and overland conveyor.

4.8 Rehabilitation of bauxite residue areas

Objective

To design, construct and operate the residue areas in a manner that maintains the integrity of the containment system.

To maximise as far as practicable the extraction of caustic soda from the bauxite residue.

To minimise as far as practicable impacts on the State forest resulting from construction activities.

To manage the residue areas in an environmentally acceptable manner until they meet the requirements of a closure and rehabilitation strategy agreed with the State.

Policy Information

The Agreement and the ERMP form the basis for environmental conditions relating to the methods of disposal of bauxite residue and the construction and management of tailings impoundments. Proposals for the storage and management of residue have been approved by the Government and require the protection of water resources and the progressive rehabilitation of residue disposal areas.

Part V licence conditions administered by the DEP require the proponent to take all reasonable and practicable measures to prevent or minimise the generation of dust in open areas.

Technical Information

Prior to disposal, bauxite residue is filtered and washed in the refinery process area to recover as much sodium hydroxide as possible. At the end of this process small amounts of sodium hydroxide, sodium carbonate and sodium bicarbonate remain in the thick residue. If not contained, leaching of these alkaline substances and salts from the bauxite residue into the environment would have the potential to affect the quality of nearby water resources in the Brunswick River catchment.

On the residue surface, sodium hydroxide is exposed to air and reacts with atmospheric carbon dioxide to form sodium carbonate. If the residue dries out and is exposed to strong winds the

sodium carbonate together with silica (from kaolinite) and iron oxide particles may give rise to dust emissions. This dust has the potential to be a source of irritant to personnel and impact upon surrounding vegetation.

Worsley has developed and implemented a residue management system which takes into account the chemical and physical properties of the residue and is designed to provide structural integrity to the residue impoundments to prevent the release of contaminated water. This system:

- minimises the amount of alkaline substances in the residue;
- promotes appropriate alternative uses of bauxite residue;
- prevents leakage by a clay seal at the base of the residue disposal areas;
- restricts disposal to the smallest practicable area; investigates practicable means of dust generation prevention;
- isolates the residue disposal areas from surrounding areas;
- enhances consolidation of the residue by incorporating the underdrainage in the design of the system; and
- returns drainage to the contained water management system.

The disposal of bauxite residue involves the stacking of low water content residue to keep coverage to a minimum, a clay seal to prevent leakage and underdrainage to facilitate consolidation and monitoring of the integrity of the clay seal. The residue impoundments are constructed according to specifications of the Australian National Committee on Large Dams (Worsley, 1995).

The first residue disposal area is due to be available for rehabilitation by the end of the decade. Worsley has initiated a research program to work toward the development of a rehabilitation prescription for the residue area surface. To date, the proponent's research has focussed on both engineering and agronomic aspects of rehabilitation by investigating options for ameliorating the chemical and physical limitations to plant growth, characterisation of water balance and settlement parameters.

Rehabilitation of the residue surface is expected to suppress dust generation in the long term. In the shorter term the generation of dust is controlled by alternating deposition of residue between residue areas. The investigation of techniques for establishment of a basal vegetated cover to control dust for longer periods is part of the rehabilitation prescription development program.

The CER states that Worsley recognises the potential future value of bauxite residue for use as a soil amendment agent, in nutrient adsorption systems, and in industrial applications such as pigmenting, or use in construction. Worsley is at present defining the characteristics of residue for use as a soil amendment agent and in nutrient adsorption systems. Worsley continues to monitor alternative uses for bauxite residue.

The proponent has indicated that closure and long term management aspects of the residue disposal areas are to be addressed in its decommissioning strategy. The strategy will be developed in consultation with the relevant government agencies and will be periodically reviewed to ensure that:

- rehabilitation strategies for key operations areas are kept current in respect of new environmental standards and regulations;
- financial estimates for rehabilitation provisions are kept current for key project areas; and
- emerging issues relevant to project rehabilitation are identified well in advance of decommissioning.

No additional residue disposal area will be required as a result of the expansion. Rather, the approved areas would be developed at different rates.

Monitoring and past performance

Monitoring and performance by the proponent in preventing contamination of nearby water resources is detailed in Section 4.9 of this report. Regular measurement of water quality in monitoring bores has revealed that no seepage of alkaline water has been detected outside of the contained water management system. In addition to this monitoring, weekly samples of underdrainage are collected and analysed for potential contamination.

Since refinery operations began in 1984, one localised seepage was detected in 1992 from beneath one residue disposal area. Groundwater collected from beneath the residue disposal area continues to be redirected to the contained water management system. This is expected to continue until the residue disposal area is no longer used.

Monitoring of geotechnical properties and structural stability of the bauxite residue areas is ongoing. Construction of new embankments on the residue impoundments proceeds only when stability testing meets with design safety specifications.

Worsley have a continuous dust monitoring program around the refinery lease area using portable high volume dust samplers.

Worsley has given a comprehensive list of commitments relating to the management and closure of the bauxite residue disposal areas including the development of completion criteria (Commitments 70 to 76 and 101 to 104 and 106).

Comments from key agencies / interest groups

The WA Forest Alliance submitted that closure criteria and long term management strategies for residue areas should be agreed before approval is granted. If this is not done, then criteria and accompanying agreements should be reviewed in a separate public review process.

Response from the proponent

Worsley supports any reasonable public review associated with the establishment of completion criteria and a closure strategy for residue disposal areas. Community consultation on environmental issues is consistent with Worsley's environmental management approach outlined in section 5.1 of the CER. Worsley has stated that it has always understood that a public review would be a necessary part of establishment of completion criteria and a closure strategy in association with EMLG.

Environmental Protection Authority evaluation

The EPA recognises the importance of developing agreed completion criteria and a closure strategy for residue disposal areas, as at some stage in the future there will be the need to divest management responsibility for these areas from Worsley to back to the State (CALM). Given that a number of Government agencies may have useful input, the EPA supports the view that the criteria and strategy to be developed and reviewed through the existing Environmental Management Liaison Group (EMLG).

The EPA also notes and commends Worsley's willingness to involve the community in the process of developing and implementing its closure strategy (see response to Question 3.1(Bauxite Residue), Appendix 2). The EPA considers it would be appropriate for the EMLG consult with the community on the proposed completion criteria and closure strategy, prior to their finalisation.

The EPA also notes the comprehensive list of commitments made by the proponent relating to the management and closure of the bauxite residue disposal areas. In addition to commitments specifically relating to the residue areas, Worsley has also committed to apply environmental strategies to achieve the objectives for this issue, and where monitoring and auditing results indicate that an objective is not being met, will make the necessary changes to those strategies (Commitments 107, 108 and 109).

The EPA concludes that, subject to the proponent documenting these commitments as part of its environmental management plan, this issue can be managed to achieve the assessment objectives (Recommendation 3, Section 5).

4.9 Atmospheric emissions, including greenhouse gases

Objective

The EPA's objective is to ensure that gaseous emissions, including greenhouse gases and odours, both individually and cumulatively, do not cause an environmental or human health problem in the area around the refinery. The proponent should use all reasonable and practicable measures to reduce the discharge of wastes, including gases.

Policy information

The EPA has promulgated two Environmental Protection Policies (EPPs) for atmospheric pollutants for the Kwinana and Kalgoorlie areas. No policy has been developed for the Collie area to date. The EPA uses the Kwinana EPP standards and limits as guidelines for the assessment of new industrial projects (where there are no existing sources) and for existing industrial plants which are seeking approval for modifications, such as this proposal (EPA, 1992).

In the Kwinana EPP, a limit is defined as "a concentration not to be exceeded" and a standard is defined as "a concentration which it is desirable not to exceed". The standard is interpreted as the value which the ground level concentration must be below for 99.9% of the time. The standards and limits for sulphur dioxide and particulates used in the EPP for the Kwinana policy area are summarised in Table 3.

Table 3. Ambient Air Quality Standards and Limits for Sulphur Dioxide and Particulate Emissions (Kwinana EPP).

Emission	Zone	Averaging Period	Standard ($\mu g/m^3$)	Limit ($\mu g/m^3$)
Sulphur Dioxide	Industrial estate	1 hour	700	1,400
		24 hour	200	365
		annual	60	80
	Buffer area	1 hour	500	1,000
		24 hour	150	200
		annual	50	60
	Residential	1 hour	350	700
		24 hour	125	200
		annual	50	60
Particulates	Maximum	15 minute	-	1,000
	Industrial Estate	24 hour	150	260
	Residential	24 hour	90	150

Part V licence conditions on the Worsley refinery stipulate that the concentration of particulates in the exit gases from any stack shall not exceed 250 mg/m^3 and the mass emission of SO_2 from the powerhouse stack shall not exceed 520 g/s. The proponent is required to measure the sulphur content of coal used as fuel, and to ensure that the sulphur concentration does not exceed 1.0%.

The National Health and Medical Research Council (NH&MRC) guidelines require that the ambient concentration of nitrogen dioxide (NO_2) does not exceed 170 ppm or 320 ug/m^3 (as a one hour average, and not to be exceeded more than once a month). Guidelines for maximum concentrations of oxides of nitrogen (NOx) emissions from stacks and vents may also apply to industrial plants. Gas burners with low levels of NOx are available commercially.

In its assessment of the proposed Collie power station (EPA, 1990), the EPA concluded that a conventional coal-fired power station was one of the least environmentally acceptable options for the generation of electricity. The EPA recommended that a combined cycle gas turbine power station should be developed as Western Australia's next base load power plant.

Carbon dioxide is a greenhouse gas and worldwide industrial emissions are considered to be a major contributor to global warming. The Federal Government, in accordance with international agreements, has announced an intention to stabilise carbon dioxide emissions in Australia by the year 2000. The Commonwealth has urged a programme of co-operative agreements between industry and the government to reduce greenhouse emissions.

The EPA recently considered greenhouse gas emission policies in general, including the approach taken by the Commonwealth government and the review undertaken by the DEP into the status of WA's approach.

The EPA provisional policy with respect to greenhouse gases recognises the significant contribution to greenhouse gases that large resource processing projects can make. Accordingly, the EPA considers that a proponent should:

1. calculate the greenhouse gas emissions for the project;
2. estimate the international offsets achieved by implementation of their proposal;
3. indicate the "no regrets" measures adopted to reduce greenhouse gas emissions; and
4. enter into a voluntary agreement with the State, in which they will commit to "no regrets" measures and approaches to abate greenhouse gas emissions, and to enhance sinks.

"No regrets" refers to those measures for the reduction of emissions of greenhouse gases. These include measures to increase efficiency, to protect and expand forests, and to limit the emission of chlorofluorocarbons. To the extent that these efforts have a net benefit, or at least no net cost, in addition to addressing the enhanced greenhouse effect, they have become known as "no regrets" options (Greenhouse Gas Coordination Council, 1994).

The 1979 ERMP forms the basis for existing commitments which relate to minimising and monitoring atmospheric emissions.

Technical information

The primary emissions from the current refinery site are sulphur dioxide (SO_2), oxides of nitrogen (NO_X) and particulates from the powerhouse and calciners. In addition, dust from materials handling facilities and fugitive dust from around the site, and odours may also arise from the refinery.

New plant to be installed as a result of the proposed expansion which will lead to a significant increase in the emission rate of gases and particulates includes a liquor purification facility to improve the efficiency of the Bayer process, either a coal or gas-fired boiler to provide for the additional energy demand of the expansion and two additional gas fired calciners to remove chemically combined water to form alumina product. The installation of the proposed liquor burning facility may also produce volatile organic compounds and resultant odours as a result of burning off the organic impurities in the process liquor.

The CER states that the installation of the new boiler and calciners, and retrofit of old equipment if practicable will incorporate best practicable pollution suppression technology.

The isolated location of the refinery away from populated areas and other industry generally reduces the potential for atmospheric emissions to impact upon surrounding neighbours. However the cumulative impact of emissions from the proposed expansion at Worsley, when combined with the Muja power station and the proposed Collie power station emissions, needs careful consideration, particularly sulphur dioxide emissions.

Results of a modelling exercise to predict the impact of the refinery expansion on atmospheric emissions are presented in the CER. Estimates of the ground level concentrations from stack emissions were determined using AUSPLUME, the Victorian EPA's dispersion model, and convective analysis techniques using the morning fumigation model of Deardorff and Wills (1982). Data used from the modelling was obtained from the extensive air quality and meteorological measurements obtained near Muja by SECWA in 1983 and 1984.

The current and predicted emission rates are summarised in Table 4 (source WNI, 1995).

Table 4. Emission of Sulphur Dioxide, Dust, Oxides of Nitrogen and Carbon Dioxide from the Refinery.

Source	Mass Emission Rates (g/s)			CO_2
	SO_2*	Dust	NO_x	(Total Gg/annum)
Existing refinery capacity (1.75 Mtpa)				1372
Powerhouse	304	5.5	97	
Calciners (per unit)	0.08	1.2	0.42	
Refinery expansion[1,2]				2058
Powerhouse	454	9.3	164	
Calciners (per unit)	0.1	1.2	0.42	
Refinery expansion[1,3]				Not yet
Powerhouse	340	7.0	140.3	available
Calciners (per unit)	0.1	0.1	0.42	

1 To 3.5 Mtpa and incorporating the Stage 1 upgrade of existing plant to 2 Mtpa
2 Assumes the additional boiler is coal fired
3 Assumes the additional burner is gas fired
* Calculated by sulphur content in coal; assuming 100% conversion to SO_2.

Sulphur Dioxide

Sulphur dioxide is a colourless gas which has a pungent odour and can irritate and be absorbed in the respiratory tract. The sensitivity of humans to sulphur dioxide varies considerably and asthmatics may suffer adverse reactions at quite low levels.

The gas also dissolves in moisture forming dilute sulphurous acid, which then forms sulphuric acid and sulphates, which can be readily absorbed onto small airborne particles. This increases the potential for adverse effects on humans and for environmental impacts such as leaf damage to plants and reduced water quality in wetlands (EPA, 1996).

Sulphur dioxide is the most significant source of atmospheric emissions from the Worsley refinery and is associated with the use of coal as the fuel source in power generation. The proponent is yet to determine whether coal or natural gas will be used as the fuel source for the proposed expansion. Currently 10,610 t/a of sulphur dioxide is produced by the refinery operations, and this is predicted to increase by another 54% to 16,370 t/a, assuming the power station fuel source is coal.

If the power station fuel source was gas rather than coal, the emission of SO_2 would not be expected to significantly increase following the expansion. Using gas would reduce the total SO_2 emissions from the powerhouse stacks from 454 g/s to 340 g/s when refinery production reaches 3.5 Mtpa (Worsley, 1996).

Modelling by the proponent indicates that, for sulphur dioxide, maximum hourly and 9th highest hourly average concentrations will be 866 and 451 $\mu g/m^3$. These peak concentrations are predicted to occur at distance of 0.5 to 1 km from the powerhouse and calciner stacks and within the Worsley refinery lease area. These values are higher than the residential zone

standards of 700 and 350 µg/m3 in the Kwinana EPP, but are well below the industrial zone standard of 1400 and 700 µg/m3.

At the nearest residential site, the maximum and 9th highest hourly concentrations of SO_2 will be 350 and 150 µg/m3, which are well below the Kwinana EPP residential air quality standards. The highest maximum 24 hour and annual average concentrations of 88 and 10.4 µg/m3 respectively are also well below the standards. At the refinery lease boundary the buffer zone standards are met.

Results of the morning fumigation modelling indicate that at downwind distances of 6 and 15 km (less than the distance to the nearest residence and Collie) the most likely worst case concentrations would be 445 and 382 µg/m3 respectively. Therefore, fumigation will not result in adverse impacts on air quality within the region.

The modelled concentrations were determined using hypothetical worst case meteorological conditions which are unlikely to occur even once per year.

Nitrogen Dioxide

Nitrogen dioxide (NO_2) is a reddish brown gas which is soluble in water and is a strong oxidant. The major sources of man-made emissions to the atmosphere derive from the combustion of fossil fuels. In most situations, nitric oxide is emitted and is then transformed into NO_2 in the atmosphere. At low concentrations, NO_2 can cause irritation of the mucous membranes and may cause or exacerbate respiratory problems such as asthma and bronchitis (EPA, 1996).

NO_2 emissions from the Worsley refinery are primarily a product of combustion associated with the power station, with a very small contribution from the calciners. Currently 4,310 t/a of nitrogen oxides are produced by the refinery and this is predicted to rise to 6,650 t/a when the proposed expansion is in operation (an increase of 54%).

The proponent has only modelled ground level concentrations of NO_2, as NO_2 is the most significant environmental contaminant of the nitrogen oxides. Modelling showed that for NO_2, the maximum hourly, 9th highest hourly, maximum 24 hour and annual average concentrations will be 157, 82, 21.8 and 2.4 µg/m3 respectively. These values are well below the NH&MRC guidelines of 320 µg/m3 and indicate that NO_2 emissions will have insignificant effect on regional air quality.

Carbon Dioxide and greenhouse gases

Carbon dioxide is a greenhouse gas and worldwide industrial emissions are considered to be a major contributor to global warming.

An inventory of greenhouse gas emissions from the current bauxite/alumina project has identified that the majority of greenhouse emissions originate from the stationary fuel combustions sources, in particular the coal-fired powerhouse, and to a lesser extent the gas-fired calciners. Other sources included in the inventory have been emissions from fuel combustion from the mobile vehicle fleet, fuel storage facilities, and land use changes associated with the operation.

The proponent has developed a greenhouse gas strategy which aims to improve energy efficiency, decrease where practicable the generation of greenhouse gases, and maximise the development or preservation of new and existing greenhouse sinks respectively. Worsley will also participate in industry-wide approaches to reduce greenhouse emissions where practicable.

Odour

Odours are currently generated at the refinery site from the reaction of caustic soda and organic material within the bauxite ore, and from the emission of hydrogen sulphide from the solar evaporation pond.

The oxidation of organic impurities within the process liquor associated with the proposed liquor purification facility may result in emission of low concentrations of volatile organic compounds (VOCs). Liquor purification technology is currently employed at other alumina refineries. The proponent predicts that, as a result of dilution and dispersion of VOCs, ground level concentrations will be well within air quality standards.

Monitoring and past performance

Worsley is required by Part V licence conditions to monitor emissions of SO_2 and particulates from the powerhouse and calciner stacks. NO_X emissions are also periodically monitored. Levels of SO_2 and particulates are required to be reported to the DEP if any licence condition is exceeded. Monitored emissions shown in Table 4 are well within licence conditions. Monitoring of the sulphur concentration of coal used at the refinery averaged 0.6% during 1995, well below the 1.0% limit.

The emission of sulphur dioxide was reduced in 1985, as a result of the conversion of the fuel source for the calciners from fuel oil to natural gas (which has negligible sulphur content).

Regional air quality monitoring in Collie over a four month period has indicated SO_2 concentrations of only 25 $\mu g/m^3$ to be attributable to Worsley (indicating the fumigation modelling performed is likely to be conservative).

Prior to 1989 hydrogen sulphide odours originated from a solar evaporation pond which was also used for co-disposal of sodium oxalate. Since oxalate disposal into the pond was ceased in 1989, emission of odours has been reduced to very low levels and occurs occasionally in autumn as a result of "pond turnover".

The proponent has made a number of commitments relating to the monitoring of emissions and their prediction, and the incorporation of best practicable pollution suppression equipment (Commitments 56 to 60). Commitments have also been made in relation to greenhouse gas management (Commitments 83 to 87).

Comments from key agencies / interest groups

The DEP has submitted that the proponent's performance to date in meeting its licence conditions is satisfactory. The computer modelling to predict gaseous emission impacts from the proposed expansion was carried out in accordance with the DEP guidelines. The subsequent predictions made in the CER, which show that the gaseous emissions would be below air quality guidelines established by recognised organisations such as the World Health Organisation and the NH&MRC, are accepted by the DEP. The DEP considers it may be appropriate at some later stage for air quality standards to be developed specifically for the Collie area, as opposed to using those in the Kwinana EPP.

One submission from the public recommended that approval for the proposal be conditional on the use of gas (as opposed to coal) for the boiler. Another submission believed that the impact of gaseous emissions and dust on native fauna should be considered, in addition to their impact on human health. Concern was also expressed about the contribution to the greenhouse effect of bauxite mining, with the clearing of vegetation and stripping of the earth, and subsequent loss of carbon from the biota and soils to the atmosphere.

Response from the proponent

In relation to the contribution of bauxite mining to the greenhouse effect, the proponent has pointed out that Table 15, section 5.5 of the CER shows that for 1995 the net emission of greenhouse gases was estimated to be approximately 48 Gg/annum from landuse changes at the bauxite mine. After 2009 the bauxite mine becomes a greenhouse sink for the rest of its life (and beyond for some time).

In response to what basis Worsley will make its decision on whether to use coal or gas to fire the boiler for the upgrade, Worsley has responded that it will need to take into account a number of considerations including environmental benefits and issues of continuity of supply. Worsley sees that purely from an environmental perspective there are clear advantages in using gas in the new boiler. By adding a natural gas-fired boiler instead of coal to the existing coal fired boilers, the emission of SO_2 will not significantly increase following expansion.

Environmental Protection Authority evaluation

Following advice from the Department of Environmental Protection and the proponent's response to questions raised, the EPA considers that gaseous emissions from the proposed refinery expansion are manageable.

The EPA notes that the predicted concentrations for sulphur dioxide and nitrogen dioxide are within limits specified for these gases by expert authorities, however, as previously stated (EPA, 1990) the EPA supports the use of gas rather than coal as the preferred fuel.

Detailed specifications for discharge of emissions, monitoring and reporting are established by the Department of Environmental Protection in licence conditions set under Part V of the Environmental Protection Act.

The EPA notes the proponent's commitments to manage gaseous emissions from the refinery. The proponent's commitment (Commitment 57) to incorporate best practicable pollution suppression equipment on new plant is consistent with the EPA's view that proponents should use all reasonable and practicable measures to reduce the discharge of wastes, including gases (EPA, 1996). The identification, and implementation (where appropriate), of such measures is regarded by the EPA as an important component to be addressed in the proponent's Environmental Management System.

The EPA considers that the commitments provided by the proponent in relation to the management of greenhouse gases adequately address its provisional policy position for greenhouse gases described above. These commitments include the preservation of greenhouse sinks on Joint Venture-owned land and the investigation of measures to improve energy efficiency (Commitments 83 to 88).

The EPA concludes that the commitments by the proponent are sufficient to ensure that the environmental objectives in relation to gaseous emissions can be met.

4.10 Water resource management and protection - Refinery

Objective

To ensure that environmental values of water resources are maintained from adverse impacts of refinery operations and bauxite residue disposal.

Policy Information

The Worsley ERMP approved in 1980 under the State Agreement, forms the basis for environmental conditions and commitments relating to the protection of water resources.

The Part V licences for discharges to the environment issued to Worsley does not contain conditions relating to the discharge of effluent to the environment, as Worsley operates a contained water and residue management system.

A condition of the approval by the Water Authority for the construction of the freshwater lake within the refinery lease area is to maintain a discharge from the freshwater lake of not less than the summer basal flow (approximately 35 cubic metres per hour).

ANZECC has developed water quality guidelines for aquatic ecosystems and water supplies (ANZECC, 1992).

Technical Information

The refinery is located in the headwaters of the Augustus River and therefore has the potential to affect the quality of this catchment's water resource in the event of the escape of contaminated runoff or groundwater from the site. The major source of potential contaminant is caustic soda, which is present in process waters, and in lesser concentration in bauxite residue. In high concentrations the alkaline caustic liquor can affect the quality of surface and ground waters, and presents a potential hazard to personnel. However in low concentration the effects of caustic

are minimal. The water resource has important environmental values including maintenance of natural aquatic ecosystems, and public water supply.

Worsley has developed a refinery lease water management system which separates clean water from any potentially contaminated water within a water management area for reuse in the refinery. The refinery water management system consists of five key elements:

- a refinery catchment lake, which collects runoff from the refinery, and seepage decant water and runoff from the residue disposal areas. This is used for cooling purposes at the refinery and power station and as process water;
- pipehead dams, which are downstream from the residue disposal areas, which collect surface and piped underground drainage from the residue disposal areas and any seepage from under the refinery catchment lake and return these waters to the refinery catchment lake;
- a freshwater lake, which stores clean runoff for use as potable water and as occasional make-up water in the refinery catchment lake;
- solar evaporation ponds, for the evaporation of spent cleaning acids and possible containment for sodium sulphate solution from the proposed liquor purification plant; and
- a series of diversion and collection channels to divert clean runoff around to refinery process area and into the freshwater lake.

The only surface water that leaves the refinery lease area is uncontaminated, and is discharged as overflow or scour valve release from the freshwater lake to the Augustus River.

All structures at the Worsley refinery site which contain residue or contaminated water are designed to standards specified by the Australian National Committee on Large Dams which take into account appropriate soil geotechnical properties, storm frequencies and earthquake protection.

Worsley has developed a spills and stormwater management plan designed to protect local surface and groundwaters. If spills do occur, they are contained and any contaminated soil is removed and treated, and any contaminated groundwater is recovered and or treated. The strategy involves a comprehensive plant monitoring system; regular inspection and testing of new and existing storage and process vessels; employee education and training in the prevention and management of spills; and a system of reporting any incidents to allow corrective action to be taken to prevent recurrence of the incident. Containment of spills and contaminant runoff are aided by locating all refinery process vessels on concrete pads.

Monitoring and past performance

Monitoring bores are located throughout the refinery lease area and form a perimeter around the lease and downstream of the major containment components of the management system. Results of the groundwater monitoring program are reported to the Government annually and reviewed by the WRC and DEP.

The CER states that since start up, and in addition to the annual monitoring reports, two major groundwater monitoring reviews have been conducted by consultants to the proponent. These reviews have shown no adverse affect on groundwater levels and quality outside the process area as a result of the refinery or associated operations.

Surface water quality has also been monitored since refinery operations began. Weekly measurements are made of pH and the salinity of water discharging from the freshwater lake to the Augustus River. Summarised information presented in the CER shows that, throughout the monitoring period, no trends are apparent beyond normal seasonal fluctuations. This river water monitoring program is supplemented by periodic survey of the Augustus River to determine impacts on the biota of the river system.

Biological surveys conducted on behalf of the proponent in 1984 and 1992 and reported in the CER do not indicate any long term decline in the water quality, effects on river ecology or accumulation of heavy metals in the Augustus River.

Localised contamination of groundwater and soil down to 10 metres below the surface has been detected directly beneath the concrete pads containing some process vessels. Cleanup of the contamination is being achieved by dilution and abstraction of contaminated groundwater using a series of freshwater injection and recovery bores around the affected facilities and by the removal and disposal of contaminated soil into the residue disposal areas. Concurrently, concrete pads and foundations are being replaced and geofabric membranes are being installed to prevent further seepage from the facilities.

The proponent has made a comprehensive list of commitments (Commitments 61 to 69) to monitor and manage the water resources in the vicinity of the refinery operations.

Comments from key agencies / interest groups

The Water and Rivers Commission (WRC) considers the project as described in the CER as acceptable. The WRC drew attention to a number of minor points in its submission which it will be seeking a response from the proponent:

- monitoring parameters for Augustus and Brunswick Rivers are to be discussed with WRC;
- any increased water draw from surface catchments must not significantly diminish the inflow to Beela Dam which supplies water to the Brunswick region;
- confirmation is requested that chemical/waste oil tanks and process vessels have adequate perimeter bunding to control spills and handle stormwater without overtopping;
- a plan showing the location of monitoring and recovery bores is requested;
- details for the control of any acid liquors from the SO_2 wet scrubbers are required; and
- further details are required on the Anpress unit to be used to separate oily waste water.

The WRC envisages that conditions should be formulated to provide protection of the beneficial usage of the Augustus/Brunswick River system, routine monitoring and annual reporting via the Director, Pollution Prevention Division of the DEP.

The Shire of Harvey has requested that the DEP examine the security of the design of on-site dams and ensure that local water catchments are protected.

One public submission expressed concern that runoff in an extreme rainfall event may not be contained, while the new residue area is cleared and the old one is unvegetated.

Response from the proponent

In response to concerns about the design and integrity of the dams, the proponent has explained that the refinery water management system operates on a principle of containment of all contaminated and potentially contaminated water (the key elements of this system are described in section 5.4.2 of the CER). The bauxite residue disposal areas are designed to drain (both rainfall runoff and seepage) to the pipehead dams which operate at a low water level and return any seepage and runoff from the residue disposal areas to the refinery. This provides for a large storage capacity above the normal operating level in the pipehead dams. All dams are designed in accordance with current sound engineering practice, including considerations of stability under various loadings and earthquakes. The construction of dams is carried out under strict supervision.

Regarding concerns about the potential for run-off or dam overflow resulting from extreme storm events, the proponent has indicated that the containment structures at the refinery are designed and operated to contain the runoff from a six hour PMP. This same design criteria will apply to the containment structures for the expansion to 3.5 Mtpa. Historically, the most notable rainfall event for a similar time duration in Western Australia is 234 mm received in 300 minutes (Bureau of Meteorology, 1994) which is well short of the 590 mm event the dam is designed for.

Environmental Protection Authority evaluation

The EPA notes the advice from the Water and Rivers Commission regarding the general acceptability of the current operations and the proposed expansion. The EPA also notes the WRC's specific request for additional information as highlighted in the summary of their submission above. The EPA is satisfied that these matters can be addressed through the application of Works Approval and Licence Conditions under Part V of the Environmental Protection Act.

The EPA notes the proponent's comprehensive list of commitments relating to refinery water resource protection, particularly the refinery lease water management system and the spills management plan. As with other issues addressed in this report, the EPA considers it appropriate that the proponent further documents these commitments as part of its environmental management plan. This would provide a valuable basis in auditing the proponent's performance in meeting the environmental objective relating to the protection of water resources (Recommendation 3, Section 5).

On the basis of the proponent's environmental management commitments, DEP licensing and approval requirements prior to any further water resource development, the proponent's environmental performance to date, and the advice of the Water and Rivers Commission, the EPA considers that this issue can be managed to achieve the assessment objective.

4.11 Management of rail noise

Objective

The EPA's objective is to ensure that freight rail noise does not adversely affect the amenity of nearby residences.

Policy Information

Noise from rail transportation is not readily addressed under the current noise regulations in Western Australia. The current draft noise regulations do not cover railway noise.

The criteria which the DEP would recommend for rail noise are:

- Maximum passby level, L_{Amax} = 80 dB(A)
- 24-hour "Average" level, $L_{Aeq,24h}$ = 55 dB(A)

These levels are derived from a Noise Control Guideline published by the EPA of NSW (EPA of NSW, 1985). The above levels are referred to in the Guideline as "Planning levels". The Guideline also refers to "Maximum levels" which are 5 dB(A) above these levels. Westrail has incorporated railway noise criteria for urban passenger operations into its draft Environment Management Manual and these use an L_{Amax} of 80 dB(A) and $L_{Aeq,24h}$ levels of 65 dB(A) for daytime and 60 dB(A) for night time operations. Westrail has not as yet published noise standards in relation to freight operations.

In addition to the above, the DEP recommends a target level for planning purposes of 65 dBL_{Amax}. This is a level which is intended for identification of areas adjacent to railways where some noise impact, particularly in the form of sleep disturbance, may result from train movements, and is relevant to local government authorities in the planning of residential developments.

Technical information

The refinery is serviced by a railway managed by Westrail, which transports raw materials to the refinery and alumina product to the Bunbury Inner Harbour for export. The railway is an extension of the main Bunbury to Collie railway which handles predominantly bulk cargoes of alumina and coal. The CER states that currently there are 30 trains per week delivering coal, caustic and lime to the refinery. With the expansion the frequency may increase up to 65 trains per week depending on the size of the trains. No additional rail infrastructure will be required.

In its response to a request for further information on rail movements (Appendix 2), the proponent has stated that Westrail has indicated that the total number of train movements (including passenger trains but without Worsley traffic) currently using the section between Brunswick and Picton Junctions is approximately 136 per week. Worsley's existing operations add an additional 28 train movements per week.

The proponent indicates that total rail traffic in the future is difficult to estimate due to the uncertainty in the timing of developments and the configuration of Worsley trains. Subject to resolution of these uncertainties, Worsley anticipates that train movements may increase up to 270 per week if the Worsley and Alcoa expansions both proceed in the near future.

Monitoring and past performance

The DEP reported that it received complaints from the public regarding shunting noise emanating from the Picton marshalling yards.

Comments from key agencies / interest groups

The DEP has submitted certain criteria to the EPA (see 'Policy information' above), to assist in the assessment of rail noise impacts.

The DEP undertook an analysis of the current and predicted noise levels associated with rail movements in the Bunbury region. The outcome of this analysis, and subsequent discussions with Westrail staff, revealed the following:

- The distance from the railway line at which the noise level is likely to exceed 55 dB(A) $L_{Aeq,\ 24h}$ for current rail movements is predicted to be approximately 125 metres for the existing traffic at notch 8 and 86 metres at notch 5. The implication is that there is a significant corridor along the line, containing an unknown quantity of residences, over which there is likely to be a loss of amenity as a result of existing rail operations.
- Westrail has advised that, although rail movements for the Worsley project are likely to increase from 60 per week to 130 per week, the new locomotives would have a noise specification at notch 8 that was some 5 dB(A) quieter than the existing locomotives, and that the number of wagons would be about half that of the existing trains.
- The DEP estimated, based on Westrail's latest information, that the net effect of the Worsley expansion is that the affected corridor is likely to increase by about 10%. However the DEP anticipates that the cumulative impact resulting from both the proposed Worsley and approved Wagerup expansions (EPA, 1995), together with other possible developments in the area, may have a greater impact on residents in the triangle between Wagerup, Collie and Bunbury.
- Rail noise is a factor that should be taken into account by planning authorities when considering future developments which encroach within the potentially affected rail noise corridor.

The DEP wrote to Westrail to see if it is prepared to undertake a study to assess the current rail noise impacts and potential impacts associated with the expansions in the alumina industry. The aim of the study should be to identify if planning controls and ameliorative measures are required in relation to any residences in areas where the noise impacts are considered unacceptable.

Westrail has responded that it recognises that its operations have an impact on the environment (in particular noise emissions from freight operations) and is committed to the minimisation and management of these impacts through the development and implementation of applicable environmental policies and strategies. Westrail supports the proposed study to assess the impact of likely noise emissions from changes in the rail movements associated with the several new projects being considered in the Bunbury region, including the Worsley expansion.

Response from the proponent

Worsley has restated that it is prepared to co-operate as far as practicable with any Westrail initiative to investigate environmental impacts in regard to train movements associated with the Worsley Project.

Environmental Protection Authority evaluation

Potential rail noise impacts on the amenity of residents in the area between Collie, Wagerup and Bunbury are of concern to the EPA. The EPA notes the potential for such impacts to significantly increase as a result of the proposed Worsley expansion and the approved expansion of the Wagerup refinery operated by Alcoa.

The EPA believes that, although Westrail, as operator of the rail system, clearly has the primary responsibility for the rail noise impacts, the major users of the rail system, including the proponent, can be regarded as having a part responsibility.

The EPA considers that Westrail, in conjunction with the users of its service, and in consultation with the Department of Environmental Protection, the Ministry for Planning and relevant local government authorities, should undertake a study into the current and future impacts of rail noise in the vicinity of its freight operations between Collie and Bunbury, Wagerup and Bunbury, and around the Picton marshalling yards. Using best practice environmental management principles, the study should include, but not be limited to:

- identification of residences within the likely affected corridors around these areas;
- identification of any land use zonings which may be incompatible with predicted noise levels, including potential residential developments within or adjacent to the corridors;
- establishment of a model for prediction of noise emissions from freight operations, taking into account variables such as locomotive type, number and notch setting, and wagon speed and number;
- adoption of a model for propagation of railway noise across the corridors;
- consideration of accepted standards for noise emissions from freight operations; and
- identification of planning controls and appropriate ameliorative measures in relation to any residences for which such measures may be warranted.

Westrail should substantially complete the study and submit a report to the EPA prior to the commissioning of the Worsley refinery expansion (Recommendation 3, Section 5).

The EPA concludes that, by undertaking the above study into rail noise from current and projected operations and, if needed, the implementation of appropriate ameliorative measures and planning controls, this will result in the EPA's objective for the management of potential rail noise impacts being met.

5. Conclusions and recommendations

The environmental issues associated with Worsley's bauxite mining and associated refinery operations have generally not changed during the past ten years of operations. During this time, the proponent has been able to refine its management measures as a result of monitoring results and operational experience.

Following review of the proponent's Consultative Environmental Review, the issues raised in the public submissions, advice received from government agencies, relevant literature and the proponent's environmental management commitments, the EPA concludes on the information currently available, that the proposal by Worsley Alumina Pty Ltd to increase the capacity of the Worsley alumina refinery from 2.0 million tonnes per annum to 3.5 million tonnes per annum, with a proportional increase in production of bauxite from mining operations, can be managed to meet the EPA's objectives.

Recommendation 1

That the Minister notes the environmental issues, and that the proposal can be managed to meet the EPA's objectives, subject to the successful implementation of the proponent's commitments and the EPA's recommended conditions and procedures, as summarised in Table 5.

ISSUES	OBJECTIVE	EVALUATION FRAMEWORK	PROPONENT'S COMMITMENTS	EPA RECOMMENDATION
ENVIRONMENTAL MANAGEMENT				
Environmental Management Systems	To apply the principles of Best Practice Environmental Management.		1. Formalise proponent's interaction with EMLG. 2. Prepare environmental audit plans. 3. Regular internal audits. 4. Annual environmental management reports.	The State government should formalise the role of the EMLG to review the environmental performance of the proponent. The proponent should formalise its commitments in an environmental management plan. The EMLG should review the proponent's performance in accordance with the plan and, where appropriate, determine compliance with environmental conditions (Recommendation 2).
MINING IMPACTS - Biophysical				
Impact of clearing on forest ecosystems	Ensure biodiversity and sustainability of forest ecosystems are maintained. Ensure rare and endangered flora and fauna are protected.	WA is a signatory to the national biodiversity strategy. Compliance with Wildlife Conservation Act (1950), Conservation and Land Management Act (1984) and the Commonwealth Endangered Species Protection Act (1992). Commitment to flora and flora conservation program contained in the 1979 ERMP.	5. Baseline flora and fauna surveys. 6. Monitor abundance and distribution of flora and fauna. 7. Defer mining in areas of potentially high conservation values. 8. Recruitment of rare or priority flora and rare and endangered fauna into rehabilitated areas. 9. Investigate wildlife corridor between forest blocks. 10. Feral animal and weed control program. 11. Support recalcitrant plant species research. 105. Assess unlogged areas in Saddleback Timber Reserve to minimise unavoidable disturbance.	The EPA's objectives for this issue will be achieved through the implementation of the proponent's environmental management commitments. No recommendation required.
Rehabilitation of mined areas	Ensure rehabilitation in State Forest is timely, sustainable and meets completion criteria agreed by State. Ensure rehabilitation on private property is in environmentally stable and sustainable condition and meets requirements of property owner.	Precedent of past projects requiring that long term rehabilitation scenarios are considered early on in a project's development, and are integrated with the mine plan. Alumina Refinery (Worsley) Agreement Act, 1973 - Consent, Compensation, and Restoration Agreement between proponent and private landowners.	12. Trial re-creation of fauna habitats in rehabilitation. 13. Monitor flora establishment and development. 14. Further develop rehabilitation enhancement techniques with CALM. 15. Revegetate State Forest with local provenance species. 16. Prompt rehabilitation of areas with high visual aesthetic values. 17. Vegetation screening in areas of significant visual impact. 106. Set completion criteria to aid the achievement of objectives in consultation with the EMLG.	The EPA's objectives for this issue will be achieved through the implementation of the proponent's environmental management commitments. No recommendation required.
Forest disease management	Minimise the risk of introducing or spreading jarrah dieback or other forest diseases.	Existing forest disease management strategy developed and implemented in consultation with CALM.	18. Maintain dieback management strategy and hygiene procedures. 19. Support research relevant to forest disease management and Worsley's operations. 20. Rehabilitate forest project areas affected by jarrah dieback. 21. Monitor rate and spread of forest disease infections.	The EPA's objectives for this issue will be achieved through the implementation of the proponent's environmental management commitments. No recommendation required.
Impact on other users of State Forest	Minimise impacts of bauxite mining activities on other users of the State Forest, through integration with CALM's forest management programme.	Management of timber reserves based on CALM Forest Management Plan 1994 to 2003. Recognised multiple uses include bauxite mining, recreation, timber production, and bee keeping.	22. Identify areas outside PBA with potentially high conservation value that can be precluded from mining without significant impact on the life of the project. 23. Implement integrated fire management plan with CALM. 24. Maximise the salvage of forest products prior to clearing. 25. Develop a fox control strategy in the PBA.	The EPA's objectives for this issue will be achieved through the implementation of the proponent's environmental management commitments. No recommendation required.
Water resource management and protection	Ensure that environmental values of water resources including quality and quantity of potable resources, are maintained from adverse impacts of bauxite mining activities.	Proponent has an existing water resource management programme addressing water supply and quality issues. Continued implementation of the existing water monitoring program.	26. Investigate alternative sources of water supply. 27. Investigate increasing efficiency of water used for dust suppression. 28. Monitor conductivity in surface waters, groundwater levels in borefields and health of Tunnell Road heathland. 29. Investigate stored salts in the Marradong and Hotham North areas prior to mining. 30. Defer mining within the Hunt A Catchment until after 1998.	The EPA's objectives for this issue will be achieved through the implementation of the proponent's environmental management commitment, the DEP works approval and licensing process and the WRC's Rights to Water and Irrigation Act requirements. No recommendation required.
Noise impacts from mining and overland conveyor	To comply with statutory requirements so that the amenity of nearby residents is protected from noise impacts resulting from bauxite mining activities and operation of the overland conveyor.	Compliance with draft Environmental Protection (Noise) Regulations. Airblast overpressure emissions regulated under Part V Licence Conditions.	31. Comply with noise regulations. 32. Predict sound levels to verify output of ENM model. 33. Continue program of sound power reduction initiatives. 34. Facilitate management of sound levels from mining operations. 35. Specify low sound power levels and minimum unfavourable sound characteristics when selecting new mining equipment and plant. 36. Monitor and report on airblast overpressure levels. 37. Investigate and identify corrective action when airblast overpressure greater than 110 dB(lin) peak. 38. Report to DEP any blast that creates airblast overpressure greater than 120 dB(lin) peak. 39. Measure ground vibration levels when new areas are opened for mining. 40. Investigate complaints and take corrective action where required. 54. Investigate mitigation measures to reduce conveyor noise emissions. 55. Monitor noise emissions from the overland conveyor for compliance with limit as prescribed under the 1995 amendments to the Agreement Act limit.	The EPA's objectives for this issue will be achieved through the implementation of the proponent's environmental management commitments. The proponent's commitments are to be formalised into a management plan, to facilitate the determination of compliance (Recommendation 2). No recommendation required.

Table 5. Summary of EPA recommendations.

ISSUES	OBJECTIVE	EVALUATION FRAMEWORK	PROPONENT'S COMMITMENTS	EPA RECOMMENDATION
Biophysical Impacts				
Rehabilitation of bauxite residue areas	To design, construct and operate the residue areas in a manner that maintains the integrity of the containment system. To maximise as far as practicable the extraction of caustic soda from the bauxite residue. To minimise, as far as practicable, impacts on State Forest resulting from construction activities. To manage the residue areas in an environmentally acceptable manner until they meet the requirements of a closure and rehabilitation strategy agreed with the State.	Proponent has initiated a research programme toward the development of a rehabilitation prescription for the residue area surface. Development of a closure and long term management strategy is closely linked to this prescription. Major consideration for the decommissioning of these areas is the protection of water resources.	70. Monitor ambient dust throughout the refinery lease and bauxite residue disposal areas. 71. Minimise fugitive dust from bauxite residue disposal areas. 72. Develop rehabilitation prescription for the bauxite residue disposal areas. 73. Develop long term management plan for bauxite residue disposal areas including a closure strategy, in conjunction with relevant Government agencies. 74. Continue to implement a system of quality control for construction of bauxite residue disposal areas. 75. Continue to monitor underdrainage from the bauxite residue disposal areas. 76. Monitor alternative uses of bauxite residue. 101. Prepare decommissioning plans in accordance with land use objectives. 102. Develop closure plans in consultation with key agencies. 103. Undertake regular review of decommissioning plans to take into account emerging issues and the findings of research. 104. Develop completion criteria for rehabilitation in consultation with CALM and other key agencies 106. Set completion criteria to facilitate the achievement of objectives in consultation with the EMLG.	The EPA considers that the EMLG should facilitate community consultation regarding the finalisation of closure strategies and completion criteria, and recognised that the proponent has already acknowledged this. The EPA's objectives for this issue will be achieved through the implementation of the proponent's environmental management commitments, and the formalisation of these commitments within an environmental management plan (Recommendation 2).
Pollution Potential				
Atmospheric emissions including greenhouse gases	Comply with statutory requirements so that the ecological values of off-site areas and the amenity and health of nearby residents are protected from adverse atmospheric emissions from the refinery. To reduce as much as practicable emissions of greenhouse gases.	SO_2 and particulate emissions regulated via Part V Licence Conditions. NHMRC guidelines used for NOx emissions. Greenhouse Gas Abatement measures of the United Nations Framework Convention on Climate Change. Predicted effects based on results of refinery air emission modelling. The EPA's assessment of the Collie Power Station determined that coal was the least desirable fuel source for power generation.	56. Monitor gases and particulate emissions. 57. Incorporate best practicable pollution suppression equipment on plant discharging to the atmosphere. 58. Monitor ground level concentrations of SO_2 and NO_x to validate dispersion modelling. 59. Monitor meteorological conditions suitable for prediction of plume rise and dispersion. 60. Quantify emissions of VOCs from liquor purification facility. 83. Preserve greenhouse sinks on Joint Venturer-owned land. 84. Minimise burning of forest debris. 85. Remove all halon-fixed flooding fire extinguishing systems. 86. Reafforest an area of Joint Venturer-owned land equal to any sustained increase in mine open area. 87. Investigate potential to improve energy efficiency of calciners, power generation and steam raising facilities. 88. Investigate alternative fuel sources for lower greenhouse emissions.	The EPA considers that gas rather than coal is a preferable fuel source for the proposed expansion. The EPA also recognises, however, that its objectives for this issue will be achieved through the implementation of the proponent's environmental management commitments. No recommendation required.
Water resource management and protection	To ensure that environmental values of water resources including water quality and quantity of potable resources, are maintained from adverse impacts of refinery operation and bauxite residue disposal.	ANZECC water quality guidelines for aquatic ecosystems and water supply used to evaluate potential impacts on water resources. Proponent has an existing water management strategy which separates clean water from potentially contaminated water for re-use in refinery. Existing surface and groundwater monitoring programme.	61. Monitor groundwater quality within and downstream of the freshwater lake. 62. Conduct periodic ecological ecosystem monitoring. 63. Recover or treat any contaminated groundwater. 64. Maintain a basal summer flow of approximately 35 m^3/hr from the freshwater lake. 65. Report monitoring results annually to Govt. 66. Implement the refinery lease water management system. 67. Implement spills management. 68. Monitor comprehensively the condition of plant and equipment. 69. Evaluate and update emergency response plan for hazardous materials.	The EPA's objectives for this issue will be achieved through the implementation of the proponent's environmental management commitments and approvals required under Part V of the Environmental Protection Act. The proponent's commitments are to be formalised into a management plan, to facilitate the determination of compliance (Recommendation 2).
Management of transport noise	To comply with statutory requirements so that the amenity of nearby residents is protected from noise impacts resulting from transport operations.	Currently 30 trains per week deliver coal, caustic and lime to the refinery and transport alumina to Bunbury Port. Changes to train configurations may result in train movements increasing to 65 per week.		Westrail and other users should undertake a study into the current and future impacts of rail noise in the vicinity of its freight operations between Collie and Bunbury, Wagerup and Bunbury, and around the Picton Marshalling Yards (Recommendation 3).

Table 5. Summary of EPA recommendations (cont'd).

Recommendation 2

That, if the Minister for the Environment approves the implementation of this proposal, then the proposal be subject to the recommended conditions and procedures set out in Section 6 of this report.

Recommendation 3

That in addition to recommendation 1, the following procedures should apply if the proposal is to be implemented:

- **the State Government formalises the role of the Environmental Management Liaison Group in reviewing and reporting the environmental performance of the proponent;**
- **the proponent formalises its environmental management commitments in an environmental management plan; and**
- **the Environmental Management Liaison Group should review the proponent's performance in accordance with the plan, and, where appropriate, advise the Minister for the Environment through the Minister for Resources Development on the proponent's compliance with the environmental conditions.**

Recommendation 4

That on associated matters recommends:

Westrail, in conjunction with the users of its service, and in consultation with the Department of Environmental Protection, the Ministry for Planning and relevant local government authorities, undertake a study into the current and future impacts of rail noise in the vicinity of its freight operations between Collie and Bunbury, Wagerup and Bunbury, and around the Picton Marshalling Yards. The study should include, but not be limited to:

- **identification of residences within the likely affected corridors around these areas;**
- **identification of any land use zonings which may be incompatible with predicted noise levels, including potential residential developments within or adjacent to the corridors;**
- **establishment of a model for prediction of noise emissions from freight operations, taking into account variables such as locomotive type, number and notch setting, and wagon speed and number;**
- **adoption of a model for propagation of railway noise across the corridors;**
- **consideration of accepted standards for noise emissions from freight operations; and**
- **identification of appropriate ameliorative measures for rail operations and any residences for which such measures may be warranted.**

Westrail should substantially complete the study and submit a report to the EPA prior to the commissioning of the Worsley refinery expansion.

6. Recommended environmental conditions

Based on its assessment of this proposal and the recommendations in this report, the Environmental Protection Authority considers that the following Recommended Environmental Conditions are appropriate.

PROPOSAL: INCREASE IN PRODUCTION CAPACITY OF WORSLEY ALUMINA REFINERY TO 3.5 MILLION TONNES PER ANNUM, AND ASSOCIATED BAUXITE MINING OPERATIONS

CURRENT PROPONENT: WORSLEY ALUMINA PTY LTD

1 Proponent Commitments

The proponent has made a number of environmental management commitments in order to protect the environment.

1-1 In implementing the proposal, the proponent shall fulfil the commitments made in the Consultative Environmental Review and in response to issues raised following public submissions; provided that the commitments are not inconsistent with the conditions or procedures contained in this statement.

The environmental management commitments (June 1996) were published in Environmental Protection Authority Bulletin 823 (Appendix 4) and a copy is attached.

2 Implementation

Changes to the proposal which are not substantial may be carried out with the approval of the Minister for the Environment.

2-1 Subject to these conditions, the manner of detailed implementation of the proposal shall conform in substance with that set out in any designs, specifications, plans or other technical material submitted by the proponent to the Environmental Protection Authority with the proposal.

2-2 Where, in the course of the detailed implementation referred to in condition 2-1, the proponent seeks to change the designs, specifications, plans or other technical material submitted to the Environmental Protection Authority in any way that the Minister for the Environment determines, on the advice of the Environmental Protection Authority, is not substantial, those changes may be effected.

3 Proponent

These conditions legally apply to the nominated proponent.

3-1 No transfer of ownership, control or management of the project which would give rise to a need for the replacement of the proponent shall take place until the Minister for the Environment has advised the proponent that approval has been given for the nomination of a replacement proponent. Any request for the exercise of that power of the Minister shall be accompanied by a copy of this statement endorsed with an undertaking by the proposed replacement proponent to carry out the project in accordance with the conditions and procedures set out in the statement.

4 Environmental Management Plan

4-1 Prior to plant wet commissioning, the proponent shall formalise the environmental management commitments in an environmental management plan to enable review of performance by the Environmental Management Liaison Group.

The requirements for reporting on the environmental management plan can be combined with the proponent's existing reporting requirements to the State.

5 Decommissioning

5-1 In line with commitments 100 to 104, the proponent shall carry out the satisfactory decommissioning of the project, removal of the plant and installations, and rehabilitation of the site and its environs.

5-2 To achieve the objectives of condition 5-1, at least six months prior to decommissioning, the proponent shall prepare a decommissioning and rehabilitation plan.

5-3 The proponent shall implement the plan required by condition 5-2.

6 Time Limit on Approval

The environmental approval for the proposal is limited.

6-1 If the proponent has not substantially commenced the project within five years of the date of this statement, then the approval to implement the proposal as granted in this statement shall lapse and be void. The Minister for the Environment shall determine any question as to whether the project has been substantially commenced.

Any application to extend the period of five years referred to in this condition shall be made before the expiration of that period to the Minister for the Environment.

Where the proponent demonstrates to the requirements of the Minister for the Environment on advice of the Department of Environmental Protection that the environmental parameters of the proposal have not changed significantly, then the Minister may grant an extension not exceeding five years.

7 Compliance Auditing

To help determine environmental performance and compliance with conditions, periodic reports on the implementation of the proposal are required.

7-1 The proponent shall submit periodic Performance and Compliance Reports, in accordance with an audit programme prepared by the Department of Environmental Protection in consultation with the proponent.

Procedure

1 Unless otherwise specified, the Department of Environmental Protection is responsible for assessing compliance with the conditions contained in this statement and for issuing formal clearance of conditions.

2 Where compliance with any condition is in dispute, the matter will be determined by the Minister for the Environment.

3 Where the proponent is required to provide reports to the Minister for the Environment, unless otherwise required, it will be adequate to incorporate such reports within those required under the Alumina Refinery (Worsley) Agreement Act 1973, and the Minister responsible for administering that Act will forward the relevant information to the Minister for the Environment.

4 Environmental Management Liaison Group:

The Environmental Management Liaison Group comprises representatives of State Government agencies whose areas of responsibility are affected by the mining and refinery operations of the proponent. This group will continue to review the mining plans of the proponent and review the proponent's environmental performance in accordance with the Environmental Management Plan required by condition 4-1 above. The Environmental Management Liaison Group shall, where appropriate, advise the Minister for the Environment through the Minister for Resources Development on the proponent's compliance with the environmental conditions. The EMLG shall consult with the community on the proposed completion criteria and closure strategy, prior to finalisation.

5 Railway Transport Operations

Westrail, in conjunction with the users of its service, and in consultation with the Department of Environmental Protection, the Ministry for Planning and relevant local government authorities, will undertake a study into the current and future impacts of rail noise in the vicinity of its freight operations between Collie and Bunbury, Wagerup and Bunbury, and around the Picton Marshalling Yards. The study should include, but not be limited to:

- identification of residences within the likely affected corridors around these areas;
- identification of any land use zonings which may be incompatible with predicted noise levels, including potential residential developments within or adjacent to the corridors;
- establishment of a model for prediction of noise emissions from freight operations, taking into account variables such as locomotive type, number and notch setting, and wagon speed and number;
- adoption of a model for propagation of railway noise across the corridors;
- consideration of accepted standards for noise emissions from freight operations; and
- identification of appropriate ameliorative measures for rail operations and any residences for which such measures may be warranted.

Westrail should substantially complete the study and submit a report to the Environmental Protection Authority prior to the commissioning of the Worsley refinery expansion.

Note

1 The proponent is required to apply for a Works Approval and Licence for this project under the provisions of Part V of the Environmental Protection Act.

7. References

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Bureau of Meteorology (1994), *The estimation of probable maximum precipitation in Australia: generalised short duration method*, Bulletin 53, Australian Government Publishing Service.

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Ninox Wildlife Consulting (1995), Assessment of the local and regional fauna conservation significance in the Tunnell Road heathland.

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Worsley (1996) Response to issues raised in public submissions on the CER (see Appendix 2 of this report).