Increase in alumina production to 3.3 million tonnes per annum at Wagerup Alumina refinery, and associated bauxite mining activities

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Alcoa of Australia Ltd

Report and recommendations
of the Environmental Protection Authority

Environmental Protection Authority
Perth, Western Australia
Bulletin 779
May 1995

SSA

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 **9 June, 1995.**

Environmental Impact Assessment (EIA)

Process Timelines in weeks

Date	Timeline commences from receipt of full details of proposal by proponent	Time (weeks)
24/10/94	Proponent Document Released for Public Comment	4
18/11/94	Public Comment Period Closed	
14/12/94	Issues Raised During Public Comment Period Summarised by EPA and Forwarded to the Proponent	4
10/2/95	Proponent's response to the issues raised received	8
10/4/95	Commitments on noise management provided by proponent	8
24/5/95	EPA reported to the Minister for the Environment	7

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Contents

Contents (cont'd)

Contents (cont'd)

Summary and recommendations

The proponent, Alcoa of Australia Ltd (Alcoa), proposes to increase the capacity of its Wagerup Refinery, located about 120 km south of Perth (Figure 1), from the current 1.7 million tonnes of alumina per annum (M tpa) to 3.3 M tpa, with a proportionate increase in production of bauxite from the mobile mining operations, currently located about 8 km east of the refinery (Figure 2).

In 1978 Alcoa proposed to produce alumina at Wagerup at a rate of 4 Mtpa in its Environmental Review and Management Programme. Upon advice from government agencies, the Environmental Protection Authority (EPA) recommended that the alumina refinery could proceed, but that there should be no further expansion beyond 2 Mtpa without the approval of the State. The protection of flora and fauna, forest conservation, water quality, further land use issues, recreational activities and co-ordination of research committees were key issues at the time.

The Wagerup operations were further reviewed by the EPA in 1989 at Consultative Environmental Review (CER) level, when Alcoa proposed to expand its operations from 840,000 tonnes of alumina per annum to 1.5 M tpa.

The Minister for Resources Development referred the latest proposed expansion from 1.7Mtpa to 3.3Mtpa to the EPA on 8 August 1994 for assessment. The EPA set the level of assessment at CER.

The EPA has assessed the potential environmental impacts of the proposed expansion, as described in the CER, and utilised additional information supplied by other government agencies, the public and the proponent. Additionally, officers of the Department of Environmental Protection carried out site inspections and discussed environmental issues with interested members of the local community and relevant government departments.

The EPA has considered the proponent's performance in managing environmental impacts associated with the existing operations, and how the incremental effects associated with this proposed expansion would affect the environment. In its evaluation, the EPA had regard for advice from those government agencies with the relevant expertise. In this regard the EPA notes the on-going role of the Mining and Management Programme Liaison Group and the Residue Planning Liaison Group in assessing the environmental impacts of bauxite mining and residue disposal on behalf of the State.

The main environmental issues relating to the proposed expansion at Wagerup are similar to those considered in previous assessments, namely:

Mining:

- flora and fauna conservation in the jarrah forest;
- dieback management;
- final rehabilitation criteria;
- water resource protection;
- mining related noise impacts; and
- impacts on local communities.

Refinery:

- noise impacts from refinery and transport operations;
- dust impacts from bauxite residue disposal;
- odour and air emissions; and
- long term bauxite residue management.

The purpose of this assessment is to consider the environmental acceptability of the proposed expansion, rather than to reconsider whether the existing approved operation is environmentally acceptable. However, the EPA has provided advice on Alcoa's environmental management performance on these aspects. Additionally, the expansion does not increase the area to be mined; rather it increases the rate of mining within approved areas.

In its assessment of this proposal, the EPA was cognisant of the precautionary approach previously adopted in 1978 to restrict the Wagerup operations to 2 Mtpa, until sufficient evidence was produced to show that the key environmental issues were manageable at a higher production rate.

In relation to the protection of forest and water conservation issues, the EPA notes that the proponent has been instrumental in progressing knowledge of these environmental issues. This research, and the close working relationship between Alcoa and the expert government agencies such as the Department of Conservation and Land Management and the Water Authority of Western Australia, has given the EPA confidence to conclude that the protection of flora and fauna and water resources are currently being managed in an acceptable manner, and would continue to do so at the proposed expanded rate. The EPA considers that, prior to approval of the proponent's mining plans, the MMPLG should be assured that the vegetation communities to be affected by bauxite mining and associated activities are adequately represented in the forest conservation estate, or can be adequately represented through amendments to the estate. The EPA has asked the DEP, which is represented on the MMPLG, to ensure that this issue is addressed in the annual review of the proponent's mining plans.

The EPA considers that rehabilitated mining areas should be handed back to the State at an acceptable standard, and has recommended that the proponent should submit details of a programme to develop final rehabilitation criteria, to meet the requirements of the Minister for the Environment and the Minister for Resources Development within 12 months of approval of this proposal.

A significant development in this assessment (compared to 1978 and 1989) is the proportion of issues raised relating to impacts on the local community, particularly noise and dust. The EPA considers that the noise commitments provided by the proponent (as a consequence of this assessment) should ensure that noise levels from the existing and expanded operations comply with existing as well as soon to be amended noise regulations. Impacts on the local community from the existing and expanded bauxite mining operations should be manageable, subject to Alcoa undertaking wider consultation and addressing the community's concerns in the preparation of its mining plans, consideration of any residual community concerns by the Mining and Management Programme Liaison Group, and the establishment of buffer distances appropriate for Alcoa's various operations.

In relation to dust emissions from the refinery operations, the EPA considers that the proponent should put in place a programme to improve dust management as a condition of the Works Approval for the proposed expansion. The objective of the programme should be that ambient dust levels meet the equivalent of the Environmental Protection Policy (Atmospheric Wastes) (Kwinana) for Area C (rural and residential areas). Final conditions for dust levels can then be set under Alcoa's licence (Part V of the Environmental Protection Act, 1986).

The EPA strongly endorses the proponent's decision to incorporate low NO_x burners and other state of the art technology for the proposed expansion and considers that gaseous emissions would be manageable, conditional upon the proponent providing details on its control of NO_x and greenhouse gases on an annual basis.

The EPA considers that bauxite residue disposal and management for the proposed expansion is acceptable, subject to the proponent fulfilling its revised commitments and developing a "closure strategy" for the residue storage areas at Wagerup to the requirements of the Minister for the Environment.

The EPA concludes that with satisfactory implementation of the EPA's recommendations and the proponent's commitments, it is environmentally acceptable to increase the capacity of the Wagerup Refinery from the current 1.7 M tpa to 3.3 M tpa, with a proportionate increase in

production of bauxite from the mobile mining operations, as proposed in Alcoa's CER and the company's response to submissions.

Recommendation Number	Summary of recommendations
1	**The proponent's proposal to increase the production capacity of the Wagerup Refinery from the current 1.7 million tonnes of alumina per annum to 3.3 million tonnes of alumina per annum, with a proportionate increase in production of bauxite from the mobile mining operations, is environmentally acceptable, subject to:** • **the EPA's recommendations in this report;** • **the revised Environmental Conditions; and** • **the proponent's consolidated list of environmental management commitments.**
2	**The Recommended Environmental Conditions should become the sole conditions for the proposed expansion, and that they supersede all previous Ministerial Environmental conditions for the project.**
3	**Within 12 months of approval, the proponent should submit details of a programme to develop final rehabilitation criteria and, subsequently, implement this programme.**
4	**Alcoa should ensure that the affected local government authorities and communities are fully consulted and their concerns addressed in the preparation of mining plans. The Mining and Management Programme Liaison Group should seek and consider the views of affected owners within 4 km of its operations, prior to advising the State on the acceptability of these plans.**
5	**To protect the amenity and lifestyle of private properties from mining-related impacts, within 12 months of approval of this proposal, the proponent should prepare a plan detailing buffer distances appropriate for the various operations. This plan should be subsequently implemented and periodically reviewed.**
6	**The proponent should put in place a programme to improve dust management, to ensure that ambient dust levels meet the equivalent of the Environmental Protection Policy (Atmospheric Wastes) (Kwinana) for Area C (rural and residential areas).**
7	**The proponent should provide details on its control of NOx emissions and greenhouse gases in its annual reporting of environmental research and operations.**
8	**To enable bauxite residue areas to be handed back to the State at an acceptable standard, the proponent should develop and implement a "closure strategy" for the residue storage areas at Wagerup and report annually on the progress of this strategy.**

9	**A number of standard conditions and procedures should be added to the Ministerial Statement for the project, to ensure conformity with Environmental Conditions imposed on other recently assessed proposals. These allow for minor changes to occur to the project without the need for formal assessment, auditing of environmental conditions and commitments, verification of compliance, and arbitration in case of a dispute.**

1. Introduction and background

1.1 The purpose of this report

This report and recommendations provide the Environmental Protection Authority's (EPA) formal advice to the Minister for the Environment on the environmental acceptability of the proposed increase in alumina production from Alcoa of Australia Ltd's alumina refinery at Wagerup.

1.2 Previous assessments by the Environmental Protection Authority

1978 Environmental Review and Management Programme

In May 1978 Alcoa submitted an Environmental Review and Management Programme (ERMP) describing a proposal to produce alumina at Wagerup at a rate of 4 million tonnes per annum (Mtpa). The EPA received over 200 submissions from the public and government agencies, including a detailed report from the Technical Advisory Group (TAG) set up by the State Government and comprised of experts from the key government agencies. TAG advised the EPA that, whilst some expansion appeared justified of Alcoa's alumina production (which at that time was generated from the Kwinana and Pinjarra refineries), this should not occur without changes to better control of bauxite mining operations throughout the Darling Range. TAG pointed out that significant environmental issues remained unresolved, including the impacts of dieback spread and mining on flora, fauna and water quality, combined with the uncertainty of successful rehabilitation methods.

On the basis of advice (principally from TAG), the EPA adopted a precautionary approach and recommended against the State approving the ERMP (EPA 1978). Instead, the EPA recommended that construction of the alumina refinery could proceed, but that there should be no further expansion of the Wagerup refinery beyond 2 Mtpa without the approval of the State. The EPA made a number of specific recommendations related to the protection of flora and fauna, forest conservation, water quality in the catchment, land use issues, recreational activities and co-ordination of research committees (Appendix 1). The EPA's most serious criticism of the draft ERMP related to the Company's position at the time that bauxite mining took priority over other land uses.

Alcoa subsequently revised its ERMP and resubmitted it in September 1978, with a proposal to produce alumina to a maximum of 2 Mtpa. The revised ERMP was approved by the EPA and the State Government in October 1978. The proposal was commissioned in 1984 and operated at a rate of 0.67 Mtpa.

1989 Consultative Environmental Review

The Wagerup operations were further assessed by the EPA at CER level in 1989, when Alcoa proposed to expand its operations to 1.5 Mtpa of alumina. The EPA decided to formally re-assess the proposal because of the considerable elapsed time since the ERMP was assessed in 1978. The EPA assessed the Consultative Environmental Review (CER) in the context of significant changes in the scope of the project in relation to predicted impacts and changes to environmental management programmes, and compared the proponent's performance against the commitments made in the 1978 ERMP.

The EPA received 5 submissions from government agencies and conservation bodies and, on the basis of this advice, concluded that the expansion was environmentally acceptable, subject to a number of recommendations and commitments by the company. These recommendations (Appendix 2) included liaison with the Department of Conservation and Land Management

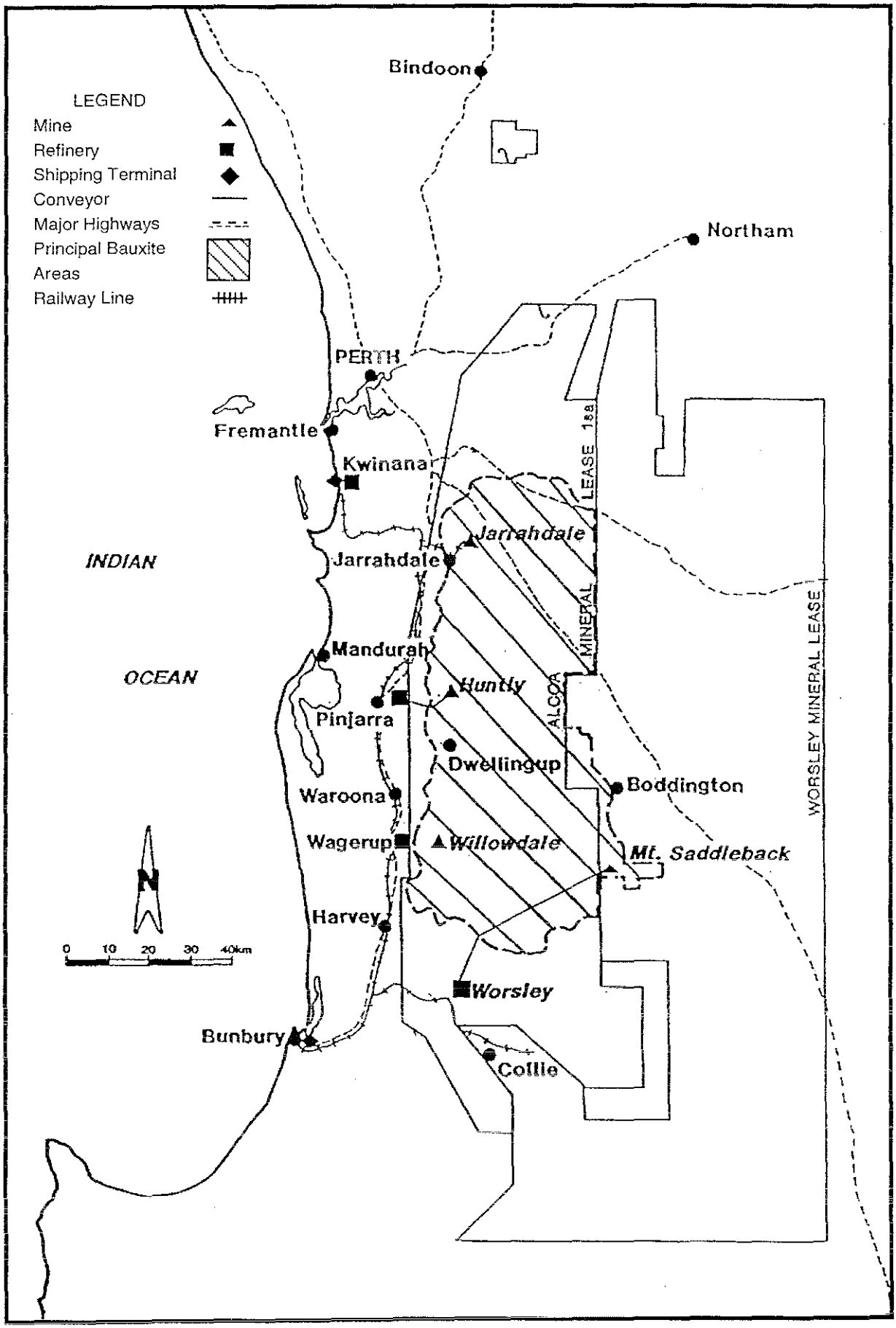


Figure 1. Bauxite mining and alumina refinery operations in WA. (Source: Figure 1 of the CER)

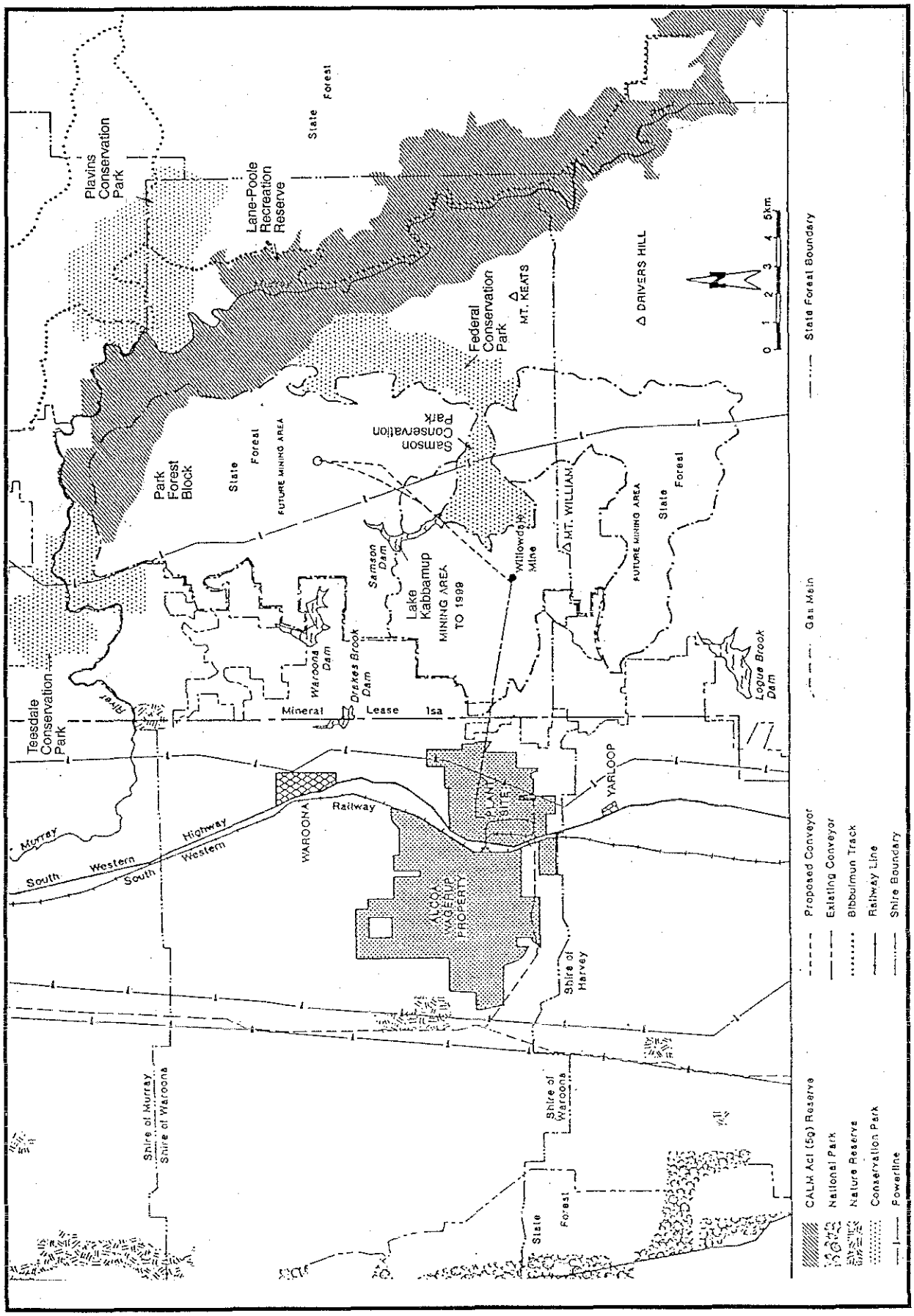


Figure 2. Location map, Wagerup refinery and Willowdale minesite. (Source: Figure 2 of the CER)

(CALM) to integrate mining schedules with forest management, development of a "walk-away" solution for the bauxite residue, reduction of greenhouse gas emissions, preparation of decommissioning and rehabilitation plans for the refinery, liaison with the Shire of Waroona for social impact monitoring, and for all of Alcoa's operations to come under the jurisdiction of the Environmental Protection (EP) Act 1986.

Since March 1990 the Wagerup project has been subject to Environmental Conditions under Part IV of the EP Act 1986, which included recommendations by the EPA and commitments made by the proponent in conjunction with the September 1978 ERMP. The operations are also subject to licence conditions under Part V of the EP Act 1986, to prevent the pollution of air and water in the vicinity of the refinery.

1.3 Rationale for this assessment

In its assessment of this proposal, the EPA was cognisant of the precautionary approach previously adopted in 1978 to restrict the Wagerup operations to 2 Mtpa, until sufficient evidence was produced to show that the key environmental issues were manageable at a higher production rate. The EPA had regard for the advice of those government agencies with relevant expertise on key issues of environmental importance, to assist it in making conclusions regarding the environmental acceptability of the proposed expansion to 3.3 Mtpa. In assessing this proposal, the EPA has placed emphasis on the proponent's performance in managing environmental impacts associated with the existing operations, and how the incremental effects associated with this proposed expansion would affect the environment.

2. Summary description of proposal

The proponent, Alcoa of Australia Ltd (Alcoa), proposes to increase the capacity of its Wagerup Refinery, located about 120 km south of Perth, from the current 1.7 Mtpa to 3.3 Mtpa of alumina, with a proportionate increase in production of bauxite from the mobile mining operations, currently located at Willowdale, about 8 km east of the refinery (Figure 1). The proposal is described in detail in the proponent's CER (Alcoa, 1994).

The proposed expansion at Wagerup Refinery will include a third production unit replicating the existing two units with some technology enhancements. It is predicted that operation of this new facility could commence by the end of 1996.

It is expected that mining will continue in the Willowdale North area, bounded by Samson Brook, the Murray River and the Darling Scarp for a period of 10 - 15 years (Figure 2). There will be no change to the total mining area as a result of the expansion - only the rate of mining will change.

With the proposed expansion at the refinery, there will be an increase in the volume of washed bauxite residue, with the active drying area requirement to be increased to 300 ha. The total area required for residue storage is not expected to increase.

There will be an increase in the frequency of road, rail and shipping movements to cater for the increased alumina production.

A comparison of the current and proposed operations is set out in Table 1.

Table 1. Summary of environmental impacts associated with proposed expansion

	Current	Expansion	Effect
Mining			
Bauxite as mined (Mtpa)	6.6	12.4	+ 5.8
Forest area cleared (ha/yr)	140	260	+ 120
Shifts operated (per year)	312	600	+ 288
Refinery			
Alumina produced (Mtpa)	1.7	3.3	+ 1.6
Water consumption (Gl/year)	1.5	2.6	+ 1.1
Bauxite residue produced (Mtpa)	3.5	6.3	+ 2.8
Total bauxite residue storage area (ha)	145	300	+ 155
NOx emissions (tpa)	1,087	1,901	+ 814
Greenhouse gas emissions as CO_2 (1000 tpa)	942	1,692	+ 750
Particulates (tpa)	84	126	+ 42
Noise levels (downwind) at Bancell Road (dB(A))	52	53	+ 1
Truck movements (per day)	26	32	+ 6
Light vehicle movements (per day)	320	420	+ 100
Rail wagon movements (per week)	198	360	+ 162

3. Environmental impact assessment method

3.1 The assessment process

General

The environmental impact assessment for this proposal followed the Environmental impact assessment administrative procedures 1993 (EPA, 1993), as shown in the flow chart in Appendix 3.

This assessment

The Minister for Resources Development referred this proposal to the EPA on 8 August 1994 for assessment.

In its assessment of the potential environmental impacts of this proposal, the EPA utilised information in the CER, advice from key government agencies, public submissions and responses prepared by the proponent. The summary of submissions and the proponent's response to those submissions appears in Appendix 4, and a list of submitters appears in Appendix 5. Additional information concerning public submissions is provided below.

Additionally, officers of the DEP carried out site inspections and discussed environmental issues with interested members of the local community and relevant government departments. The Environmental Assessments Committee of the EPA was briefed by representatives from the Mining and Management Programme Liaison Group (MMPLG) on its role in advising the State Government on the acceptability Alcoa's mining plans.

Limitation

This evaluation has been undertaken using information currently available. The information has been provided by the proponent through preparation of the CER (in response to guidelines issued by the DEP), by DEP officers utilising their own expertise and reference material, by utilising expertise and information from other State government agencies, 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 Submissions

Comments were sought on the proposal from key government agencies, community groups, local residents and the general public. The CER was available for public comment for a period of four weeks commencing 24 October and ending 18 November 1994.

There were 19 submissions , within the following categories:

- 12 submissions from individuals, groups and organisations; and
- 7 submissions from State, local and other government agencies.

The environmental issues of concern which were raised in public submissions are detailed in Appendix 6 and cover the following:

Bauxite mining - Flora and fauna conservation, rehabilitation, dieback management, protection of water resources, noise, dust, impacts on local community, bauxite resource utilisation and Alcoa's interaction with other forest users.

Refinery impacts - Noise, dust, gaseous emissions, buffer zones, residue disposal and groundwater and surface water protection.

There were a number of issues raised of lesser environmental importance. Some issues were more of a socio-economic nature and are handled more appropriately by other processes.

Some submissions raised concerns about certain undesirable impacts from the existing operations, and there were two submissions from the public that were definitely not in favour of the proposed expansion, including that of the Conservation Council of WA. The majority of submissions came from the local community, in contrast to those received for the 1978 ERMP review where the majority came from the general community.

The proponent's responses to issues raised in submissions are provided in Appendix 4. The EPA has considered the submissions received and the proponent's response as part of the assessment.

3.3 Identification of significant environmental issues

The EPA has identified environmental issues that it considered important to evaluate for this assessment. This was done on the basis of submissions from government agencies and members of the public, previous assessments by the EPA, and advice from the DEP on compliance by Alcoa in relation to Licence Conditions and Environmental Conditions set on the project by the Minister for the Environment in March 1990.

The EPA's assessment report focuses upon the issues considered to be significant in environmental terms. Other less significant environmental issues raised in public submissions are considered in less detail (Sections 4.1.7 and 4.2.5). There are also issues that are more appropriately addressed by other processes.

4. Evaluation

4.1 Assessment of bauxite mining related impacts

4.1.1 Conservation of flora and fauna of the jarrah forest

4.1.1.1 Objective

The Environmental Protection Authority's objective for conservation of the jarrah forest is to ensure that the diversity and sustainability of the forest ecosystem are adequately protected from the impacts of bauxite mining.

4.1.1.2 Evaluation framework

Existing Environmental Conditions and commitments

The current proposal is subject to a number of Environmental Conditions as set out in the Minister's Statement of March 1989 (Appendix 7). In relation to forest conservation, the company is required to ensure that its mining schedules are integrated with forest management schedules by liaising closely with CALM. The forest conservation commitments made by the company relate to the preparation and approval by the State of its mining and management programmes, foregoing bauxite resources in the jarrah forest conservation areas, and the use of site-specific environmental management procedures when mining adjacent to the conservation areas (including particular consideration of dieback management and mine rehabilitation requirements). As with other environmental factors that are affected by its operations, the company is committed to an ongoing environmental research programme and annual reporting arrangements.

Technical information

As Alcoa's principal bauxite area in the Darling Range (Figure 2) covers about 27% of the publicly owned jarrah forest, the potential impacts of bauxite mining on the conservation values of the jarrah forest should be viewed in both a regional and local context.

Conservation values of the Lane Poole Reserve and the Willowdale North area

In 1985, Alcoa agreed to exclude or indefinitely defer mining in conservation reserves and other special purpose areas (covering about 25% of the principal bauxite area within its mineral lease), but retained the right to mine bauxite in the recreation zone of the Lane Poole Reserve (about 105 million tonnes of bauxite), of which about 20% lies within the Willowdale North area. The CER states that the establishment of an ecologically representative system of conservation reserves within the jarrah forest has ensured the preservation of nearly all significant ecosystem types.

The CER describes the forest quality in the Lane Pool Reserve as generally good, although dieback disease is widespread in the Samson and Federal conservation parks and on the lateritic uplands of the section of the recreation zone west of Nanga Road. The facilities section of the recreation zone is one of the few areas near the metropolitan area that allows camping immediately adjacent to a relatively natural bush setting and within a major river valley. The Murray River valley is a popular picnicking, bushwalking, canoeing, marroning and fishing area, attracting up to 200,000 visitors annually.

The CER states that none of the Willowdale North area meets the accepted criteria for wilderness classification. There is almost no virgin "old growth" forest in either the current Willowdale mining area or Willowdale North, except for two small pockets totalling about 160 ha in the Teesdale conservation park of the Lane Poole Reserve which will not be affected by mining. None of the Willowdale North area is listed on the Register of the National Estate or is on the interim list for the Register. The CER states that the small area of the recreation zone of Lane Poole Reserve of interest for mining within the next 25 years is extensively degraded by dieback disease and is therefore unlikely to meet objective criteria for listing on the Register of the National Estate. The majority of the area, and virtually all of the area likely to be mined, has been classified as being of moderate scenic quality. Fifteen percent of the Willowdale North area, mostly associated with valleys and major streams, was assessed as being of high scenic quality.

Operational impacts and management of bauxite mining on flora and fauna in the Willowdale North area

Mining at Willowdale is currently centred on a crusher site near Mt. William but it is planned to relocate the operations to Willowdale North about 1999, for a period of 10-15 years. The areas to be cleared will be the same as for the existing operations, only that the timing of clearing will be brought forward as a result of the proposed expansion. The CER states that the total area to be cleared at Willowdale North represents less than one quarter of one percent of the state jarrah forest.

Mining is expected to have a localised impact on the flora due to direct losses during clearing and possible indirect losses associated with the spread of dieback. The CER states that most of the vegetation types to be affected at Willowdale North are well represented in the nearby Lane Poole Reserve and other conservation parks in the jarrah forest.

The CER states that mining should have little effect on populations of the priority flora species *Acacia oncinophylla* aff. ssp. *patulifolia* as this species occurs adjacent to granite outcrops which will not be mined. Similarly, the only known population of *Eucalyptus graniticola* exists near granite outcrops on the Darling Scarp. The other priority species occur mainly in stream zones and river valleys which generally do not contain bauxite.

For dieback hygiene reasons, clearing operations in areas of dieback-free forest take place in dry soil conditions, ie. summer and autumn. The proponent notes that at that time of the year almost all mammal and bird species are not breeding, and reptiles are relatively mobile, therefore it is likely that many species are able to move and avoid mining operations. Long-term

surveys on reptiles and birds around Alcoa's other bauxite mines have shown that no declines occur in either the species richness or densities of these fauna groups.

The proponent considers that stringent erosion control techniques and a comprehensive water monitoring programme at Willowdale North should ensure that mining activities do not have significant impact on aquatic fauna.

The company has given numerous undertakings in the CER outlining various strategies which would be undertaken to manage and minimise the environmental impacts of bauxite mining on the flora and fauna of the jarrah forest.

Additional commitments made by the proponent in this proposal

The proponent has made further commitments (Appendix 8) in relation to forest conservation and reducing the impacts of mining on the environment. These include:

- the indefinite deferment of mining in the facilities section of the recreation zone of the Lane Poole Reserve and the exclusion from mining of steep slope areas of the recreation zone of the Murray River valley;
- planning and management of its mining operations to minimise disturbance to biologically diverse areas fringing major rock outcrops and stream zones, the maintenance of appropriate buffers between these areas and minepit boundaries, and to construct stream crossings in a manner which facilitates their removal and rehabilitation after use; and
- continuing its programme of biological surveys and support of activities contributing to the conservation of rare, endangered and priority species existing within the vicinity of its mining operations.

4.1.1.3 Submissions

Comments from key government agencies

The Mining and Management Programme Liaison Group (MMPLG) comprises of representatives from CALM, DEP, the Department of Minerals and Energy (DOME), Water Authority (WAWA) and the Department of Resource Development (DRD). Its role is to review the mining plans prepared by Alcoa on a regular basis and to advise the State on the acceptability of these plans. The MMPLG made the following comments in relation to flora and fauna impacts from mining:

"In evaluating each MMP (Mining and Management Programme), the MMPLG takes into account other land uses (other than bauxite mining) while ensuring that Alcoa can maintain a commercially viable mining operation. In this way, the best interests of the community are served."

"Pursuit of this objective has led the MMPLG to look for mining strategies that have regard for (amongst other factors):

- management and conservation of forests;
- protection of flora and fauna."

In a separate submission, CALM indicated that the CER had been prepared in close consultation with its operations and specialist staff, and involved many discussions, field visits and reviews of draft documents. CALM noted that considerable research efforts have been directed at developing a better understanding of the jarrah forest eco-system and its component parts and processes in recent years.

CALM also noted that parts of the area proposed for mining in the Park Block within the Lane Poole Reserve are severely affected by dieback and are a long way from the Murray River and its main tributaries. These areas would be dealt with through the normal MMPLG process to ensure that conservation interests are catered for. Similarly, minor modifications to the boundaries to the Lane Pool Reserve would be examined by the MMPLG.

DOME made the following comments:

"...Given Alcoa's proven track record, this Department believes that the environmental impacts associated with the changes in rate of mining...will be minimal."

"Further, the Department believes that Alcoa's decision to mine in the Samson Brook area including some degraded areas of the Lane Poole Recreation Reserve is acceptable. ...there will be an opportunity to effect rehabilitation of the dieback affected forest in the mining area. The Company has agreed to forego mining in more sensitive areas such as along the Murray River."

"It is considered that the MMP process is best suited to manage the ongoing impact of bauxite mining in the Darling Escarpment."

The DEP has advised that it will seek the advice of CALM regarding satisfactory compliance by the proponent with regard to its commitments for forest conservation and reducing the impacts of mining on the environment.

Public Submissions

In relation to flora and fauna, public submissions raised concerns about conservation, ecological diversity and sustainability, impacts of forest fragmentation, dieback management, and fauna protection. The Conservation Council of WA was particularly concerned that steps are taken to ensure that all site vegetation types are represented and all ecosystem types are preserved in the conservation estate.

4.1.1.4 Proponent's response to submissions

The proponent has provided detailed responses to forest conservation issues raised in submissions (Sections A1, A4 and A5 of Appendix 4).

Alcoa has responded that its comments about adequate representation of the vegetation types within the conservation estate referred to in the CER, relate only to the jarrah forest of interest for bauxite mining, and not to the whole jarrah forest. These comments were based on information published in government forest management strategy documents and work undertaken for Alcoa by L.M. Mattiske and Associates. The representation of the site-vegetation types was assessed by comparing the results at Willowdale with publications and the current representation of the site-vegetation types in the reserves in the Northern Forest Region (refer to CALM's Regional Management Plans 1987-97). The company considers that it is not possible to make a quantitative comparison of the area of representation of the site-vegetation types outlined in the CER in the conservation reserves, because the same level of mapping has not been carried out for most of the reserves, nor indeed for most of the jarrah forest other than future bauxite mining areas.

Alcoa's comments in relation to the methodology inadequacy of establishing conservation areas in the jarrah forest are as follows:

"Alcoa's perception is that the assessment and review process leading to the establishment and subsequent expansion of the reserves system in the jarrah forest was commendably thorough."

"Decisions on an appropriate methodology for evaluating the adequacy of the conservation reserve system in the jarrah forest are the prerogative of the Department of Conservation and Land Management (CALM), the government agency which has been allocated the responsibility of managing the jarrah forest on behalf of the community."

"... Alcoa does not necessarily support the notion that the adequacy of the conservation reserve system should be reviewed simply because further botanical surveys have allowed a more detailed classification of site-vegetation types than existed previously."

Alcoa concludes that its net impact on the jarrah forest ecosystem as a whole will remain small, given the restricted area of forest likely to be affected by mining, the effectiveness of current rehabilitation and dieback control measures and the existence of a comprehensive system of conservation reserves. This impact would be partially offset by the company's contribution to

the reversal of existing forest degradation related to dieback spread and predation by feral animals.

4.1.1.5 Evaluation

In considering the potential impacts of the proposed expansion on the flora and fauna of the jarrah forest, the EPA has relied upon the advice of key government agencies. The EPA notes that CALM interacts with the proponent on a regular basis, was involved in the preparation of the CER and has indicated that it did not find the proposal to be unacceptable.

The EPA notes the additional commitments made by the proponent in relation to forest conservation and reducing the impacts of mining on the environment. Additionally the EPA notes that the DEP will seek the advice of CALM regarding the satisfactory compliance by the proponent with regard to these commitments.

In its previous assessment of conservation reserves for the System 6 area (EPA, 1983), the EPA recognised the uniqueness and importance of the jarrah forest ecosystem, and the need to provide adequate management to protect conservation, amenity and other land values. The EPA notes the submission from the Conservation Council that steps should be taken to ensure that all site vegetation types are represented and all ecosystem types are preserved in the conservation estate. The EPA considers that, prior to approval of the proponent's mining plans, the MMPLG should be assured that the vegetation communities to be impacted upon by bauxite mining and associated activities are adequately represented in the forest conservation estate, or can be adequately represented through amendments to the estate. The EPA has asked the DEP, which is represented on the MMPLG, to ensure that this issue is addressed in the annual review of the proponent's mining plans.

The EPA considers, on the basis of:

- **advice from the relevant state agencies as a result of this assessment;**
- **annual reviews of the company's mine plans and research and monitoring programmes by relevant state government agencies through the MMPLG;**
- **existing Environmental Conditions and proponent commitments on the project; and**
- **further undertakings and legally binding commitments given by the company as a result of this CER;**

that the EPA's objective for conservation of the jarrah forest can be met and therefore the impact of Alcoa's current and proposed expanded bauxite operations on the flora and fauna of the jarrah forest are environmentally acceptable.

4.1.2 Final rehabilitation criteria (completion criteria) for the return of mined areas to the State

4.1.2.1 Objective

The Environmental Protection Authority's objective is to ensure that the rehabilitation of areas affected by bauxite mining and associated activities is sustainable and environmentally acceptable.

4.1.2.2 Evaluation framework

Existing Environmental Conditions and commitments

The existing commitments made by Alcoa in 1989 (Appendix 7) require the company to:-

Ensure that the proposed methods of rehabilitation are in accordance with procedures agreed with the State; ensure that Alcoa's detailed rehabilitation proposals best suit the land use priorities established by the State; carry out monitoring of rehabilitated areas in co-operation with CALM whilst responsible for these areas; rehabilitate dieback-affected areas adjacent to its mining operations regardless of the cause of introduction of the disease; and implement an ongoing environmental research programme and annual reporting arrangements.

Technical information

For the expanded proposal the rate of rehabilitation will be increased to match the increased rate of clearing and mining. The increased rate of mining will not change the objectives, methods or effectiveness of the current rehabilitation process. The CER states that mine plans will be developed so as to minimise the time between clearing and rehabilitation of mine-pits, commensurate with effective dieback management and the need for grade and impurity control of the bauxite being delivered to the refinery.

Alcoa monitors rehabilitated areas for density and diversity at regular intervals. The CER reports that results from monitoring and from research trials have shown that survival and growth of jarrah has been good. Monitoring results are reported to relevant State agencies on an annual basis.

Recent developments in rehabilitation process

The CER summarises a number of recent advances in rehabilitation practices at Willowdale. These include:-

The development of clearly defined rehabilitation objectives and prescriptions in conjunction with CALM's Regional Management Plans and Working Arrangements; the maximisation of double stripping and direct return of top soil; comprehensive landscaping of mined areas; deep ripping (to 1.5 m) to eliminate the need for additional drainage control structures; the direct seeding of only jarrah forest species for tree revegetation, with jarrah being the major species; use of provenance-correct (local) species for understorey; and a comprehensive dieback management strategy.

Rehabilitation objectives and completion criteria

The CER states that Alcoa's objective for bauxite mine rehabilitation is to establish a stable, self-regenerating jarrah forest ecosystem, planned to enhance or maintain water, timber, recreation, conservation and/or other nominated forest values defined in CALM's Regional Management Plan for the Swan and Central Forest Regions. The prescription for rehabilitation is reviewed and updated annually in response to research and monitoring results.

A working group with representatives from CALM and Alcoa has been established to develop completion criteria that would allow the State to objectively determine the success of rehabilitation in areas affected by bauxite mining, prior to handing back the ongoing responsibility for the management of these areas. The CER states that rehabilitation of bauxite mines can be considered complete when any obligation for a continued financial or operational input from the company ceases. The working group will recommend criteria to describe the desired state of rehabilitation at this time. Criteria for older areas of rehabilitation established using earlier techniques will be formulated in 1995.

No additional commitments relating to rehabilitation have been proposed in this CER.

4.1.2.3 Submissions

Comments from key government agencies

Comments by CALM on the general content of the CER and its acceptability are covered in Section 4.1.1.3 of this report. CALM noted that programmes had been established to monitor rehabilitation parameters such as water quality, nutrient exchange, tree growth, regeneration success, fauna distribution, dieback spread and other parameters.

CALM raised the issue of intangible forest values and how Alcoa's land use management activities impact on these values. CALM indicated that its knowledge about public recreation

needs, landscape perceptions and community attitudes about forest values, management activities and strategies in south-west forest areas is limited.

CALM suggested that Alcoa give an additional commitment in relation to developing and implementing a comprehensive landscape management programme designed specifically for its mine operations in the jarrah forest.

The Department of Minerals and Energy pointed out that the State will benefit by the opportunity to effect rehabilitation of the dieback affected forest in the mining area of the recreation area of the Lane Poole reserve.

The MMPLG submitted that it was considering two issues in relation to rehabilitation:

- "Post mining plans must be developed for all three mines. This should maximise benefits to the State arising from infrastructure put in place by Alcoa.
- CALM and Alcoa must develop effective completion criteria for the native forests of the Darling escarpment. This is particularly important because a number of rehabilitated areas are reaching a level of maturity such that Alcoa may seek to hand them back to the State."

The MMPLG also pointed out the major opportunities to mine and rehabilitate areas of forest that are severely affected by dieback, as a consequence of Alcoa choosing to access bauxite south of Dwellingup via the Wagerup refinery.

The MMPLG concluded:

> "It is considered that the MMP process is best suited to manage the ongoing impact of bauxite mining in the Darling Escarpment. This includes the development of post mining plans, completion criteria and the potential for mining in the intermediate rainfall zone."

Public submissions

Issues raised in public submissions included the need to rehabilitate areas with a jarrah forest ecosystem, the uncertainty of long term survival of rehabilitated areas, doubts about the long term survival of jarrah which is replanted in pit floors and potential widespread damage to the environment as a result of seed collection throughout the forest. The Conservation Council was concerned about long delays in rehabilitation and the increase in area unrehabilitated as a result of the expanded operations.

4.1.2.4 Proponent's response to submissions

The proponent has provided additional information in response to rehabilitation issues raised in submissions (Section A3 of Appendix 4). The company has prefaced its responses with the following statement:

> "Alcoa is committed to continuous improvement in all key performance areas of its operations, including mine rehabilitation."

The company acknowledges that forests are long-lived ecosystems which take many decades to fully develop. However, it pointed out that the research and monitoring of its oldest rehabilitation, although not considered a mature forest as yet, indicates that current rehabilitation procedures are meeting the objective of re-establishing a self-sustaining jarrah forest ecosystem. The oldest jarrah trees growing in rehabilitated areas are 23 years old and these trees are growing well.

In relation to an increase in unrehabilitated areas, the company has indicated that annual rehabilitation rates will increase to ensure that only areas essential for the maintenance of an efficient mining operation remain open. After the start up of the next crusher facility in 1999, the maximum mining area open will be approximately 850 ha .

In response to concerns about the impacts of seed collection, Alcoa has indicated that Eucalypt seed is collected from areas being logged or cleared for mining. The native seed industry is regulated by CALM, with strict licensing conditions in place to prevent environmental damage by seed picking activities.

In relation to public recreation needs, landscape perceptions and community attitudes about forest values, management activities and strategies in south-west forest areas, Alcoa indicated that it has commissioned professional surveys of public opinion for many years. A consistently overwhelming proportion of respondents indicated a preference for rehabilitation to return the forest to its original state. The company has also worked closely with CALM's Recreation & Landscape and Community Education branch. The company notes that the broader aspects of community attitudes about forest values and management activities and strategies would be more appropriately directed to CALM.

In relation to the Willowdale Mine, the company has commissioned consultants to conduct a survey of recreational users of the forest in and around Lane Poole Reserve. Their views about recreational needs and mine rehabilitation objectives will be sought.

4.1.2.5 Evaluation

The EPA notes the significant advances made by the company in its rehabilitation practices at Willowdale, made possible by the substantial environmental research and development undertaken by the company. For many years now this research information has been made available to the State's expert agencies in minesite rehabilitation, CALM and the Department of Minerals and Energy (DOME), both of which made or implied favourable submissions in this assessment regarding the standard of rehabilitation achieved by Alcoa to date. Such comments are in direct contrast to the advice provided by the Technical Advisory Group to the EPA in 1978, which expressed serious concerns about the success of the rehabilitation at that stage.

The EPA notes the advice by the MMPLG regarding the need for post mining plans and the development of completion criteria and procedures for rehabilitated mining areas. The EPA believes that completion criteria are essential if the State is to objectively determine the success of rehabilitation in areas affected by mining, prior to taking on the ongoing responsibility for their management. The EPA notes that CALM and Alcoa are working together to develop completion criteria. The EPA considers that Alcoa should continue this work, however the working group should be broadened to include the DEP, WAWA, DRD and DOME, to ensure that all aspects of rehabilitation are covered in the final criteria.

To enable rehabilitated mining areas to be handed back to the State at an acceptable standard, the EPA considers that, within 12 months of approval the proponent should submit details of a programme to develop final rehabilitation criteria and, subsequently, implement this programme, to the requirements of the Minister for the Environment and the Minister for Resources Development on advice of the Environmental Protection Authority, the Water Authority of Western Australia and the Department of Conservation and Land Management (Recommendation 3).

The EPA notes CALM's comments regarding the need for community consultation on the type of rehabilitation that should be undertaken by Alcoa and, on the advice of DEP, considers the response and undertakings given by Alcoa adequately cover this issue.

The EPA considers, on the basis of advice from those government agencies with relevant expert advice, existing Environmental Conditions and commitments in relation to rehabilitation methods, research and monitoring programmes, and conditional upon the development and implementation of agreed completion criteria, that the rehabilitation of areas affected by current and expanded bauxite mining and associated activities for the Wagerup Refinery will be sustainable.

4.1.3 Dieback management

4.1.3.1 Objective

The Environmental Protection Authority's objective is that bauxite mining and associated activities within areas of State Forest should be conducted in a manner that protects dieback-free uplands and avoids the spread of dieback disease downslope.

4.1.3.2 Evaluation framework

Existing Environmental Conditions and commitments

In 1989 Alcoa committed to implement a comprehensive dieback management programme designed specifically for its mine operations on the jarrah forest (Appendix 7). This included the rehabilitation of dieback affected areas adjacent to its mine operating areas, regardless of the cause of introduction of the disease. As with other environmental factors that are affected by its operations, the company is committed to an ongoing environmental research programme and annual reporting arrangements.

Technical information

The CER states that the impact of the fungus *Phytophthora cinnamoni* (commonly referred to as dieback) varies at different sites. On some sites, the introduction of dieback results in the death of most of the jarrah trees and many understorey species. At other sites, the symptoms of the disease can be more subtle with only a few understorey species affected. In general, dieback has a greater impact on poorly drained sites than on well drained sites.

The CER acknowledges the potential for mining activities and drainage from minepits, haul roads, and other roads and structures, if not well managed, to result in the introduction of new dieback infections or in pre-existing disease impacts being intensified. However, surveys conducted by the company on areas adjacent to and downslope of mined areas at Del Park and Huntly (Figure 1) have shown a very minor spread of the disease, with indications that even some of this increase was unrelated to bauxite mining.

The CER indicates that the area of uninfected forest at risk from dieback spread due to mining in Willowdale North is comparatively low because much of the mining will be in or above dieback-affected forest. Some areas of forest east of Lake Kabbamup have been interpreted as free of dieback but have a high potential risk for infection by natural spread. Mine plans will take into account the need to protect unmined forest in these areas from drainage waters and other possible vectors of dieback infection.

Various procedures for managing dieback have been developed jointly by CALM and Alcoa (and are reviewed annually) to minimise the impact of bauxite mining and associated activities on the vegetation and fauna species detrimentally affected by dieback-induced vegetation changes.

Dieback mapping is carried out by CALM using aerial photographs and field verification before all pre-mining activities. Dieback hygiene maps are used as the basis for dieback management plans which cover all forest areas at least 10 years ahead of mining.

A Dieback Management Strategy has been developed by Alcoa for the Willowdale Mine. Its objectives are to effectively reduce dieback spread by all stages of the mining operations, prevent the introduction of *Phytophthora cinnamomi* to dieback-free soils which will be used in mine rehabilitation or construction, protect forest adjacent to mining from dieback introduction or intensification of existing infection. The strategy includes rating forest according to its dieback status and the potential risk of dieback infection and spread, cleaning all vehicles entering dieback-free areas, controlling drainage from the clean-down facilities, locating haul roads in susceptible areas as low as possible in the landscape, and the routing of haul roads so the clearing of healthy forest is reduced to a practical minimum. These principles are also applied to conveyor alignments and crusher sites where possible. Access to and from the active

mining areas via forest tracks is restricted by CALM and Alcoa. Dieback-free hilltops are protected, especially during times of major activity, by gates, barriers and signs. Educating employees and contractors about dieback, its spread and the dieback management procedures they must follow, is an integral part of the dieback management strategy.

Alcoa funds a programme, known as the Dieback Forest Rehabilitation (DFR) programme, to treat dieback-affected forest within the mining perimeter at Willowdale and its other mines. This is done regardless of the cause of introduction of the disease to the area. Treatments include establishing and fertilising trees and understorey in forest where the overstorey is extensively degraded by dieback, and creating fauna habitats.

The CER states that, given the unusually high incidence of dieback disease in current and future mining areas at Willowdale and Willowdale North, a sub-regional plan will be developed jointly with CALM to improve the conservation and recreational value of the whole forest in both areas by means of the DFR programme. The main focus of DFR activity will be in the areas adjoining the Lane Poole Reserve. The most severely dieback-affected sites on black gravel soils are not amenable to rehabilitation using the current DFR prescriptions. Research will be initiated to develop rehabilitation methods better suited to these particular sites.

No additional commitments in relation to dieback management have been made in this CER.

4.1.3.3 Submissions

Comments from key government agencies

CALM pointed out the considerable research efforts made and programmes developed to monitor dieback spread. Favourable comments by CALM in relation to the preparation of the CER were noted in Section 4.1.1.3 of this report. As with flora and fauna impacts, CALM was offered a further opportunity to comment on the environmental acceptability of the proposed expansion, given its role as the expert agency in relation to dieback. CALM similarly responded that if it had a problem with the CER, this would have been indicated in its submission.

The EPA notes the Department of Minerals and Energy's comments that the proposal to mine in degraded areas of the Lane Poole Recreation Reserve is acceptable, and that there would be an opportunity to effect rehabilitation of dieback affected forest in that area.

The Mining and Management Programme Liaison Group (MMPLG) submitted that its subsidiary the Mining Operations Group (MOG) oversees the development of prescriptions for dieback hygiene and the DFR programme. The MMPLG also noted the major opportunities to mine and rehabilitate areas of forest that are severely affected by dieback, as a result of the company's decision to access bauxitic areas south of Dwellingup via the Wagerup refinery.

The DEP has advised that it will seek the advice of CALM regarding satisfactory compliance by the proponent with regard to its commitment to implement a comprehensive dieback management programme designed specifically for its mine operations on the jarrah forest.

Public submissions

Two public submissions raised concerns about the spread of dieback into unaffected areas of the State Forest (particularly downslope). The owners of Lot 471 (Fig 5) was particularly concerned about the potential for dieback in the area to spread on to their property as a result of mining operations, and that this could affect their plans to establish a seed orchard.

4.1.3.4 Proponent's response to submissions

The proponent has provided additional information in response to rehabilitation issues raised in submissions (Section A2 of Appendix 4).

In response to concerns about downslope movement of dieback, the company has indicated that moist valley floor sites throughout the jarrah forest are commonly infected by dieback, and in most circumstances the valleys are more likely to be sources of inoculum for infection of

upslope forest rather than the reverse. The company has also indicated that bauxite mining can actually decrease the rate of downward spread of dieback, such as when upland "spot infections" are removed during mining and later replaced in the lower part of the rehabilitated area, where there is a much lower risk of infection.

Alcoa has stressed that none of its bauxite operations are being undertaken in forest which is completely free from dieback. Within the 10 year mining perimeters of the three bauxite mines, the overall incidence of dieback ranges from 28% to 64%, the latter being the figure for Willowdale. The company acknowledges that its operations do contribute to the spread of dieback (estimated to be in the range 0.1-1%). These impacts are at least partially offset by the dieback forest rehabilitation program, in which Alcoa funds the rehabilitation of dieback affected forest adjacent to its operations irrespective of the cause of the infection. The bulk of the areas treated under the programme were infected as a consequence of other activities well before any mining in the area.

In relation to the spread of dieback from mining operations on Lot 471, the company considers that mining will have no effect on the property owner's plans to establish a seed orchard, as the property is separated from the nearest mineable orebodies by a distance of at least one kilometre, with intervening streams to the south and east. The company points out that the catchment area of Cyprus Brook is already extensively degraded by dieback and that dieback spores almost certainly already exist in the stream water.

In response to concerns about what specific dieback hygiene measures the company would adopt, Alcoa has responded:

> "Within the Willowdale North area most of the valley floor vegetation except for the deeply incised valleys draining into the Murray River is already affected by dieback to some extent. Therefore, the priority will be to minimise intensification of the disease. This will be achieved by maintaining a high level of dieback management and by minimising changes in local hydrological conditions."
>
> "Areas of potentially high dieback impact are identified by botanical survey and site-vegetation mapping before mining. These are taken into account by drainage systems so that drainage water is directed away from dieback-susceptible and uninfected or lightly-infected but potentially high impact sites, scheduling nearby construction and mine development activities to the summer months, and scheduling ore extraction to minimise the time between clearing and rehabilitation of adjacent minepits."
>
> "Alcoa will liaise with CALM to determine what monitoring might be necessary in situations where mining is planned adjacent to valley systems containing site- vegetation types which are currently uninfected but susceptible to dieback."

4.1.3.5 Evaluation

During its review of the May 1978 ERMP, the EPA was advised by the Technical Advisory Group (TAG) that the combination of bauxite mining and ancillary dieback spread could have a profound affect on the landscape of the Darling Range. Other land users would suffer as a result of Alcoa's activities and there could be a serious impact on water quality in the eastern areas. Adequate control measures to lessen the impact were not in place at the time that would lessen the potential impact. TAG advised that, in view of the uncertainty and potentially large impact, the State should retain strict control on options for expansion of bauxite mining.

The EPA notes the substantial contribution to dieback research undertaken by the company since 1978 and made available to CALM and other relevant government agencies. The EPA notes also the changes to planning and operational procedures put in place by the company as part of its Dieback Management Strategy, in consultation with CALM. As with other environmental impacts on the jarrah forest considered in this assessment, the EPA notes that CALM interacts with the proponent on a regular basis on operational and planning issues, was involved in the preparation of the CER, and has indicated that it did not find the proposal to be unacceptable. This response, and similar submissions from other relevant government agencies, are in contrast to the advice provided by TAG to the EPA in 1978. The conclusion

reached by the EPA is that CALM's strict dieback hygiene measures has managed to control the disease to the point of avoiding the predicted worst case spread forecast by TAG.

The EPA supports, on the basis of advice of government agencies on the substantial benefits to the State from the Dieback Forest Rehabilitation programme, the regional approach to dieback rehabilitation by the company, with its active support in treating dieback affected forest in proximity to its operations.

The EPA notes that the DEP will seek the advice of CALM regarding satisfactory compliance by the proponent with regard to its commitment to implement a comprehensive dieback management programme designed specifically for its mine operations on the jarrah forest.

The EPA concludes, on the basis of the company's established Dieback Management Strategy and Dieback Forest Rehabilitation Programme, existing Environmental Conditions and commitments in relation to dieback management and research and monitoring programmes, and advice from the relevant state agencies as a result of this assessment, that the proponent is managing its current bauxite mining and associated activities at Willowdale in a manner that is controlling the spread of dieback disease, and therefore the proposed expansion is environmentally acceptable.

4.1.4 Water resource protection

4.1.4.1 Objective

The Environmental Protection Authority's objective is to ensure that the quality and quantity of water resources, especially for public water supply purposes, are protected from the impacts of bauxite mining and associated activities.

4.1.4.2 Evaluation framework

Existing Environmental Conditions and commitments

Alcoa committed in 1989 (Appendix 7) to not mine bauxite in the eastern, lower rainfall portion of Alcoa's lease, until research shows that mining operations can be conducted without significantly increasing the salinity of water resources.

Technical information

Surface water

The Willowdale North area is within the high rainfall zone (>1100 mm per year) of the Darling Range which produces relatively high yields of good quality surface water. Some of the mining in the Willowdale North area will occur in the catchments of three water supply dams: Samson Dam (Lake Kabbamup), Samson Pipehead Dam and Waroona Dam (Lake Navarino) - refer to Figure 2. The water from Samson Dam is used for irrigation and potable water, from Samson Pipehead Dam for potable water and from Waroona Dam for irrigation. Waroona Dam is also used for water-based recreation. Numerous small agricultural dams exist in the foothills and scarp area with some farmers relying on summer base flows for a variety of purposes. The CER states that mining in the Willowdale North area may cause localised, transient changes to local streams but no significant detrimental long-term effects are expected.

Changes to the forest canopy cover can result in significant changes to catchment water yield particularly in the high rainfall zone. The CER states that increases in water yield in the order of 10-20% are likely to occur following mining, but these will return to pre-mining levels within 5-10 years as rehabilitation re-establishes the water balance in the mined areas. Rehabilitated sites of this age will consume more water than dieback-affected forest and it may be necessary to thin the minepit regrowth if the elevated water yields from catchments heavily affected by dieback declines below acceptable levels.

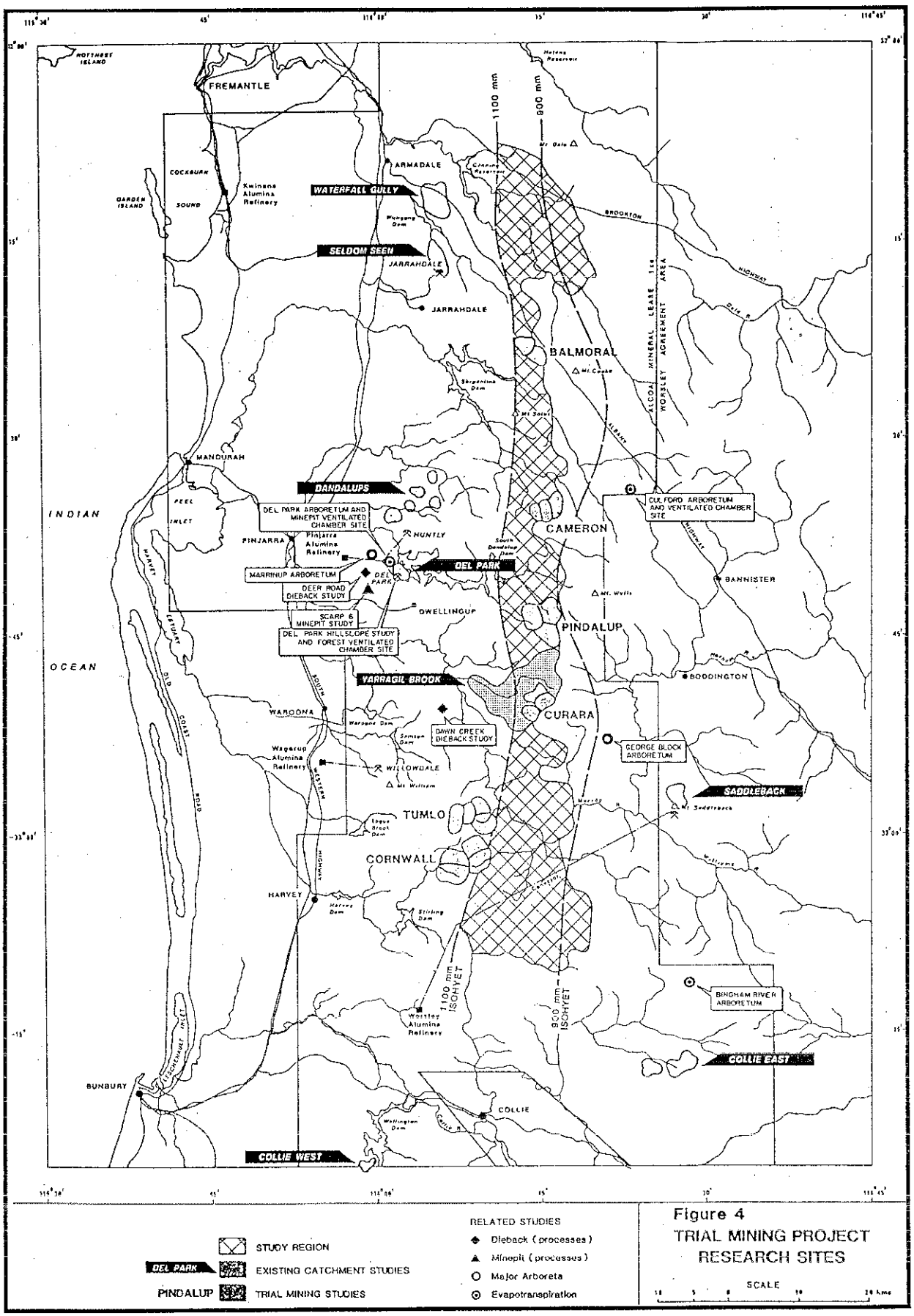


Figure 3. Rainfall isohyets in relation to current bauxite mining activities and potential trial mining areas (Source: Bauxite Subcommittee, 1985)

The major water quality issue in mining areas in the high rainfall zone is turbidity. The CER describes a number of predictive, design and operational procedures used by Alcoa to protect the quality of surface water emanating from the mining areas. Similarly Alcoa has developed procedures to manage and contain oil or fuel spillage during mine vehicle refuelling and minor servicing in the field and at the workshop facility.

Extensive monitoring by the proponent, of streams which drain Alcoa's mining areas show that stream turbidity events associated with mining are infrequent and temporary (Table 4.2 of the CER). Streams draining catchments where rehabilitation has been completed have turbidity levels similar to those in unmined forest areas. No long-term adverse effects on stream zone vegetation due to turbid runoff from haul roads have been detected.

Groundwater

The correlation between salt stored in the soil profile and present day rainfall is well documented (Low et al., 1984). Soil solute concentrations in excess of 10,000 mg/L are common in areas below 700 mm of rainfall per year, compared with less than 100 mg/L in areas with greater than 1100 mm of rainfall per year. Soil salt storage levels increase rapidly with distance inland from the 1100 mm/annum isohyet (Figure 3). Extensive land clearing for agriculture in these drier areas (mainly below the 900 mm/annum isohyet) has led to large increases in river salinity.

Very slight increases in stream salinity chloride have been detected after mining at mine sites other than Willowdale. However, nine years after rehabilitation was completed, stream salinity had returned to pre-mining levels.

Data from 21 boreholes drilled in and around the current Willowdale mining area shows that the average volumetric total soluble salts is 0.09 kg/m^3 (range 0.04 to 0.20 kg/m^3) which is at the low end of the typical range for the high rainfall zone. Groundwater salinity samples collected from these boreholes ranged from 77 to 244 mg/l total soluble salts. Results of stream baseflow sampling carried out in May 1994, after the driest summer on record, indicate that the area has low soil salt storages typical of the high rainfall zone.

The CER states that no soil salt storage and groundwater data are available for the immediate Willowdale North area. However, because of its similar rainfall, drainage patterns, landform and vegetation, it is expected to have similar salinity characteristics to other areas of the high rainfall zone in which Alcoa currently operates.

Alcoa proposed in the CER to drill up to 20 representative soil salinity/groundwater bores in late 1994 to confirm that soil salt storages and groundwater salinities for the Willowdale North area are typical of the high rainfall zone. The outcome of this drilling programme is given by the proponent in Section 4.1.4.4 of this report.

In relation to the research commitment that would allow the company to mine bauxite in the higher salinity, low rainfall zone of its lease, the company indicated in the CER that a Joint Intermediate Rainfall Zone Research Programme was being conducted, with the aim of developing appropriate environmental management procedures. Catchment models are also being developed which will be capable of predicting the effects of land-use changes including mining and rehabilitation on stream salinity. The research programme includes a demonstration mining and rehabilitation project east of the Huntly Mine (Figure 1) scheduled to commence about the year 2005. Depending on the results from this and other research, modelling and inventory programmes, full-scale bauxite mining in the eastern part of the mineral lease could occur from about the year 2020.

The CER states that there is sufficient bauxite in the high rainfall western part of the mineral lease for the Kwinana, Pinjarra and expanded Wagerup refineries to continue operating at full capacity for about 40 years, and that the proposed expansion will not result in a need for premature access to lower rainfall areas.

4.1.4.3 Submissions

Comments from key government agencies

The Water Authority of Western Australia (WAWA) commented that the CER addressed most aspects adequately. WAWA made a number of specific comments:

> "... there is some concern that mine management and planning strategies in the Jarrahdale/Serpentine/South Dandalup areas may not be entirely applicable to the Willowdale mine area."
>
> "The current research programme has shown that rather than an even distribution of salinity risk, pockets of higher and lower salinity exist in the intermediate rainfall area. There is little quantification of these factors in the Willowdale area. While the bulk of the expanded area lies in the higher rainfall area, it is recommended that an ongoing programme of surface water and groundwater monitoring is commenced. The 1994 sampling programme outlined in Table 4.2 (of the CER) provides a reasonable basis for an ongoing programme."
>
> "Groundwater level, salinity and soil salt storage information is currently limited in the Willowdale area. From this limited information it is evident that groundwater and soil salinities are typical of the high rainfall zone. The proposal to gather further data from drilling in 1994 is endorsed and it is recommended that a drilling programme is continued to better quantify groundwater and soil salinities towards the eastern extremities of the future Willowdale mine area. Obtaining such data, say from a five year programme, will give added confidence in applying research analysis and modelling predictions to the Willowdale area."

The MMPLG submitted that it evaluated the company's mining strategies in the context of the maintenance of water quality and quantity from catchments. The MMPLG also commented that the effects of bauxite mining in the higher salt "intermediate rainfall zone" should be established, preferably by 2000/2002. This issue would be in conjunction with the Research Steering Group. The MMPLG concluded that the MMP process is best suited to manage the ongoing impact of bauxite mining in the Darling Escarpment, including the potential for mining in the intermediate rainfall zone.

Public submissions

One submission considered it unacceptable for Alcoa to mine in catchments that are used for potable water and irrigation, due to the risk of higher salinity. Three submissions from property owners in the area expressed concern about the potential for the bauxite mining operations to affect their private water catchments.

4.1.4.4 Proponent's response to submissions

The proponent has provided additional information in response to water resources issues raised in submissions (Section A6 of Appendix 4).

In relation to the acceptability of mining in the catchments of public water supplies, the company provided the following response:

> "Alcoa has been mining bauxite in the Darling Range for 32 years and for much of that time one or other of its mines has been operating in water supply catchments. Streams draining the mining areas are carefully monitored by Alcoa and monitoring is also undertaken by Water Authority personnel. Alcoa's data are summarised and reported annually to the State Government in the Reviews of Environmental Research and Operations."
>
> "The results from the monitoring programs (Table 4.2 of the CER) show that Alcoa's operations have not had a significant effect on the quality of water resources. The company is confident it can maintain this performance in the Willowdale North area."

In response to concerns of private owners with water resources potentially affected by the company's mining operations, the company has responded:

> "...when bauxite deposits.... have been better defined by drilling and are under consideration for inclusion in a draft 5 year mine plan to be submitted to the State Government's Mining and Management Programme Liaison Group, Alcoa will consult with the property owners in the area to help develop a management program which will minimise any potential impacts of the operations."

In response to concerns regarding potential salinity impacts resulting from mine management and planning strategies proposed for future mining at Willowdale North, the company has responded that these are based on 11 years of experience at Willowdale itself as well as experience from the northern operations. In relation to water resources, they are based on a sound understanding of the basic hydrological processes and terrain attributes which determine catchment response.

The company has reported the results of its recent drilling programme, proposed in the CER:

> "Twenty-two boreholes, two more than proposed in the CER, have since been drilled in Willowdale North. Their average volumetric total soluble salt content was 0.08 kg/m3 and the average groundwater salinity was 147 mg/l TSS. These are exceptionally low salinity levels by comparison with averages for the high rainfall zone of the jarrah forest as a whole. Very low soil and groundwater salinities were entirely predictable given the rainfall, terrain characteristics and low stream baseflow salinities existing in the Willowdale North area. No further salinity drilling will be undertaken in Willowdale North."

4.1.4.5 Evaluation

In its review of the May 1978 ERMP, the EPA was advised by TAG of the conflict between bauxite mining operations and principal water supplies of the State, because of the large amounts of soluble salts stored in the deeper subsoils, and the potential for bauxite mining to release these salts into the river systems in eastern part of the company's lease area (east of the 1150 mm isohyet). TAG advised of the important relationship between water quality and quantity, and the effects of dieback on the jarrah forest and the successful revegetation of mining areas.

On the basis of the advice from TAG, the EPA concluded in 1978 that:

> "...in the long run the security of water resources of the south west of the State must rate higher priority than bauxite mining. ...The effects of mining on water quality are still imperfectly understood, moreover the capacity to re-establish mature forests with hydrologic properties akin to jarrah in the drier risk prone areas is at this stage completely unknown. Field trials will need to extend over perhaps twenty years or more. "
>
> "The Authority believes that the onus of proof that no significant deterioration in water resources will result from mining should rest with the company, not the State."

The EPA notes the substantial hydrological research undertaken and proposed by the company since 1978, in conjunction with WAWA and research bodies, to facilitate an environmentally acceptable mining operation in the more saline areas in the eastern area of Alcoa's lease. The EPA considers that the Research Steering Group, through the agency of the MMPLG and involvement of WAWA, is an appropriate body to advise the State on the acceptability of the research and monitoring work undertaken.

The EPA notes that WAWA, as the expert government agency on water resource impacts in the Darling Range, finds the proposed expansion of the Wagerup operations generally acceptable. In relation to WAWA's recommendation that a drilling programme be carried out to better quantify groundwater and soil salinities towards the eastern extremities of the future Willowdale mine area, the EPA notes that this work has since been completed by Alcoa. The EPA understands that results of this work will be reported to WAWA, but notes that the company has reported that salt storage contents and groundwater salinity levels are extremely low by comparison with averages for the high rainfall zone of the jarrah forest and that no further

salinity drilling would be undertaken in Willowdale North area. The EPA considers that the company should continue to maintain and improve its predictive, design and operational procedures to maintain water quality in water catchments around its current operations at Willowdale, in close co-operation with WAWA.

On the basis of advice from the DEP, the EPA considers that Alcoa should consult with property owners whose water resources may be affected, well in advance of its mining operations. The EPA considers that the company should advise the MMPLG of what action it has taken in this regard when it submits its draft 5 and 10 Year Mine Plans each year. This issue is addressed in more detail in Section 4.1.6.5.

The EPA considers, on the basis of the company's ongoing hydrological research programme, established procedures described by the company in the CER to protect water resources, and advice from the relevant state and federal agencies as a result of this assessment, that the proponent is managing its current bauxite mining and associated activities at Willowdale in a manner that protects the quality and quantity of water resources, and therefore considers that the proposed expansion is environmentally acceptable.

4.1.5 Noise impacts from bauxite mining and associated operations

4.1.5.1 Objective

The Environmental Protection Authority's objective is to ensure that the bauxite mining operations and associated activities do not exceed the relevant environmental protection noise standards. In so doing, the health and amenity of surrounding residents should not be unacceptably affected by noise emissions from these operations.

4.1.5.2 Evaluation framework

Noise regulations

Noise levels for projects within Western Australia are subject to the Noise Abatement (Neighbourhood Annoyance) Regulations 1979, 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 residences in country areas, such as those near the Willowdale Mine, the Assigned Noise Levels would be 30 dB(A) at night (10.00 pm - 7.00 am); 35 dB(A) during the evening (7.00 pm - 10.00 pm) and on weekends/public holidays (7.00 am - 7.00 pm); and 40 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 mining related noise impacts for the proposed expansion considers the draft regulations, since these are likely to be in force by the time of commencement of the proposed mining operations.

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 45 dB(A) during the day, some 5 dB(A) higher than the current regulations.

Technical information

Potential sources of noise for the bauxite mining operations include drilling and blasting, ripping of caprock by bulldozer, mobile machinery such as loaders and haul trucks and fixed plant such as the crushing facilities and the overland conveyor running from the crusher to the Wagerup refinery.

The proponent indicated that blasting would be the main source of noise that would cause most concern to neighbouring property owners. The proponent has suggested that the frequency of blasting will not necessarily increase as a result of the increased rate of mining, due to the proposed use of a large bulldozer to rip caprock in more noise sensitive areas.

Monitoring of the noise from blasting is planned to continue with the installation of a remote acoustic monitoring system at specific residential sites. As part of its internal standards the proponent will continue to aim to conduct blasting only when predicted pressure levels from their blast prediction model are below 115 dB(linear) peak.

Noise levels from trucks and loaders have been deemed by the proponent not to be a concern for most neighbours. However, if it does become a concern, the proponent has stated that it is prepared to limit such operations in these areas to daytime shifts only.

The proponent has suggested in the CER that noise levels from the new Willowdale crusher site are not expected to be a concern, on the basis that the site will be at least 5 km from the nearest habitation. The CER claimed noise levels from the crusher, measured 800 m away, recorded only background levels, which were about 49-50 dB(A) for that particular day.

4.1.5.3 Submissions

Comments from key government agencies

The DEP, as the expert government agency for noise impacts on the public, found the information provided in the CER relating to this issue to be unsatisfactory due to the lack of detail and was unable to properly assess the proposal on this basis. The DEP noted that the CER relied on the recorded low incidence of complaints as a basis, without demonstrating quantitatively that the expansion would comply with the noise regulations. The DEP requested further information in relation to location of nearest residences and predicted and measured noise levels from mining areas, crusher sites, and conveyors adjacent to these nearest residences.

The proponent subsequently provided the requested details of the proposed operations and engaged the expertise of Herring Storer Acoustics (HSA) to undertake an acoustic modelling program and analysis into key areas of the project. The HSA report (February 1995) contained a map showing nearest residences and computer modelled noise contours predicting noise levels of current mining operations. The DEP subsequently carried out a detailed technical evaluation of the information and its report is presented as Appendix 9.

Mining

The potential noise impacts on residents from the existing mining operations are illustrated in Figure 4, which shows the noise contours for worst case conditions, ie. with a light north-easterly breeze blowing from the minesite towards the nearest residences. Using this scenario from the HSA report, the DEP considered that noise from mining operations could exceed the 35 dB(A) limit for night time if operations were closer than 4 km from a residence. The DEP has thus identified seven residences that could be impacted upon by noise from the current mining operations. In relation to future mining operations, the DEP recommended that noise predictions be carried out when mining operations are proposed within 4 km of any residence and that a noise management plan be developed if the noise predictions indicate a possible exceedance of the regulations. The noise management plan would address such issues as the source sound levels of major items of plant; changes to operations to achieve compliance with regulations; details of noise monitoring procedures and any other measures to be taken where compliance with the regulations is predicted to be difficult.

Blasting

In its assessment of the likely noise impacts of blasting, the DEP stated that, with the experience now gathered in the use of the prediction model, Alcoa's ability to anticipate complaints should be good enough to minimise future complaints. The two factors assisting in this are that mining will generally occur further away from residences, in particular the Yarloop townsite, and that the proposed use of a large bulldozer to rip caprock should reduce the need

for blasting. The DEP noted that the internal criteria used by Alcoa for airblast overpressure are 5 dB lower than the levels currently used by the DEP in setting licence conditions for prescribed premises.

Overland conveyor

In relation to noise from the overland conveyor, the DEP expressed concern that the conveyor would operate on many more nights under the proposed operations. The DEP's advice therefore considered, as a deficiency, the limited assessment of noise from the overland conveyor presented in the CER. The DEP submitted that there was a strong argument that noise from the existing conveyor operations may exceed both the current and proposed regulations, particularly in relation to a residence situated about 1 km from the conveyor. Unfortunately, the HSA report did not address this issue in detail. The DEP therefore recommended that the proponent should:

- conduct further studies into the potential impact of the conveyor noise;
- implement noise controls as are necessary to ensure compliance with the draft Environmental Protection (Noise) Regulations 1995; and
- to monitor noise levels emanating from the conveyor to ensure compliance with the relevant regulations prior to the commencement of the proposed operations.

The DEP has evaluated the additional commitments made by the proponent to manage noise impacts from the existing and proposed expanded mining and associated operations (Section 4.1.5.4), and has submitted that, subject to full implementation of these commitments, noise impacts should be manageable.

Public Submissions

There were seven public submissions raising concerns about the adverse effects of noise resulting from blasting, the conveyor and mining machinery such as bulldozers. Four of these submissions were from property owners close to current or future mining areas.

4.1.5.4 Proponent's response to submissions

As indicated in 4.1.5.3 above, the proponent has provided additional information in response to noise issues raised in submissions (Section 8 of Appendix 4) and commissioned the report by Herring Storer Acoustics referred to above.

As a result of the DEP's assessment of the HSA report, the proponent made several detailed commitments in relation to the issue of noise. Refer to Appendix 10.

Additional commitments made by the proponent

With respect to the existing Willowdale minesite, the proponent has made a commitment to:

- commission an authoritative assessment of noise emissions associated with its mobile mining operations at the Willowdale Mine;
- take measures to reduce noise emissions to comply with the relevant noise regulations by the end of 1996; and
- periodically monitor noise levels at designated reference points and report on results in the Review of Environmental Research and Operations which is submitted annually to the Department of Resources Development and relevant state and local government agencies.

In terms of the proposed expansion, the proponent is committed to:

- design the plant and equipment associated with the expansion to meet the draft Environmental Protection (Noise) Regulations 1995 and to operate it in accordance with the environmental noise regulations promulgated subsequently; and
- reach agreement with the DEP on a noise management procedure for private residences in the vicinity of future mining operations; and

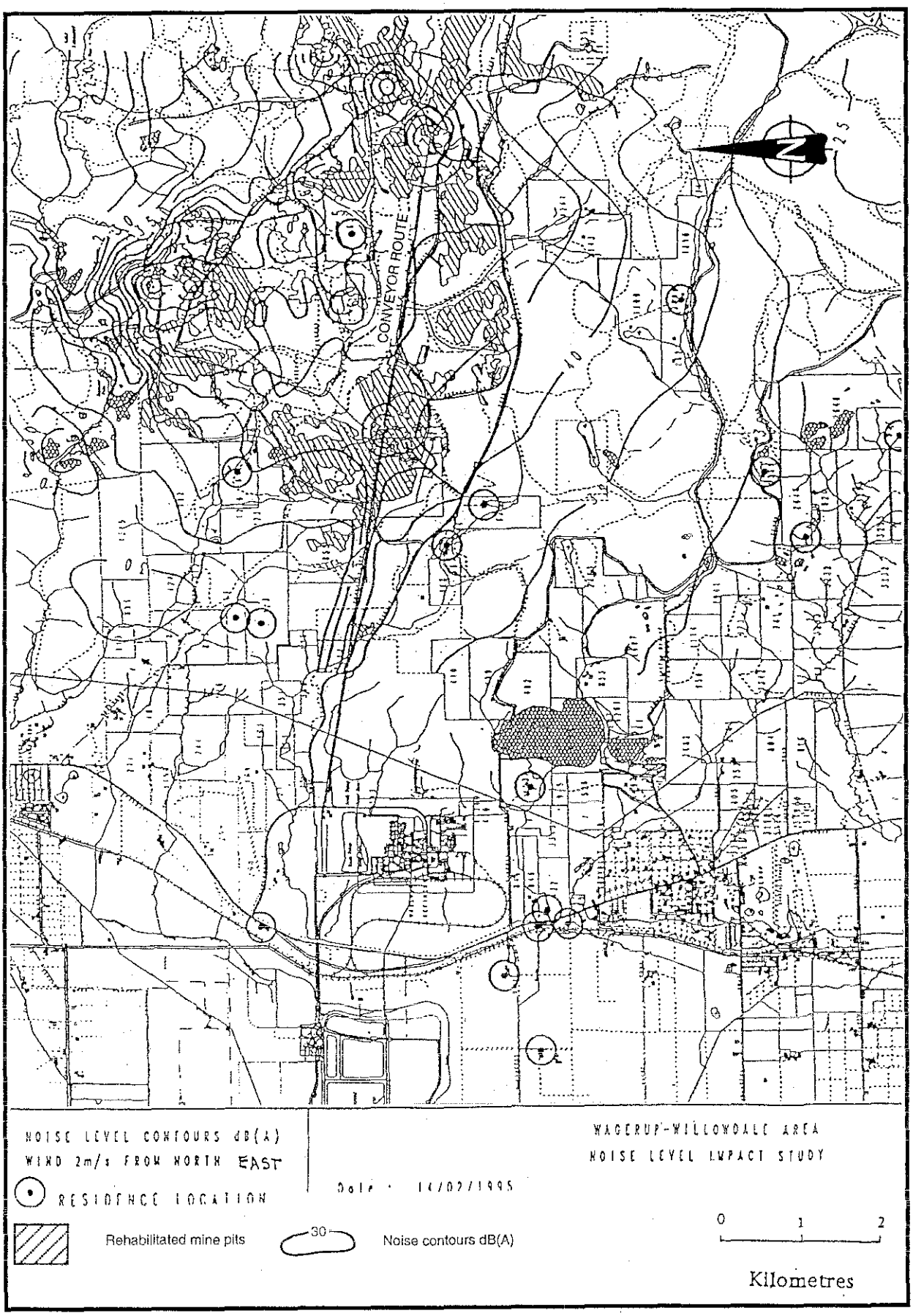


Figure 4. Noise level contours for worst case scenario around the Willowdale mine site with a light north easterly breeze. (Source: HSA report)

- prepare a noise management plan for operations within any area subject to the noise management procedure, to be included in subsequent five-year mining and management plans submitted to the MMPLG.

4.1.5.5 Evaluation

The EPA recognises the concerns of nearby residents regarding noise from the bauxite mining operations. The EPA notes the advice of the DEP based on recent noise modelling predictions, that there are likely to be breaches of the existing noise regulations occurring in relation to the current mining operations and the overland conveyor. The EPA notes that such exceedances are likely to become more frequent under the proposed expansion unless appropriate noise reduction measures are taken in relation to the mining operations and the overland conveyor.

The EPA notes the involvement of the DEP in getting the proponent to acknowledge and address the noise impacts created by bauxite mining activities, with the end result being a number of comprehensive commitments by the proponent.

The EPA accepts as reasonable, the proponent's commitments on noise in relation to bauxite mining and the associated operations. The EPA considers that the proponent's commitments would need to be fully implemented, in consultation with the DEP and to the satisfaction of the EPA, to ensure that this issue is satisfactorily addressed. Additionally, the EPA considers that, where appropriate, critical aspects of these commitments should be implemented before commissioning of the additional facilities for the proposed expansion at the refinery.

4.1.6 Impacts of bauxite mining on the local community

4.1.6.1 Objective

The Environmental Protection Authority's objective is to ensure that the amenity and lifestyle of the local community is not substantially affected by the bauxite mining operations and associated activities.

4.1.6.2 Evaluation framework

Existing Environmental Conditions and commitments

Alcoa committed in 1989 (Appendix 7) to co-operate in a joint community services programme in conjunction with the State and the Shire of Waroona to monitor socio-economic effects of the project and provide input for community services planning.

Technical information

Bauxite mining operations associated with the Wagerup refinery have the potential to impact upon a significant number of residences and property owners in the Darling Ranges. The location of private residences in close proximity to current and future bauxite mining operations for the Wagerup alumina refinery are shown in Figure 5.

The CER states that the mining operations generally do not impact significantly on local and regional planning other than that related to forest management. Matters such as the realignment or temporary closure of forest roads used by the general public will continue to be discussed with the Shires of Waroona, Harvey and Murray and property owners on a case by case basis.

The CER acknowledges that Willowdale North differs from the current mining area in that some of the operations will occur relatively close to valuable public recreation and tourism assets. Maintaining access to and enjoyment of these assets is an important consideration in local and regional planning. Alcoa has broadened its normal mine planning consultation process for Willowdale North to include the Shire of Waroona, Peel Development Commission and Lane Poole Reserve Advisory Committee.

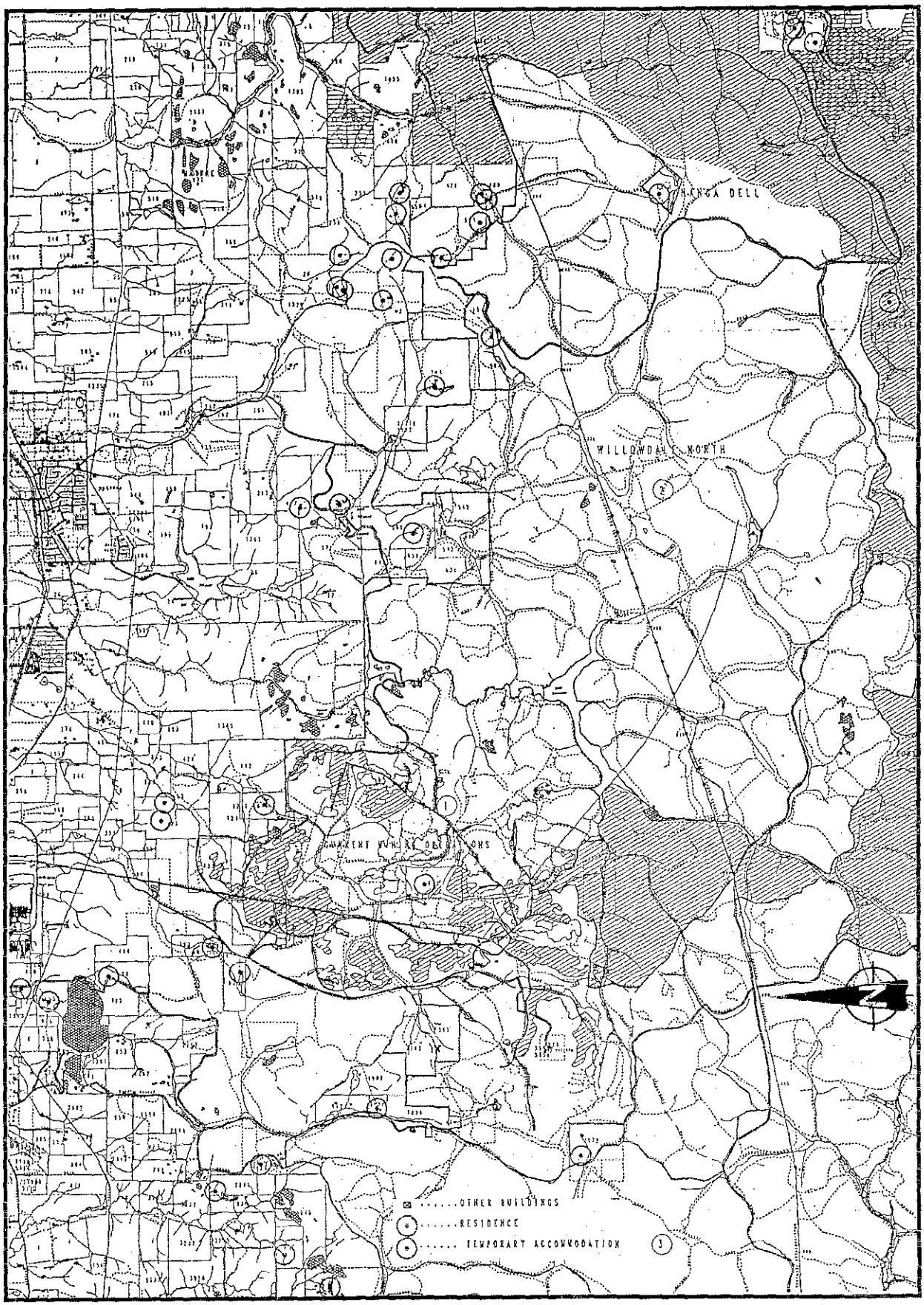


Figure 5. Location of private residences in close proximity to current and future bauxite mining operations for the Wagerup alumina refinery. (Source: proponent's response to submissions)

The company provides information and makes submissions to assist agencies such as CALM, the Department of Planning and Urban Development, the South West Development Authority and the Peel Development Commission to formulate regional plans. In addition to five year mining plans, Alcoa provides the MMPLG with preliminary ten year plans and conceptual 25 year plans.

The CER states that consultation by Alcoa with neighbours and others likely to be directly affected by the future operations is included as part of the planning process.

No additional commitments in relation to community impacts were made by the proponent for this CER.

4.1.6.3 Submissions

Submissions from government agencies

No submission was received from the Shire of Waroona, which covers most of the Willowdale North area. The Shire of Harvey, which covers bauxite areas to be mined after Willowdale North, has reviewed the CER and has no objection to the proposal.

CALM raised the issue of socially based research into community values and preferences in relation to rehabilitation (Section 4.1.2.3).

The DEP has indicated that noise impacts from bauxite mining operations are likely to affect the local community more than most other environmental impacts. In its assessment of the acoustic modelling report by HSA (Appendix 9), the DEP indicated that those properties within 4 km of mining operations could be affected by mining noise, aside from the effects of blasting.

The DEP has advised that the concerns of local residents would be lessened if Alcoa consulted more widely than at present, particularly with the owners of properties within 4 km of its current and proposed mining operations. The DEP has suggested that any residual areas of local community concern should be addressed by the MMPLG in its review of the company's mine plans.

In relation to buffer zones to protect the amenity and lifestyle of private properties from mining impacts, the DEP has advised that, prior to the commencement of operations in an area, Alcoa should have determined buffer distances appropriate for its various operations. In addition to factors of importance to the company, other issues that concern local property owners should be taken into account, including likely noise, vibration and dust impacts on residents and property from the type of mining proposed, aesthetic and conservation values of the forest affected in relation to the properties, and potential hydrological impacts. The DEP advised that Alcoa should prepare a plan, in consultation with the DEP and the affected local authorities, detailing buffer distances appropriate for its various operations, to meet the requirements of the Minister for the Environment within 12 months of approval of the proposed expansion.

Public submissions

Six submissions were received regarding the existing and potential impacts of bauxite mining on the local community and recreational users of the forest. Most of the submissions raised concerns about noise and dust from blasting and machinery. Other concerns raised included potential impacts on water supplies, existing and planned businesses, general amenity of the area (due to peace and quite, scenic beauty), traffic and road access. A number of submissions suggested the use of 0.5 to 1.0 km buffer zones around their properties, regardless of the ability of the company to manage noise levels. Two submissions acknowledged the consultation efforts of the company, and one submission objected to being excluded form the consultation process in relation to mine planning. Most submissions accepted the bauxite mining operations as inevitable. One submission considered that there should be some form of redress or compensation for damage and loss of facilities and enjoyment.

4.1.6.4 Proponent's response to submissions

The proponent's responses to potential impacts on private water resources and noise impacts have been addressed earlier in this report (Sections 4.1.4.4 and 4.1.5.4). Detailed responses to other community impacts are provided in Section A9 of Appendix 4.

In relation to potential impacts of mining on the amenity of the Willowdale North area, the company has responded:

> "The company believes its operations can be managed in a way which will leave amenity values in Willowdale North at least equivalent to those existing now. ....Community input will be sought through surveys and discussions with the Lane-Poole Reserve Advisory Committee and key user groups."

In relation impacts on the beauty, peace and quite of local residents, the company states:

> "Alcoa understands that some local property owners may feel that the presence of mining operations is unacceptable under any circumstances because of possible disruption to some of the attributes which attracted them to the area. This view must be balanced against the very substantial economic benefits which accrue to the state and nation from the operations. It must also be balanced against Alcoa's own rights as embodied in various Agreement Acts ratified by the Parliament of Western Australia. Alcoa was granted the mineral lease which includes the Willowdale North area 34 years ago. Many property owners would have purchased their land within or adjacent to a pre-existing mineral lease."
>
> "Alcoa has a long history of working co-operatively with neighbours to resolve differences whenever possible, and will continue to operate in that manner."

In relation to the extent of community and neighbour consultation for mine planning undertaken by the company , the company has responded:

> "Neighbours are consulted on issues affecting them directly and are invited to an annual open day in which the proposed 5 year mine plan is displayed and discussed. All immediate neighbours in the Willowdale North area who mine personnel have been able to contact have been or will be invited to tour the operations so that they may gain a better appreciation of what it involves and the environmental protection measures used."
>
> "In cases where broader community issues have been involved, such as the mining operations near Dwellingup in the early to mid 1980s, consultation has been of a more formal nature and involved a representative community group."
>
> "Alcoa believes the public environmental assessment process now in progress, and the consultation processes mentioned above, provide ample opportunity for input to relevant aspects of mine planning by neighbours and local communities who could be directly affected by the operations."

The company has indicated that details on monitoring results, complaints by the public and changes to environmental management are provided in its annual and triennial Reviews of Environmental Research and Operations to the State Government. The Triennial reviews are more comprehensive and are placed in the EPA library for perusal by the public. In more recent years Alcoa has also provided copies to the local authorities and district libraries nearest the operations.

Compensation for damage caused by the company's operations is not an issue within the EPA's scope. Alcoa has pointed out benefits to the community from its operations, such as its post mining rehabilitation and dieback forest rehabilitation programs, which are expected to enhance the health and amenity of degraded forest areas.

Alcoa has provided responses to other more socio-economic issues, such as security of residents and their properties, impacts on businesses, property access and road upgrading.

4.1.6.5 Evaluation

The EPA notes the concerns of the local community in relation to the current and proposed expanded operations.

The EPA notes also the efforts undertaken by the company to consult with the local community and the measures implemented in its planning and operations to minimise its impacts in the likely areas of concern. The EPA has considered previously in this report (Section 4.1.5.5) the additional commitments given by the company to manage noise issues, in response to the DEP's review of its acoustic modelling report.

The EPA considers that the impacts of bauxite mining and associated activities on the local community are manageable, conditional upon Alcoa undertaking wider consultation and addressing the community's concerns in the preparation of its mining plans (Recommendation 4) and adhering to appropriate buffer zones (Recommendation 5). To ensure that any residual areas of local community concern are addressed, the EPA considers that the MMPLG should seek and consider the views of affected owners within 4 km of its operations, prior to advising the State on the acceptability of these plans.

4.1.7 Other mining related issues

The following issues were also raised in several of the submissions. The proponent has provided detailed responses to these issues in Section A4 and Section A7 of Appendix 4.

Dust control

Five submissions raised concerns about the potential for dust created from bauxite mining activities to affect their amenity.

The proponent has acknowledged the potential for mining operations to create dust in localised areas around mine-pits, haul roads and crusher sites. The increased number of truck movements between the mine-pits and the crusher would be a potential source of additional dust, but this would be controlled by watering of haul roads and other conventional dust suppression method such as soil stabilisation around heavily trafficked areas.

The EPA did not seek a specific response from the proponent in relation to dust management, but has dealt with the issue in Section 4.1.6 (Impacts of bauxite mining on the local community). The proponent has provided responses to community impacts in Section A9 of Appendix 4.

The EPA considers that dust impacts created by bauxite mining activities on the local community are manageable by the implementation of the company's normal dust suppression management, undertaking wider consultation in the preparation of its mining plans (Recommendation 4) and adhering to appropriate buffer zones (Recommendation 5).

Utilisation of forest wastes

One submission queried the type and quantity of waste generated from forest clearing, after commercial timber had been extracted.

The proponent responded that timber harvesting contractors supervised by CALM currently salvage all merchantable product from Alcoa's minesite clearing. Some stumps and hollow logs are stockpiled for future return during the rehabilitation process. The company indicated that only material which is uneconomic to harvest using current equipment and technology is burnt. The volume of material involved has not been quantified.

In relation to utilisation of the waste, the company responded:

> "CALM, Alcoa and other interested groups are continually searching to find viable uses for the waste material. Chipping of the green residue for particle board manufacture is a promising recent development. The Wesfi company has successfully used chip from small diameter jarrah and marri blended with softwood chips to produce medium density fibreboard. This high quality product has potential to satisfy a growing domestic and

overseas market. Its commercial viability and the suitability of waste from minesite clearing as a source of chips are being investigated."

Sustainability of bauxite mining operations

In response to the Conservation Council's claim that bauxite mining is "the epitome of unsustainable activity", the company has responded that sustainable development can be broadly defined as development that meets the needs of the present generation without compromising the ability of future generations to meet their needs. The company specifically commented:

> "The extraction of minerals is compatible with this concept of sustainability provided rehabilitation after mining restores an appropriate land use capability. Mining can be viewed as a temporary land use which does not compromise other land uses in the long term. ...While bauxite is a non-renewable resource, the aluminium which is the eventual product of bauxite mining is either put to a permanent use, or is used and recycled. In fact, one of the great benefits of aluminium is that it can be recycled indefinitely using a small fraction of the energy input required to produce the primary metal."
>
> "Economic development, including bauxite mining, generates community prosperity which provides both intra- and inter-generational benefits. Economic development creates a store of cultural, scientific, educational and other accomplishments, along with physical infrastructure, which future generations inherit."

Relinquishment (by the State) of areas previously sterilised for environmental reasons

In response to a concern that there could be pressure put on the State to relinquish areas previously sterilised for environmental reasons, Alcoa responded that its corporate values are such that it would not seek to gain access to previously "sterilised" bauxite reserves unless it felt confident that the factors causing the sterilisation no longer applied. In relation to agreed conservation areas, the company responded that access for purposes other than ore transport will not occur while their conservation values remain.

More efficient use of bauxite resources

The DEP queried the potential for more efficient use of the bauxite resource. Alcoa responded accordingly:

> "It is in Alcoa's interest to maximise the recovery of ore from any area in an attempt to minimise both environmental impact and development costs. The alumina cut off grade has been lowered over the years to a point where any further reduction would compromise the economic viability of the operations. It should be noted that alumina cut off grade, while being important, must be balanced with several other parameters which affect economic recovery of alumina from the bauxite ore."

Environmental criteria in mining decisions

In response to the DEP's queries regarding what environmental criteria are considered by Alcoa alongside economic and other criteria when making decisions to mine particular areas, ore bodies, or parts thereof, the company responded that environmental criteria are considered and evaluated on an ongoing basis and at a range of scales. On a regional scale, these include agreement not to mine bauxite System 6 conservation reserves and a commitment that bauxite mining will not take place in the eastern, lower rainfall portion until research shows that the operations can be conducted without significantly increasing the salinity of water resources. The company reiterated a number of operational procedures identified in the CER, which it used to minimise its impacts on the environment and local community.

Alcoa summarised it's overall objective as

> "to extract as much of the available bauxite as possible, consistent with responsible management of the operations both socially and environmentally. To do otherwise would represent a poor utilisation of the State's mineral resources and unnecessarily expand the perimeter of the active mining area, with consequent impacts on other land uses."

Aboriginal heritage

In response to what specific consultation had occurred with Aboriginal people to identify any additional sites of Aboriginal heritage significance, Alcoa responded that the CER states that field archaeological and ethnographic surveys would be undertaken. The company indicated that archaeological surveys had now been completed and Alcoa has received a draft report. The ethnographic studies are currently being conducted, and will include consultation with Aboriginal people to identify any sites of Aboriginal heritage significance.

Evaluation

With respect to these other issues, the EPA proposes no further recommendations to the proponent's commitments.

4.2 Assessment of alumina refinery related impacts

4.2.1 Noise from refinery and transport operations

4.2.1.1 Objective

The Environmental Protection Authority's objective is to ensure that operations associated with the Wagerup alumina refinery do not exceed the relevant environmental protection noise standards. In so doing, the health and amenity of surrounding residents should not be unacceptably affected by noise emissions from the refinery operations.

4.2.1.2 Evaluation framework

Noise regulations

The EPA's evaluation of noise impacts is based on the DEP's advice in relation to the draft Environmental Protection (Noise) Regulations 1995. For a more detailed discussion on noise legislation, refer to section 4.1.5.2 on mining-related noise. In this context the Maximum Allowable Noise Levels at night-time, for residences around the refinery, would be in the range 35 to 40 dB(A) (with additional adjustment for tonal components), depending on the land use zonings surrounding the residences.

Technical information

Alcoa made the assumption in its 1978 ERMP that measured noise levels at various locations around the existing Pinjarra refinery would provide a reasonably accurate indication of the noise levels that were likely to occur in the Wagerup area once the refinery was operating. Results at the time indicated that the average equivalent continuous sound level (Leq) of six sites located 3 - 5 km from the Pinjarra refinery was 47 dB(A).

The current CER quotes noise levels at two points on Boundary Road on the northern perimeter of Yarloop, approximately 2 km south of the Wagerup refinery, measured on 28/6/93 in response to a complaint. Noise levels were 38 and 42 dB(A) respectively, and a low frequency component was noted. Investigations were initiated by Alcoa into means of lowering the tonal noise output for the source concerned, which was identified as the blower in the calcination building.

Noise monitoring at points on the property boundary and beyond is performed by Alcoa in response to any increase in general noise levels noted by employees or from external complaints. The CER stated that noise complaints from the public are now infrequent, indicating the overall success of the management strategies adopted. Nine complaints about noise were recorded in the 1984-86 triennium, and only one in the 1991-93 triennium.

4.2.1.3 Submissions

Comments from key government agencies

The DEP, as the key government agency with expertise in assessing environmental noise impacts, was concerned that the existing refinery operations may be causing excessive noise and considered the CER to be lacking in detail in this regard. Consequently, the DEP requested further information in relation to locations of nearest residences and predicted and measured noise levels encompassing these nearest residences; and also in relation to road and rail movements.

This information was subsequently provided and the issues further addressed in the report by Herring Storer Acoustics (HSA) dated February 1995. The DEP's report is provided in Appendix 9.

Refinery noise

The HSA report predicted noise levels around the refinery using a computer model which utilised sound power level data for refinery equipment and digitized topographic data. The HSA model relates to the proposed upgraded operations, for which the noise levels are predicted to be only 1 dB(A) above the existing levels. The model was confirmed by noise level monitoring at Bancell Road and showed that the noise level from the existing refinery on 18 January 1995, was approximately 47 dB(A). Figure 6 describes the predicted noise level contours for worst case conditions with a light northerly breeze.

The HSA report also demonstrated that the noise character is tonal at 500 Hz, which would increase its annoying effect. In terms of the nearest residence, therefore, it is apparent that the existing operations and the proposed expansion may result in a significant exceedance of both the current and proposed noise regulations.

The DEP also advised that, under a worst case scenario (light northerly breeze) there would be significant noise impacts on other residences to the south of the refinery, extending well into the Yarloop townsite, under both the existing operations and the proposed expansion.

The DEP recommended that a noise management plan be prepared for the refinery. The aim of this plan would be to reduce the noise levels of the existing refinery to enable it to comply with the proposed draft noise regulations by the time of start up of the expanded operations.

Transportation noise

The DEP also identified significant noise impacts in relation to transportation operations, in particular train movements between the refinery and Bunbury and the trucking of lime to the refinery at night through the towns of Pinjarra and Waroona. These issues were addressed in some detail in the HSA report and in the DEP report.

In relation to rail noise from the refinery loop, this was found in both reports to meet acceptable criteria.

Noise from rail traffic between Wagerup and Bunbury was assessed by HSA in terms of predicted increases resulting from the expansion, which were found to be negligible. While the DEP agreed with this finding, it noted that the current levels were in excess of generally accepted criteria of a maximum level for any event of 80 dB(A) and an "average" level of 55 dB(A). These levels are exceeded within 135 metres from the track under the existing operations, increasing to 153 metres under the proposed expansion. To reduce the likelihood of sleep disturbance, the DEP suggests that planning authorities should consider a more stringent criterion of a maximum level of 65 dB(A) for any event, for new residential developments. This level may be exceeded up to 400 metres from the railway line. The DEP recommended that a study of rail noise be undertaken to identify the extent of the noise impact along this route and options for practical ameliorative measures, either through noise reduction measures at the railway line or through building design.

The DEP report points out that, while the noise impacts due to traffic are not the responsibility of the proponent once the traffic leaves the premises, the impact of traffic associated with the

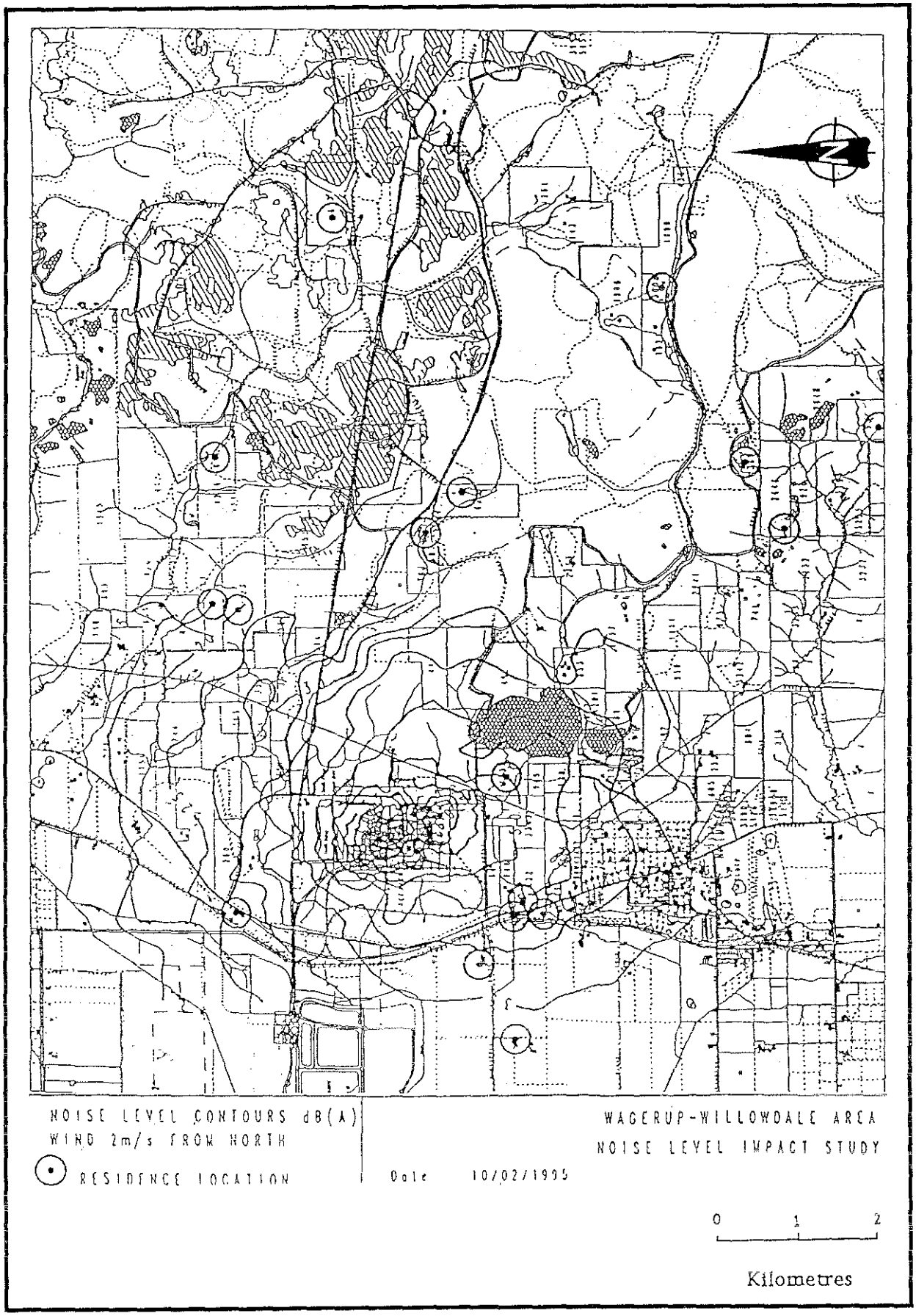


Figure 6. Noise level contours for worst case scenario around the Wagerup Refinery with a light northerly breeze. (Source: HSA report)

proposal is clearly identifiable. Consequently, the DEP considers that the proponent has a duty to take whatever measures are practicable to minimise this impact.

Noise from rail traffic into the Bunbury port would not result in a significant impact, according to the DEP report, since there are no known residences within a distance of approximately 100 metres from the track, where the acceptable criteria may be exceeded. However, both this distance and the 400 metre distance related to the "planning" criterion mentioned above should be noted by the City of Bunbury in considering proposals for future residential development.

In relation to the noise of lime trucking operations, the DEP found that, while the increase in noise levels as predicted by HSA will be small, the absolute levels are significant. Using the DEP's criteria for traffic noise, the area affected by noise would increase from 150 metres to 160 metres on both sides of the road as a result of the expansion. The DEP also expressed concern that the hours of truck movements were likely to increase from 6.00 am - 2.15 am to 6.00 am - 3.45 am.

The details of the DEP's technical evaluation of the HSA report can be referred to in Appendix 9.

Public Submissions

Public submissions indicated concern that noise emissions emanating from the present refinery were affecting residents, particularly at night under certain wind conditions. The major noise issues raised were the public address system, various blower systems, the filling of bauxite storage silos and the impact of increased road and rail traffic.

4.2.1.4 Proponent's response to submissions

The DEP's assessment of the HSA report was made available to the proponent in March 1995 and as a consequence the proponent has responded with significant additional commitments to manage noise impacts associated with the existing operations and proposed expansion at the refinery.

Additional commitments made by the proponent

The proponent has made several detailed commitments in relation to the issue of noise, as a result of the DEP's assessment of the HSA report. With respect to the refinery, these commitments centre around:

- the commissioning of additional studies to verify predicted noise levels in the vicinity of the refinery;
- the formulation and implementation of a plan to reduce noise emissions from the refinery to meet the relevant noise regulations by the end of 1996;
- the periodic monitoring of noise levels at designated reference points and the reporting of results in the Review of Environmental Research and Operations which is submitted annually to the Department of Resources Development and relevant state and local government agencies;
- the designing of refinery plant and equipment associated with the expansion to meet the draft Environmental Protection (Noise) Regulations 1995 and to operate it in accordance with the environmental noise regulations promulgated subsequently;
- reviewing the proposed extension of the hours of its contracted lime trucking operation in consultation with the Shires of Waroona and Murray while taking into account relevant factors such as safety, noise, cost and traffic density; and
- reviewing contractual arrangements with the transport company to ensure all vehicles meet the current noise emission requirements.

4.2.1.5 Evaluation

The EPA recognises the concerns of nearby residents regarding noise from the alumina refinery. The EPA notes the advice of the DEP that recent noise modelling and measurements indicate significant breaches of the current and proposed noise regulations may occur as a result of the existing refinery operations and the proposed expansion. The EPA also notes the likely impact of rail and road traffic associated with the proposal and draws to the attention of the relevant local government authorities and State government transport authorities, the results of the assessment by the DEP.

The EPA accepts the proponent's commitments on noise emanating from the alumina refinery. Accordingly, the EPA has made no recommendation. However, the EPA considers that the proponent's commitments would need to be fully implemented to the satisfaction of the DEP to ensure that this issue is satisfactorily addressed. Additionally, the EPA considers that these commitments should be implemented before the commissioning of the expansion.

4.2.2 Dust from refinery, bauxite residue and transport operations

4.2.2.1 Objective

The Environmental Protection Authority's objective is to protect surrounding residents so that dust emissions will not impact upon their amenity or cause health problems.

4.2.2.2 Evaluation framework

Policy

Under the present pollution prevention licence, particulate point sources (namely the three calciner stacks and the oxalate kiln) are regulated at a limit of 250 mg/m^3.

The CER indicated that Alcoa uses an objective of 120 ug/m^3 for ambient dust levels around the bauxite residue areas. This is based on the recently reviewed Victorian State Environmental Protection Policy for the Air Environment and is used as an indicator of dust nuisance.

The WA Environmental Protection Policy (Atmospheric Wastes) (Kwinana) specifies an ambient dust limit (averaged over 24 hours) for land used predominantly for residential and rural purposes (Area C) of 150 ug/m^3 with a standard (a concentration which it is desirable not to exceed) of 90 ug/m^3.

Technical information

Particulate matter (largely alumina) is emitted from point sources within the refinery, namely the three calciner stacks and the oxalate kiln. During 1993, the mean monitored particulate emissions from the stacks were 15 - 39 mg/m^3 for the three calciners and 90 mg/m^3 for the oxalate kiln. Control of particulates discharged from calciner stacks is by multiclones (multiple small cyclones in parallel assemblages) and electrostatic precipitators (ESPs). The oxalate destruction kiln stack is controlled by use of a wet scrubber, which removes both particulates and gases effectively.

The CER stated that the expansion will ultimately include two additional calciners and increased throughput for the oxalate kiln. In addition, a process liquor burning facility, will also undergo an increase in production throughput. The CER indicated that the mass loading of particulates from these sources will increase, but will remain at levels which will not cause a significant increase in ambient dust levels outside the plantsite property boundaries.

Bauxite dust can be generated by wind action upon the bauxite stockpiles and spillages at transfer points within the refinery bauxite transportation system. The magnitude of the emitted

dust from such fugitive sources is variable and dependant on the frequency and intensity of strong drying winds.

Fugitive dust sources at alumina conveyancing transfer points are controlled by a negative pressure system and capture hoods and seals. Alumina dust can result from imperfect cleaning down of the alumina wagons. Modifications to improve wagon filling whilst preventing spillage from over-filling are to be introduced at the train loading stations.

One adverse consequence of the change to dry stacking, implemented in 1991, is the increased potential for dust generation. Accordingly, the EPA set as a Works Approval condition for the new dry stacking operation a requirement for a programme of dust monitoring around the residue area. The CER stated that the impacts of ambient dust excursions from the residue storage area are relatively low, and comprise infrequent exposure of nearby properties to nuisance dust, usually at times when general background dust levels arising from strong winds are also present. The predominant constituents of residue dust are alumina, silica and iron oxide minerals with minor amounts of sodium carbonate. At the levels indicated and for the typical particle size distributions associated with windblown dust, no adverse health effects are expected.

The CER identifies a number of techniques used to control dust emissions around the bauxite residue areas. A network of sprinklers has been installed across the drying beds and are used to dampen the surface of the mud prior to a wind event and again during a windy period if required. A buffer area has been defined around the residue disposal area and public access ways and residential areas to minimise the public impact of dust, noise and visibility. Five hundred metres was allowed adjacent to the South West Railway and generally a minimum of 200m from secondary boundary roads and neighbouring properties.

The CER indicated that due to the larger active bauxite residue drying area required after the expansion, the potential for dust generation will increase and that it will be necessary to give close attention to all the dust management procedures.

4.2.2.3 Submissions

Comments from key government agencies

The Health Department of Western Australia, as the expert government agency in relation to public health, has submitted that it is unlikely that aluminium oxide dust could cause serious respiratory effects, unless exposure to particles of respirable size was high. However, it indicated that it is possible that dust containing alkaline compounds could affect respiratory tissue adversely. This would depend on the pH, the dust particle size and the extent of the exposure. The Health Department also stated that a more detailed analysis of these parameters, as well as medical opinion on the symptoms described in the public submissions was required to determine whether or not the dust from the Alcoa operations was the cause.

In relation to the concerns of neighbours regarding excessive dust emissions from the refinery operations, the DEP has advised that the proponent should put in place a programme to improve dust management. The objective of the programme should be that ambient dust levels meet the requirements of the Environmental Protection Policy (Atmospheric Wastes) (Kwinana) for Area C (rural and residential areas). The DEP has advised that preparation of this dust management programme should be a condition of the Works Approval for the proposed expansion.

Public Submissions

Public submissions expressed concern about how dust emanating from the refinery and bauxite residue storage areas could impact upon the health and quality of lifestyle of nearby residents. Details were provided of the increased levels of upper respiratory problems experienced by nearby residents and those living in Yarloop and Waroona, which were thought to be attributable to dust from these sources.

One substantial submission highlighted several concerns about dust emissions from the bauxite residue storage areas. Anecdotal evidence was provided about how dust pollution from the bauxite residue storage areas where the dry stacking method was employed, have reduced

visibility down to approximately 400m on several occasions. The placement of dust samplers around the bauxite residue storage areas was considered to be inadequate in terms of allowing an accurate assessment of the overall dust problem, as it had failed to take into account the effect of strong intermittent winds from other directions such as north and north-east. The potential for dust and particulates from the refinery and bauxite residue storage areas to settle onto the roofs of homes and other buildings and subsequently pollute the rainwater that is collected for drinking purposes was also of concern.

The incidence of alumina dust blowing off trains leaving the refinery and the nuisance it causes to nearby residents was also detailed in several submissions.

4.2.2.4 Responses from the proponent

In response to the concerns expressed in the above public submissions (Section B2 of Appendix 4), the proponent made the following comments:

> "Alcoa considers it important to investigate any complaints from a neighbour and would be particularly concerned to investigate a complaint where a possible health issue was involved. The company is not familiar with the situation described above and finds it difficult to respond in a meaningful way on the basis of the limited information provided."
>
> "The main type of dust associated with an alumina refinery is calcined alumina dust. Calcined alumina (aluminium oxide) is the principal product of the refinery. Small quantities of it become airborne during various production, transport and transfer operations."
>
> "Reviews of clinical studies on the inhalation toxicology of alumina dust have led the U.S. Occupational Safety and Health Administration and similar organisations to conclude that alumina dust is nothing more than a nuisance dust with no unique toxicological properties. As a consequence, the exposure standard applied by international, national and state authorities is the same as that for other inert or nuisance type materials. Many substances commonly used in agriculture and building materials, such as limestone and gypsum, fall into this category."
>
> "The red coloured dust which sometimes emanates from the residue storage area under strong wind conditions is primarily fine sand and silty material consisting of hydrated iron oxide, alumina, clays and other inert mineral compounds....Sodium bicarbonate becomes alkaline on contact with moisture and in sufficient quantity can become an irritant to mucous membranes. Studies at Kwinana by the W.A. Department of Agriculture found no adverse effects of residue dust on horticultural crops other than appearance."
>
> "A continuous sampler was installed on the south-eastern corner of the residue storage area in 1993, to sample dust loads from the northerly and north-westerly winds....The average dust level recorded in the south-eastern automatic sampler during 1993 was very similar to background levels; but strong winds do sometimes cause dust to be generated off the residue areas....Residue area dust control measures have been and will continue to be improved as new techniques are developed and implemented."
>
> "The refinery is aware of the problem of alumina dust blowing off trains. As indicated in the CER, the problem is thought to have mainly been associated with trains loaded at Pinjarra. Upgrading of the loading facilities at Pinjarra was completed at the end of November 1994. The upgrading work is expected to largely eliminate the overfilling problem which was the main cause of the dust accumulation on the wagons."

4.2.2.5 Evaluation

The EPA notes the concerns of neighbours regarding excessive dust emissions from the refinery operations. **The EPA believes that the proponent should put in place a programme to improve dust management as a condition of the Works Approval**

for the proposed expansion. The objective of the programme should be that ambient dust levels meet the equivalent of the Environmental Protection Policy (Atmospheric Wastes) (Kwinana) for Area C (rural and residential areas) (Recommendation 6). Final conditions for dust levels can then be set under Alcoa's licence (Part V of the Environmental Protection Act, 1986).

In relation to any potential public health effects associated with exposure to the alkaline components of fugitive red dust emissions emanating from the bauxite residue storage areas, the EPA considers that this is a matter for resolution between the Health Department and the proponent.

Notwithstanding the above, the EPA believes that dust impacts from the existing and proposed expanded operations are manageable, contingent upon the successful implementation of the dust management programme.

4.2.3 Air emissions and odours

4.2.3.1 Objective

The Environmental Protection Authority's objective is to ensure that gaseous emissions and odours do not cause unacceptable impacts upon the environment and the health and the amenity of residents living in the area surrounding the proposed refinery.

4.2.3.2 Evaluation framework

Policy, conditions and commitments

The current proposal is subject to condition 4 of the Minister's statement of 8 March 1990 (Appendix 7), which requires the proponent to consider minimising greenhouse gas emissions in the selection of energy generation options. The proponent has not made any further commitments as a result of this proposal. There are no licence conditions for air emissions or odours.

The National Health and Medical Research Council (NH&MRC) guidelines require that the ambient concentration of nitrogen dioxide (NO_2) does not exceed 170ppm (as a one hour average, and not to be exceeded more than once a month).

Australia is a signatory to the 1992 United Nations Framework Convention on Climate Change, That Convention seeks "developed nations" - which Australia is deemed to be - to stabilise its greenhouse gas emissions (based upon the year 1990) by the year 2000, and to reduce emissions progressively thereafter.

An outcome of the 1992 Council of Australian Governments was that Australia would commit itself to undertaking measures to reduce greenhouse gas emissions through stabilisation by the year 2000, based upon 1988 levels, and to reduce them by 20% by the year 2005.

Australia reported to the recent Berlin (March 1995) Conference of Parties on the UN Convention on Climate Change, that with gas limitation measures already introduced, Australia would most likely increase its emissions by 7% above 1990 levels by the year 2000. At the Conference Australia indicated that it would commit itself to further measures resulting in emissions about 1% above the 1990 levels by the year 2000. Within this context, State by State contributions have not been determined.

Technical information

Nitrogen Oxides (NO_x)

Combustion of natural gas at temperatures above 1300°C results in the formation of oxides of nitrogen (NO_x). The principal gas present is nitric oxide which oxidises in the atmosphere to form NO_2. The acidic property of this gas causes a stinging odour at higher concentrations and

has a potential to be a respiratory irritant. If present with typical urban levels of non-methane hydro-carbons and sunlight, the result can be the formation of a photochemical smog.

NO_x monitoring data reported in the CER indicated a mean range of 36-65ppm for calciners and 82-153ppm for powerhouse boiler emissions.

The CER stated that Alcoa is focussing attention on low NO_x technologies wherever they are available, in order to keep emissions at a very low level. The proponent expects that the powerhouse boilers and calciners included in the expansion will perform well below the NHRMC(1985) guideline. Other combustion processes (liquor burning and oxalate destruction) occur in conditions that are unfavourable for NO_x formation, and as a result emissions are generally low.

The proponent is aware of considerable research into burner technology, fuel and air staging and flue gas recirculation. The proponent has undertaken to adopt appropriate aspects of these systems and technologies once developed to commercial scale in new work specifications, and in significant maintenance overhauls and upgrades. The proponent has proposed to adopt low NO_x burners for this expansion.

Sulphur Dioxide

Sulphur is not present in natural gas, but comprises about 3.2% by weight of the fuel oil held at Wagerup to cope with emergency requirements should the natural gas supply line be interrupted. Fuel oil is otherwise mainly used in test burns to confirm the operability of equipment. The low frequency of test burning and low emission rate when burning is such that no significant effect is expected to accrue to ambient sulphur dioxide concentrations near the plant.

Greenhouse Gas Emissions

Alcoa advised the EPA on 21 December 1994 that it proposed to install a frame 6 gas turbine plus a fully fired 190 t/hr heat recovery generator, in place of the 250 t/hr high pressure boiler and 30 MW turbo-alternator referred to in the CER. This would enable the expanded operation to operate independently of the SECWA grid. The additional energy consumption for the proposed expansion would therefore result in an additional emission of 750,000 tonnes of CO_2 per year, or an additional 69% of the current output. However, the proponent points out that the additional power generated at Wagerup would displace power primarily generated by less efficient coal-fired units operated by SECWA and, as a consequence, the total emissions of CO_2 would decrease by between 50,000 and 120,000 t/yr from that initially proposed in the CER.

Other greenhouse gas emissions from the refinery include methane (leakage from natural gas supply lines and unburnt fuel) and minor and diminishing quantities of CFC leakage from refrigeration, foam insulation and general solvent applications. Releases of methane within the refinery are managed by continual optimisation of combustion processes to ensure high combustion efficiency and ongoing monitoring of natural gas supply and distribution mains to keep leakage to a low level.

The CER states that the Wagerup refinery is one of the most energy efficient alumina refineries in the world. Alcoa's W.A. alumina system achieved an improvement in energy efficiency of 12% between 1978 and 1987. The enhancement (second) stage of the proposed expansion is expected to result in a further 10% improvement in energy efficiency at Wagerup.

Odour

The refining of bauxite ore by dissolution in caustic soda causes evolution of some odours due to the hydrolysis of organic matter within the ore matrix. The CER states that the problem of odours would be addressed by the management of organic impurities in the bauxite ore, and by paying attention to the key factors within the process which give rise to odour.

4.2.3.3 Submissions

Comments from key government agencies

The DEP, which is the expert government agency on gaseous emissions affecting the environment, requested further information than was provided in the CER, prior to undertaking its assessment. This information was subsequently provided to the DEP in the response to submissions (Section B3 of Appendix 4). The DEP also asked the proponent to address implications of the proposed expansion on national greenhouse gas emission targets. In its subsequent assessment, the DEP has advised that there was is little likelihood of air emissions from the expanded operations of the refinery adversely affecting nearby residents.

Public Submissions

Public submissions expressed concern about how air emissions from the refinery could impact upon the health of nearby residents. Details were provided of the increased levels of upper respiratory problems experienced by nearby residents and those living in Yarloop and Waroona. These problems, which are thought to be attributable to harmful air emissions from the existing refinery, have been addressed in Section 4.2.2.3.

Public submissions also expressed concern about how pungent chemical odours emanating from the refinery under still and humid weather conditions were affecting nearby residents.

Several submissions highlighted concerns relating to the increased production of greenhouse gases from the refinery as a consequence of its expansion in production capacity and resulting greater consumption of natural gas.

4.2.3.4 Responses from the proponent

The proponent provided detailed responses to concerns relating to air emissions and odours that were expressed in submissions received from both the public and the DEP (Section B3 of Appendix 4)

In response to the concerns expressed about odours, the proponent made the following comments:

> "Odours from alumina refineries are the result of a complex interaction of gaseous emissions at extremely low concentrations. No monitoring system capable of detecting these emissions with anywhere near the sensitivity of the human nose exists."
>
> "Alcoa has a program of monitoring and research and development to identify and characterise the sources of odours and develop measures to control them. The program is based at the Kwinana refinery. Any practicable developments applicable to the Wagerup situation will be adopted."

In response to concerns that the emission of greenhouse gases from the refinery would rise as a result of the increased alumina production and consumption of natural gas, the proponent stated that, because of Wagerup's position as a low energy consumer when compared to the world average, a significantly lower amount of CO_2 is emitted in relation to the amount of energy used as compared to overseas operations. An increase of approximately 0.2% on the 1990 national total carbon dioxide emission would occur. However, this would be accompanied by increased efficiency of energy use and lower production normalised emission rates.

In response to DEP's concerns about the sulphur content of the fuel oil, Alcoa responded that the emergency fuel oil supply contains 3.2% sulphur which , although a moderately high sulphur type fuel oil, is considered adequate for the Wagerup emergency fuel situation where the refinery is the only major industrial facility in the area.

4.2.3.5 Evaluation

The EPA understands that the refinery has the potential to generate odour. However, on advice from the DEP, it considers this issue to be manageable, subject to the proponent implementing

its stated undertaking to adopt corrective measures which may be identified as a result of its research and development program based at Kwinana refinery.

The EPA notes that the expanded proposal will contribute to more greenhouse gas emissions to the environment. The EPA understands that this proposal is in response to a global demand for alumina which would be produced elsewhere if not produced at Wagerup. In considering this issue, the EPA notes that the proponent's claim that the Wagerup Refinery is one of the most energy efficient alumina producers in the world. Should the proposed expansion proceed, the EPA considers that it would be more desirable for this additional alumina demand to be met from an efficient refinery, such as Wagerup if this is the case. As a consequence, the relative greenhouse gases emitted for this increased production would be lower on a global scale.

The EPA believes that the current NH&MRC guidelines for NO_x emissions should be used as an upper limit for assessing the performance of the proposed expansion. The EPA's view is that current technology can easily achieve lower emission limits than the NH&MRC guidelines and considers that proponents should choose best engineering design and practice to better this.

The EPA strongly endorses the proponent's decision to incorporate low NO_x burners for this expansion and its undertaking to adopt appropriate aspects of the state of the art in burner, fuel and air staging, and flue gas recirculation technology in new works specifications, and in significant maintenance overhauls and upgrades.

The EPA considers that gaseous emissions from the proposed expanded operation at the Wagerup refinery would be manageable and acceptable, conditional upon the proponent providing quantitative details of its control of greenhouse gas and NO_x emissions from the refinery in its annual reporting of environmental research and operations (Recommendation 7).

4.2.4 Long term management of bauxite residue

4.2.4.1 Objective

The Environmental Protection Authority's objective for long term management of bauxite residue is to ensure that residue areas are rehabilitated to an acceptable standard that is consistent with the intended land use, and that a walk away solution is developed, such that there is no long term liability to the State.

4.2.4.2 Evaluation framework

Existing conditions and commitments

In 1989, the proponent committed to:

- develop a walk-away solution for the bauxite residue disposal site within 12 months of the commencement of the expanded operations;
- prepare design reports on future residue disposal areas which include consideration of slope stability, seepage control groundwater monitoring and construction and operating procedures; and
- develop long-term management plans for the residue deposits including consideration for surface drainage, seepage control, groundwater management, slope stability, surface rehabilitation, aesthetic impact and future land use.

Technical information

Since the EPA's assessment of Wagerup operations in 1989, there has been a change from wet to dry storage (sometimes known as dry stacking) of the bauxite residue. Dry stacking has significantly reduced the risks associated with residue storage. The area of land exposed to

residue in the longer term will be less and the amount of free alkaline solution contained in the slurry distribution system and storage areas is less with reduced risk from spillage and seepage. The drying layers of residue are relatively shallow and the area of wet or soft mud at any one time is limited, thereby posing less risk to people and wildlife.

A Residue Planning Liaison Group (RPLG) was formed in May 1992 to coordinate and review long-term management issues, plans and development activities for bauxite residue disposal. This group includes representatives from Alcoa, DRD, DEP, the Department of Agriculture, the Department of Planning & Urban Development, DOME, WAWA and the Peel Development Commission.

The CER states that long-term management plans are being developed by planning teams at all three refineries. The plans will include end of refinery life or 50 year conceptual plans, five year operational plans, identification of major issues to be addressed and the research and development requirements to address these issues. Alcoa anticipate that the first iteration of long-term plans for Wagerup will be ready for submission to the Minister for Environment in 1995.

Alcoa's rehabilitation objective is to establish a surface condition which is low maintenance, stable, has sustainable vegetative cover, is aesthetically acceptable and is suitable for further appropriate land uses. The current rehabilitation process includes placement and shaping of a residue sand layer, installation of surface drains and runoff control structures, addition of organic soil amendments and fertiliser, and revegetation with a succession of site tolerant species (native and agricultural species) to achieve the required aesthetic and land-use objectives. The proponent acknowledges that, in the long term, the standard of rehabilitation achieved must match the land-use objectives.

The residue deposit will contain alkaline salts which will continue to leach from the deposit for many decades after closure with the action of rainwater. While it is intended that the surface vegetation system be chosen to minimise infiltration and runoff, there will nevertheless, be an ongoing requirement to collect and treat relatively alkaline drainage water to a standard suitable for discharge. The proponent is undertaking research to predict the potential impact of future discharge and expects to carry out appropriate water treatment technologies (if required).

Alcoa has acknowledged that some level of ongoing monitoring and management of the residue deposits will be required for many years after the residue areas have been decommissioned.

The land used for residue storage at Wagerup is owned by the proponent under freehold title. After decommissioning of the refinery there will probably come a time when Alcoa will wish to relinquish ownership of the land. Alcoa has indicated in the CER that aspects such as possible limitations on land use, ongoing monitoring and management responsibilities and the retention of access to the residue deposit for alternative uses will be determined well beforehand with the State Government.

Alcoa has examined a range of potential uses for bauxite residue over the last 15 years. Negotiations between Alcoa and the State Government aimed at achieving a mutually acceptable strategy for the release of residue are underway and once concluded should allow residue from the Wagerup Refinery to be more readily available for a range of soil amendment uses. However, the availability of other raw materials and the relatively small local markets limit the current opportunities for economic alternative use of large quantities of residue.

Part of the residue disposal process involves separation of fine and coarse fractions of the residue. This results in the concentration of fine particulates which contain naturally occurring radioactive elements in the red mud. Studies by the Department of Health have shown that the radiation levels are insignificant. Nevertheless, the proponent has stated that periodic monitoring of the residue's radioactive component will be carried out.

In the CER Alcoa has proposed minor changes to its current commitments with respect to bauxite residue management to make them more comprehensive and incorporate the role of the MMPLG (Appendix 8).

4.2.4.3 Submissions

Comments from key government agencies

The Department of Minerals and Energy made favourable comments in relation to the company's management of residue disposal associated with the current operations.

The DEP has advised that Alcoa has made significant progress towards developing a suitable method of rehabilitating its residue areas since 1989. It concurs with proponent's comments that there should be major benefits from an environmental and land resource perspective resulting from the recently instituted method of dry stacking, compared with the previous wet stacking method.

The DEP, as a member of the RPLG, has also advised that there has been substantial progress by the company towards developing a solution for the long term management of bauxite residue areas. The DEP considers that the initiatives by the company in community consultation, researching alternative uses for the residue, and in making financial provision in its accounts for rehabilitation and long term management, are commendable.

The DEP has advised that minor changes should be made to the current Environmental Condition on the residue management at Wagerup, including adopting the term "closure strategy" as opposed to the term "walkaway solution" and recognising the role of the RPLG. The DEP has suggested that the proponent develop a "closure strategy" for the residue storage areas at Wagerup to the requirements of the Minister for the Environment on advice of the Environmental Protection Authority and the Water Authority of Western Australia, implementing the "closure strategy" to the requirements of the Minister for the Environment, at a timing to be determined by the Minister for the Environment on advice of the Minister for Resources Development, and reporting annually on the progress towards developing the "closure strategy", to the requirements of the Residue Planning Liaison Group.

Public Submissions

There were a number of submissions from members of the public in relation to dust impacts, seepage and potential pollution of groundwater and concerns about radioactive elements in the bauxite residue. Dust issues are dealt with in Section 4.2.2). Other than the need for monitoring, there were no comments made specifically in relation to long term management of the residue.

4.2.4.4 Proponent's response to submissions

The proponent has provided responses to issues raised in submissions relating to bauxite residue disposal (Section B7 of Appendix 4). Key statements relevant to rehabilitation of the bauxite residue and development of a long term solution are as follows:

> "Alcoa, in association with relevant government agencies, has commenced a process to develop a "closure strategy" or long-term management plan for the residue deposits which satisfies the W.A. Government and the local community. These plans are in an embryonic stage including the consideration of future land use. The views of the community are actively being sought on this and other issues."
>
> "Demonstrating rehabilitation of the deposits and alternative land uses is one of Alcoa's primary residue management objectives. However, all residue storage areas at Wagerup are still active so opportunities are limited in the short term. At Pinjarra refinery 25 hectares has recently been rehabilitated to demonstrate and evaluate a range of vegetation types including pasture and native species as well as more intensive soil improvement and species selection trials. The demonstration area will be made available for public tours and feedback will be sought."
>
> "Future land use plans must be compatible with the physical nature of the deposits and not result in excessive maintenance or future liability; however, Alcoa believes that a flexible approach which identifies a range of compatible and sustainable future land uses will best serve the community."

"Possible additional radiation exposure is one issue that must be weighed up before deciding an appropriate future land use for residue deposits. It is possible that land use which results in 100% occupancy by people, such as residential development, may not be recommended (other factors also mitigate against this particular end use). The radiation levels are too low to be of concern for agriculture land uses or for use of residue for amending agricultural soils in accordance with the Department of Agriculture's Code of Practice."

4.2.4.5 Evaluation

The EPA notes the advice from the DEP regarding dry stacking, rehabilitation and progress towards a long term solution for the management of bauxite residue area.

The EPA considers that the revised commitments provided by the proponent in relation to the preparation of detailed design reports on future residue disposal areas and the development of long-term management plans for the residue deposits in consultation with the RPLG are appropriate.

Accordingly, the EPA considers that bauxite residue disposal and management for the expanded proposal are acceptable, conditional upon the proponent fulfilling its revised commitments and:

- **developing a "closure strategy" for the residue storage areas at Wagerup to the requirements of the Minister for the Environment on advice of the Environmental Protection Authority and the Water Authority of Western Australia;**
- **implementing the "closure strategy" to the requirements of the Minister Environment, at a timing to be determined by the Minister for the Environment on advice of the Minister for Resources Development; and**
- **reporting annually on the progress towards developing the "closure strategy", to the requirements of the Residue Planning Liaison Group (Recommendation 8).**

The EPA considers that minor changes be made to the current Environmental Condition on residue management at Wagerup, including adopting the term "closure strategy" as opposed to the term "walkaway solution", and recognising the role of the RPLG.

4.2.5 Other refinery related issues

The following issues were also raised in several of the submissions received.

Buffer zones and land use planning

There were no public submissions received on buffer zones or land use planning, although there were a number of submissions dealing with noise, dust, air and odour emissions which relate to this issue.

The DEP expressed concerned about the level of work performed to determine an appropriate buffer zone for the refinery and how this buffer zone related to recognised standards for similar industries. The DEP also highlighted concerns about the need to identify the compatible and incompatible land uses within this buffer zone, and how much of this land was owned by Alcoa. In addition to the above, the DEP detailed the need to establish what measures are in place, or planned, to prevent the inappropriate use of land within the buffer zone.

The proponent provided the following respective responses to the issues raised by the DEP:

"Rather than determine an arbitrary buffer zone distance, refinery environmental management practice is aimed at adherence to ambient air quality standards or neighbourhood noise regulations where legislatively established, or to internally generated standards based upon existing standards elsewhere where no W.A. standard

exists. Noise modelling has recently been undertaken as part of the action required to respond to the DEP's concerns (question B1.1 in Appendix 4). Because natural gas is a relatively clean fuel which when burnt has no emissions of SO_2 or other noxious gases, atmospheric dispersion modelling has been considered unnecessary except as an aid in the location of an ancillary plant such as the liquor burner."

"A comprehensive land management plan is currently being developed for Alcoa's Wagerup land holdings. Its primary objective is the identification of land uses which maximise opportunities for best use of the land whilst minimising the potential for conflict with social, agricultural, conservation and industrial objectives for the district generally. This will inevitably protect against the establishment of inappropriate land uses on land owned by Alcoa. The company has no means of influencing land use on private properties owned by others, other than providing advice to property owners and planning agencies."

The EPA has evaluated impacts associated with noise, dust and gaseous emissions previously in this report. The EPA notes that the proponent is developing a comprehensive land management plan for its Wagerup land holdings. The EPA considers that the issue of buffer zones for the Wagerup operations is manageable, and encourages the proponent to seek the advice of DEP, the local authorities and the Ministry of Planning in the preparation and implementation of this plan.

Surface water protection

Public submissions expressed concern about how activities within the refinery could adversely affect surface water features such as the South Samson Drain. Particular emphasis was placed on the consequent impacts this could have on downstream users, dependent native flora and fauna and the flushing and nutrient levels of the Harvey Estuary. It was also pointed out that there was a need to conserve water at the refinery, due to Western Australia's dry climate and the substantial amount of water used in the refining process and that priority should be given to recycling water .

The DEP expressed concern about Alcoa's assumption that the diversion of 1100 ML/yr of water from the South Samson Drain would not result in adverse environmental impacts downstream. In addition to this, the DEP sought clarification about what measures Alcoa had employed in recent years to conserve and recycle water.

The proponent made no formal commitments with respect to the management of surface water protection.

The EPA considers this issue to be manageable.

Groundwater protection

The EPA notes that no public submissions relating to the issue of groundwater protection were received. The Water Authority of Western Australia, as regulator with respect to Water Pollution Control Licensing, believes that there are sufficient controls in place to ensure that the continued protection of groundwaters below the residue disposal areas will be achieved. As a result of this, and in conjunction with commitments made by the proponent, the EPA considers this issue to be manageable within the existing controls.

Transportation of dangerous goods

Public submissions detailed concern about the increase in the risk of dangerous substances being introduced into the environment as a result of the transport and storage of dangerous goods. Several submissions questioned the ability of the narrow roads immediately surrounding the refinery to handle the anticipated increase in heavy vehicle traffic resulting from the proposed expansion of the refinery. The EPA notes that the proponent is aware of the need to comply with the requirements of the Dangerous Goods Regulations (1992), of the Explosives and Dangerous Goods Act (1961).

Visual aesthetics

Public submissions expressed concern about the visual impact of the expanded refinery and bauxite residue disposal areas on the general ambience and recreational amenity of the surrounding areas. The EPA notes the measures undertaken by the proponent to address this issue in its CER and 1978 ERMP and considers this issue to be manageable.

Evaluation of other refinery related issues

The EPA considers that the above issues are manageable within existing conditions, regulations and commitments and undertakings by the proponent.

4.3 Proposed changes to environmental conditions and commitments

In order to provide a single Statement of Environment Conditions from which the environmental performance of this proposal can be managed and assessed, the DEP has reviewed the statement issued in 1990 (Appendix 7). The Recommended Environmental Conditions in Section 6 of this report are a result of this review exercise, and assessment by the EPA of the proposed expansion of the Wagerup operations.

The proponent has proposed three additional management commitments in the CER in relation to forest conservation. As a result of the DEP's assessment of noise information provided by the proponent, the proponent has made a further six noise management commitments.

During the assessment the proponent has reviewed its commitments and provided a single set of up to date commitments. The proponent's Consolidated List of Environmental Management Commitments for the Wagerup operations is provided as Appendix 8 in this report.

On advice from the DEP, the EPA has recommended (Section 6) that the Minister's Statement be updated (Recommendation 2) and include a number of now standard conditions and procedures not reflected in the existing Environmental Conditions on the proposal, to ensure conformity with Environmental Conditions imposed on other recently assessed proposals (Recommendation 9).

The EPA has established an implementation and auditing system which requires the proponent to advise the Authority on how it would meet the requirements of the environmental conditions and commitments of the project. The proponent would be required to develop a progress and compliance report for this project as a component of the recommended audit programmes. The EPA considers that, where appropriate, it would be adequate to combine this reporting with reports required under the Alumina Refinery (Wagerup) Agreement Act 1978.

The EPA's experience is that it is common for details of a proposal to alter through the detailed design and construction phase. In many cases alterations are not environmentally significant or have a positive effect on the environmental performance of the project. Such non-substantial changes, especially those which improve environmental performance and protection, should be provided for.

Any approval for the proposal based on the assessment should be limited to five years. Accordingly, 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.

5. Conclusions and recommendations

The environmental issues associated with the Wagerup refinery and associated mining operations have generally not changed since the EPA's assessments were conducted in 1978 and 1989. Of note however is the proportion of issues raised relating to impacts on the local community, particularly noise and dust. The EPA concludes that, as a result of commitments made by the proponent subsequent to public review of the CER, that noise impacts from the

existing and proposed operations mining and refinery operations would be manageable. The EPA concludes that impacts on the local community from the existing and expanded bauxite mining operations are manageable, conditional upon the successful implementation of the EPA's recommendations for Alcoa to undertake wider consultation in the preparation of its mining plans and to address community's concerns, consideration of any residual community concerns by the MMPLG, and the establishment of buffer distances appropriate for Alcoa's various mining related operations.

In relation to the protection of forest and water conservation qualities that were of concern in 1978 (when it was considered not desirable to allow bauxite mining to proceed at the higher production rate), the proponent has been instrumental in progressing knowledge of these environmental issues. This research, and the close working relationship developed between Alcoa and the expert government agencies such as CALM and WAWA, has given the EPA confidence to conclude that the protection of flora and fauna and water resources are currently being managed in an acceptable manner, and would continue to do at the proposed expanded rate. To ensure that the vegetation communities to be impacted upon by bauxite mining and associated activities are adequately represented in the forest conservation estate, the MMPLG should address this issue prior to approval of the proponent's mining plans.

To enable rehabilitated mining areas to be handed back to the State at an acceptable standard, the EPA concludes that, within 12 months of approval the proponent should submit details of a programme to develop final rehabilitation criteria and, subsequently, implement this programme, to the requirements of the Minister for the Environment and the Minister for Resources Development on advice of the Environmental Protection Authority, the Water Authority of Western Australia and the Department of Conservation and Land Management.

In relation to excessive dust emissions from the refinery operations, the EPA concludes that the issue is manageable provided that the proponent should put in place a programme to improve dust management as a condition of the Works Approval for the proposed expansion. The objective of the programme should be that ambient dust levels meet the requirements of the Environmental Protection Policy (Atmospheric Wastes) (Kwinana) for Area C (rural and residential areas).

The EPA strongly endorses the proponent's decision to incorporate low NO_x burners and other state-of-the-art technology for the proposed expansion and concludes that gaseous emissions would be manageable, conditional upon the proponent providing details on NOx and greenhouse gases on an annual basis.

The EPA concludes that bauxite residue disposal and management for the proposed expansion is acceptable, conditional upon the proponent fulfilling its revised commitments and developing a "closure strategy" for the residue storage areas at Wagerup to the requirements of the Minister for the Environment on advice of the Environmental Protection Authority and the Water Authority of Western Australia, implementing the "closure strategy" to the requirements of the Minister for the Environment, at a timing to be determined by the Minister for the Environment on advice of the Minister responsible for administering the Alumina Refinery (Wagerup) Agreement Act 1978 and reporting annually on the progress towards developing the "closure strategy", to the requirements of the Residue Planning Liaison Group.

The EPA concludes, on advice from expert government agencies, that it is environmentally acceptable to increase the capacity of the Wagerup Refinery from the current 1.7 million tonnes of alumina per annum to 3.3 million tonnes of alumina per annum, with a proportionate increase in production of bauxite from the mobile mining operations, as proposed in the CER and response to submissions, subject to the proponent's commitments and the following recommendations:

Recommendation 1

The proponent's proposal to increase the production capacity of the Wagerup Refinery from the current 1.7 million tonnes of alumina per annum to 3.3 million tonnes of alumina per annum, with a proportionate increase in

production of bauxite from the mobile mining operations is environmentally acceptable and could proceed, subject to:

- the Environmental Protection Authority's recommendations in this report (Section 5);
- the revised Environmental Conditions (Section 6); and
- the proponent's consolidated list of environmental management commitments (Appendix 8).

Recommendation 2

The Recommended Environmental Conditions (Section 6) should become the sole Environmental Conditions under the Environmental Protection Act 1986 for the proposal by Alcoa of Australia Ltd to increase the production capacity of the Wagerup Refinery from the current 1.7 million tonnes of alumina per annum to 3.3 million tonnes of alumina per annum, and that they supersede all previous Environmental Conditions for the project.

Recommendation 3

To enable rehabilitated mining areas to be handed back to the State at an acceptable standard, the proponent should submit details of a programme to develop final rehabilitation criteria within 12 months of approval of this proposal and, subsequently, implement this programme, to the requirements of the Minister for the Environment and the Minister for Resources Development on advice of the Environmental Protection Authority, the Water Authority of Western Australia and the Department of Conservation and Land Management.

Recommendation 4

Alcoa should ensure that the affected local government authorities and communities are fully consulted and their concerns addressed in the preparation of mining plans to the requirements of the Minister for the Environment on advice of the Department of Environmental Protection. To ensure that any residual areas of local community concern are addressed, the Mining and Management Programme Liaison Group, which reports to the Minister for Resources Development, should seek and consider the views of affected owners within 4 km of its operations, prior to advising the State on the acceptability of these plans.

Recommendation 5

To protect the amenity and lifestyle of private properties from mining-related impacts, the proponent should prepare a plan within 12 months of approval of this proposal, in consultation with the Department of Environmental Protection and the affected local authorities, detailing buffer distances appropriate for the various operations, to the requirements of the Minister for the Environment on advice of the Department of Environmental Protection. In developing appropriate buffer distances, the proponent should take into account issues that concern local property owners, including likely noise, vibration and dust impacts on residents and property from the type of mining proposed, aesthetic and conservation values of the forest affected in relation to the properties, and potential hydrological impacts. The proponent should subsequently implement and periodically review the plan.

Recommendation 6

The proponent should put in place a programme to improve dust management as a condition of the Works Approval for the proposed expansion. The objective of the programme should be that ambient dust levels meet the equivalent of the Environmental Protection Policy (Atmospheric Wastes) (Kwinana) for Area C (rural and residential areas).

Recommendation 7

The proponent should provide details on the control of NOx emissions and greenhouse gases in its annual reporting of environmental research and operations.

Recommendation 8

To enable bauxite residue areas to be handed back to the State in an acceptable standard, the proponent should:

- develop a "closure strategy" for the residue storage areas at Wagerup to the requirements of the Minister for the Environment on advice of the Environmental Protection Authority and the Water Authority of Western Australia;
- implement the "closure strategy" to the requirements of the Minister for the Environment, at a timing to be determined by the Minister for the Environment on advice of the Minister for Resources Development; and
- report annually on the progress towards developing the "closure strategy", to the requirements of the Residue Planning Liaison Group.

The EPA considers that minor changes be made to the current Environmental Condition on residue management at Wagerup, including adopting the term "closure strategy" as opposed to the term "walkaway solution", and recognising the role of the RPLG.

Recommendation 9

The following standard conditions and procedures should be added to the Ministerial Statement for the project, to ensure conformity with recently revised standard requirements for Ministerial Statements.

Condition for implementation

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

  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. Where, in the course of that detailed implementation, the proponent seeks to change those designs, specifications, plans or other technical material 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.

Condition for compliance auditing

- **In order to ensure that environmental conditions and commitments are met, an audit system is required.**

  The proponent shall prepare periodic "Progress and Compliance Reports", to help verify the environmental performance of this project, in consultation with the Environmental Protection Authority.

Procedures

- **The Environmental Protection Authority is responsible for verifying compliance with the conditions contained in this statement, with the exception of conditions stating that the proponent shall meet the requirements of either the Minister for the Environment or any other government agency.**
- **If the Environmental Protection Authority, other government agency or proponent is in dispute concerning compliance with the conditions contained in this statement, that dispute will be determined by the Minister for the Environment.**

6. Recommended environmental conditions

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

INCREASE IN PRODUCTION CAPACITY OF WAGERUP ALUMINA PLANT TO 3.3 MILLION TONNES PER ANNUM, AND ASSOCIATED BAUXITE MINING OPERATIONS

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 correspondence to the Department of Environmental Protection of 11 April 1995; provided that the commitments are not inconsistent with the conditions or procedures contained in this statement.

A schedule of Environmental Management Commitments (May 1995) which will be audited by the Department of Environmental Protection 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. Where, in the course of that detailed implementation, the proponent seeks to change those designs, specifications, plans or other technical material 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 Long term Bauxite Residue Management

3-1 The proponent shall develop a "closure strategy" for the residue storage areas at Wagerup to the requirements of the Minister for the Environment on advice of the Environmental Protection Authority and the Water Authority of Western Australia.

3-2 The "closure strategy" shall be subsequently implemented to the requirements of the Minister for the Environment, at a timing to be determined by the Minister for the Environment on advice of the Minister responsible for administering the Alumina Refinery (Wagerup) Agreement Act 1978.

3-3 The proponent shall report annually on the progress towards developing a "closure strategy", to the requirements of the Residue Planning Liaison Group.

Note:

A "closure strategy" means that the bauxite residue storage areas at Wagerup shall either no longer require management at the time the proponent ceases refining operations, or if the Minister for the Environment determines that further management is necessary, the proponent shall make adequate provision for future management with no liability to the State.

4 Atmospheric emissions

4-1 The proponent shall provide details on the control of NOx emissions and greenhouse gases in annual reporting of environmental research and operations (see Procedure 3).

5 Social Impacts

5-1 To reduce social disruption to the Waroona district, the proponent shall maintain formal liaison and monitoring processes with the Shire of Waroona.

5-2 The proponent shall provide details on formal liaison and monitoring processes with the Shire of Waroona in its annual reporting of environmental research and operations.

6 Mining impacts on local communities

6-1 The proponent shall consult with the affected local government authorities and communities in the preparation of mining plans and address the concerns raised to the requirements of the Minister for the Environment on advice of the Department of Environmental Protection.

6-2 Prior to submission of mining plans to the State for approval, the proponent shall identify those concerns of residents within 4 km of its operations which remain unresolved.

6-3 Within 12 months of the formal authority issued to the decision-making authorities under Section 45(7) of the Environmental Protection Act 1986, to protect the amenity and lifestyle of private properties from mining-related impacts, the proponent shall prepare a plan in consultation with the Department of Environmental Protection and the affected local authorities, detailing buffer distances appropriate for the various operations, to the requirements of the Minister for the Environment on advice of the Department of Environmental Protection. In developing appropriate buffer distances, the proponent shall take into account issues that concern local property owners, including:

1. likely noise, vibration and dust impacts on residents and property from the type of mining proposed;
2. aesthetic and conservation values of the forest affected in relation to the properties; and
3. potential hydrological impacts on private properties.

6-4 The proponent shall implement and periodically review the plan required by Condition 6-3.

7 Final Rehabilitation Criteria

7-1 Within 12 months of the formal authority issued to the decision-making authorities under Section 45(7) of the Environmental Protection Act 1986, the proponent shall submit details of a programme to develop final rehabilitation criteria, to the requirements of the Minister for the Environment and the Minister for Resources Development on advice of the Environmental Protection Authority, the Water Authority of Western Australia and the Department of Conservation and Land Management.

7-2 The proponent shall subsequently implement the programme for final rehabilitation criteria required by Condition 7-1, to the requirements of the Minister for the Environment and the Minister for Resources Development on advice of the Environmental Protection Authority, the Water Authority of Western Australia and the Department of Conservation and Land Management.

8 Decommissioning

8-1 The proponent shall achieve the satisfactory decommissioning and rehabilitation of the refinery site and its environs.

8-2 At least six months prior to decommissioning, the proponent shall prepare a decommissioning and rehabilitation plan to achieve the objectives of condition 8-1.

8-3 The proponent shall implement the plan required by condition 8-2.

9 Proponent

These conditions legally apply to the nominated proponent.

9-1 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.

10 Time Limit on Approval

The environmental approval for the proposal is limited.

10-1 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 expiration of that period, to the Minister for the Environment by way of a request for a change in the condition under Section 46 of the Environmental Protection Act. (On expiration of the five year period, further consideration of the matter can only occur following a new referral to the Environmental Protection Authority).

11 Compliance Auditing

To help determine environmental performance, periodic reports on progress in implementation of the proposal are required.

11-1 The proponent shall submit periodic Progress 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 (Wagerup) Agreement Act 1978, and the Minister responsible for administering that Act will forward the relevant information to the Minister for the Environment.

Note

1 The proponent is required to hold a licence under the provisions of Part V of the Environmental Protection Act.

7. References

Alcoa of Australia Ltd. and Dames and Moore (1978a) Wagerup Alumina Project. Environmental Review and Management Programme. May 1978.

Alcoa of Australia Ltd. and Dames and Moore (1978b) Wagerup Alumina Project. Environmental Review and Management Programme (revised). September 1978.

Alcoa of Australia Ltd. (1989) Review to the Expansion to Wagerup Alumina Refinery, and Compliance with Approval Conditions. Consultative Environmental Review. October 1978.

Alcoa of Australia Ltd. (1994) Triennial Review of Environmental Research and Operations 1991-1993. Wagerup Refinery and Willowdale Mine, including Appendices.

Alcoa of Australia Ltd. and Dames and Moore (1994) Expansion of Alumina Production to 3.3 Million Tonnes Per Annum. Consultative Environmental Review. October 1994.

Bauxite Subcommittee of the Steering Coimmittee for Research on Land Use and Water Supply, The Joint State Government and Alcoa Research Programme into the Effects of Bauxite Mining on Water Resources in the Northern Jarrah Forest - Research Planing and Methodology. Public Works Dept. of W.A., Water Resources Branch Report No. W.R.B. 106.

Department of Conservation and Environment (1983) Conservation Reserves for Western Australia as recommended by the Environmental Protection Authority - 1983. The Darling System - System 6 (Red Book). Report No. 13, Department of Conservation and Environment, Western Australia.

Environmental Protection Authority (1978) Wagerup Alumina Refinery Proposal By Alcoa of Australia Ltd., Report and Recommendations of the EPA. Bulletin 50.

Environmental Protection Authority (1989) Wagerup Alumina Refinery Expansion, Report and Recommendations of the EPA. Bulletin 423.

Environmental Protection Authority (1993) A Guide to Environmental Impact Assessment in Western Australia.

Herring Storer Acoustics (1994) Report on likely noise impacts of the proposed expansion of the Alcoa Wagerup Refinery and Willowdale Mine.

Loh, I.C., Hookey, G.R. and Barrett, K.L. (1984) The Effect of Bauxite Mining on the Forest Hydrology of the Darling Range Western Australia. Public Works Dept. of W.A., Water Resources Branch Report No. W.R.B. 73.

Appendix 1

Environmental Protection Authority's recommendations on the Environmental Review and Management Programme submitted by Alcoa in May 1978 - extracted from Bulletin 50 (EPA 1978).

Environmental Protection Authority's recommendations on the Environmental Review and Management Programme submitted by Alcoa in May 1978 - extracted from Bulletin 50 (EPA 1978).

"1. that, subject to the conditions contained in our further recommendations below, the construction of the alumina refinery should be allowed to proceed.

2. that the State should not approve the ERMP as submitted by the Company.

3. that the State should require:

(a) that all mining plans of the Company should be as agreed from time to time between the Company and the State, giving recognition for the Company's need for a commercially viable mining operation and the State's need to manage and conserve the forest, to maintain water quality in the catchments, to cater for the proper needs of the community for recreation, and to protect the flora and fauna of the forest. In the event of the Company and the State at any time failing to agree on the mining plans the matter should be decided by arbitration

(b) that without the approval of the State there should be no further expansion of the Kwinana and Pinjarra refineries beyond 1.5 and 2.5 million tonnes per year respectively, nor expansion of the Wagerup refinery beyond 2 million tonnes per year

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

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

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

Appendix 2

Environmental Protection Authority's recommendations on the Consultative Environmental Review submitted by Alcoa in 1989 - extracted from Bulletin 423 (EPA 1989).

Environmental Protection Authority's recommendations on the Consultative Environmental Review submitted by Alcoa in 1989 - extracted from Bulletin 423 (EPA 1989).

The EPA considered the expansion to be environmentally acceptable, subject to the following recommendations (EPA 1989).

"Recommendation 1

The Environmental Protection Authority concludes that the Wagerup Refinery Expansion Proposal is environmentally acceptable and recommends that it could proceed provided that commitments given in the proponent's 1978 ERMP, 1978 ERMP Supplement and the 1989 CER are followed, and subject to the following recommendations.

Recommendation 2

The Environmental Protection Authority recommends that Alcoa liaises closely with the Department of Conservation and Land Management throughout the project's life to ensure that mining schedules are integrated with that of forest management.

Recommendation 3

The Environmental Protection Authority recommends that all of Alcoa's operations come under the jurisdiction of the Environmental Protection Act 1986.

Recommendation 4

The Environmental Protection Authority recommends that the proponent be required to set up a programme to develop a walk-away solution for the bauxite residue disposal across all three refineries, to the satisfaction of the Minister for the Environment, within 12 months of the commissioning of this expansion.

Recommendation 5

The Environmental Protection Authority recommends that minimising of greenhouse gas emissions should be a major factor in the proponent's selection of energy generation options.

Recommendation 6

The Environmental Protection Authority recommends that Alcoa establishes formal liaison and monitoring processes with the Shire of Waroona to the satisfaction of the Environmental Protection Authority, upon advice from the Social Impact Unit, to minimise social disruption to the Waroona district.

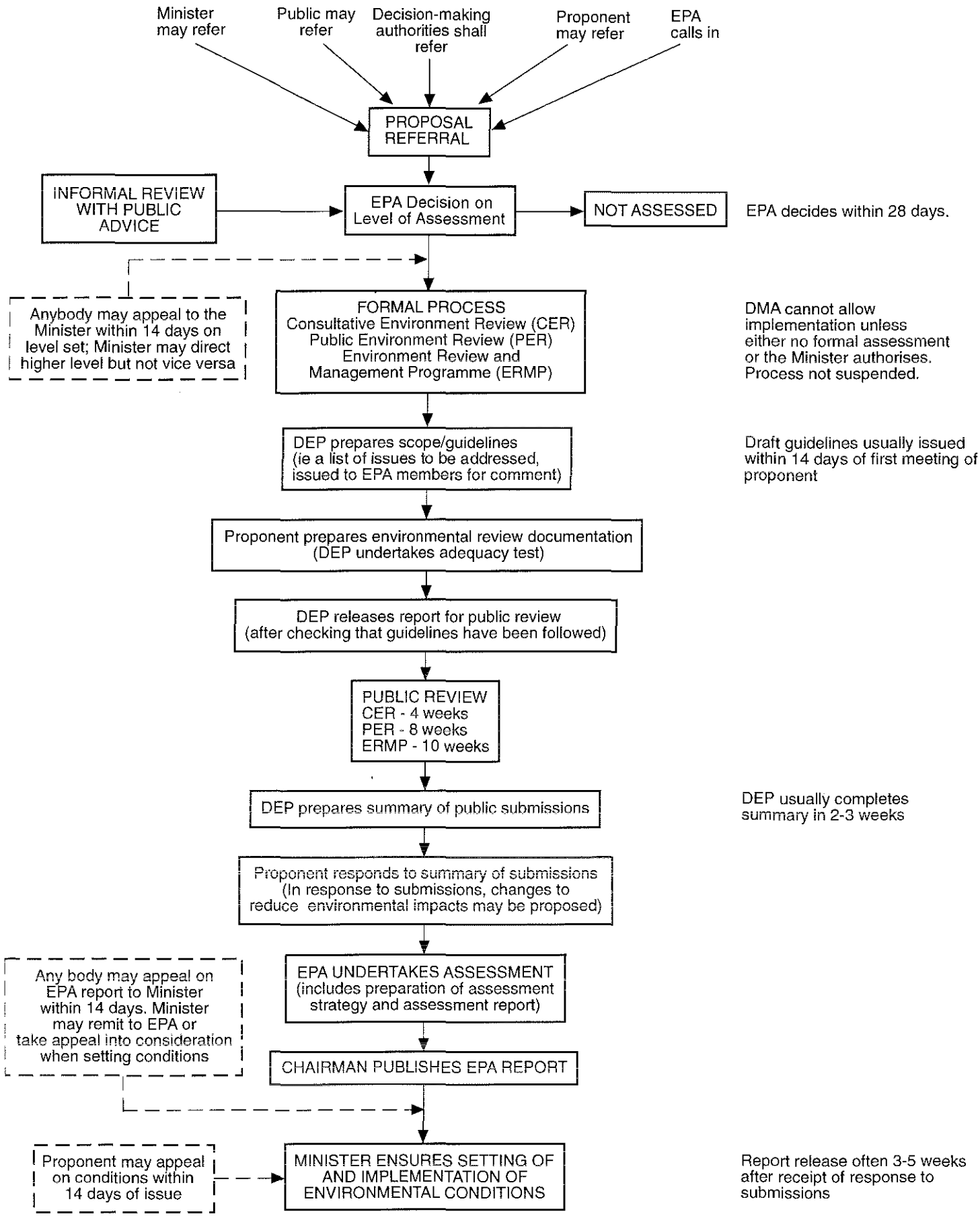
Recommendation 7

The Environmental Protection Authority recommends that the proponent should be responsible for decommissioning the plant and rehabilitating the site and environs of the expanded facility, to the satisfaction of the Environmental Protection Authority. At least six months prior to decommissioning, the proponent shall prepare, for the expanded facility and its site, a decommissioning plan to the satisfaction of the Environmental Protection Authority."

Appendix 3

Environmental impact assessment flow chart

EIA PROCESS FLOW CHART



Appendix 4

Summary of submissions and proponent's response to questions

ALCOA OF AUSTRALIA LIMITED
A C N 004 879 298
Cnr. Davy and Marmion Streets, Booragoon, Western Australia

ALCOA
AUSTRALIA

10 February 1995

The Chief Executive Officer
Dept. of Environmental Protection
Westralia Square
141 St. George's Terrace
PERTH WA 6000

Attention: Mr. S. Sadleir

Dear Mr. Sadleir

WAGERUP EXPANSION CER - RESPONSES TO NOISE QUESTIONS (ASSESSMENT #895)

Please find enclosed the complete version of our responses to the 88 questions attached to Jim Malcolm's letter of 14 December.

Our earlier letter of 20 January included responses to 87 of the questions, but we were still waiting on information from our noise consultants to allow a complete response to questions A8.1 and B1.1.

Please note that minor editorial changes have been made to our responses to a number of other questions.

I have also enclosed a revised copy of the map attached to my letter of 7 February. The original map included 6 houses near the refinery which are owned by Alcoa.

A copy of the consultant's report on noise issues will be forwarded to John Macpherson early next week.

Yours sincerely,

GRAHAM SLESSAR
Environmental Manager, W.A. Operations

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P.O. Box 252, Applecross, W.A. 6153 Telephone: (09) 316 5111 Facsimile: (09) 316 5228 Telex: AA93910

reflect the P type to the same degree with a mixture of plant indicator species that reflect sandy and gravelly soils being present.

The principles applied in the preceding discussion to the S site-vegetation type can also be applied to the T and P site-vegetation types. In the mapped areas at Willowdale various combinations of these site-vegetation types have also been used (i.e., ST, SP, etc.); however these are variants of the main site-vegetation types and can be considered to reflect global variants which would also occur in the reserve system.

It is not possible to make a quantitative comparison of the area of representation of the site-vegetation types outlined in the CER in the conservation reserves, because the same level of mapping (mapping for Alcoa areas is based on a grid of 120m x 120m and in some areas 60m x 60m) has not been carried out for most of the reserves, nor indeed for most of the jarrah forest other than future bauxite mining areas.

5.2 *On what basis is the statement made that "The establishment of an ecologically representative system of conservation reserves within the jarrah forest has ensured the preservation of nearly all significant ecosystem types"?*

Part of this question relates to question A5.1 and therefore most of the comments made in the previous response are applicable here.

In the mid 1970s work carried out by officers of the Forests Department addressed the need to reserve representative vegetation in a conservation estate. It based its selection on a range of criteria to include representation of the full range of forest vegetation types known to exist.

These criteria were essentially based on the work of Havel (1975a and b), who defined the inherent variation in site conditions and plant communities into a series of site-vegetation types. This level of definition was a marked advance on the earlier work of Smith (1974) who relied heavily on the structural formation for defining and mapping the vegetation in the jarrah forest. The vegetation "complexes" which form the basis of the reserve system are related to and based on combined site-vegetation types (Havel 1975a and b, Heddle et al. 1980b).

There are different opinions about the adequacy of the current level of representation of different site-vegetation types in the reserve system. Some would argue that no reserve system is adequate, or that additional criteria should have been included in its selection. Alcoa's perception is that the assessment and review process leading to the establishment and subsequent expansion of the reserves system in the jarrah forest was commendably thorough.

5.3 *What steps does Alcoa consider should be taken to ensure that all site-vegetation types are represented and all ecosystem types are preserved in conservation reserves.*

1.2 *How does Alcoa's research compare with that carried out by the former Forests Department, which apparently showed that clear-felling killed 90% of the birds and animals that lived in the forest?*

As no reference is given to a particular publication or other source of information, it has not been possible to substantiate the validity of this question. However, mortality of 90% of birds and mammals from present days clear-felling operations seems highly unlikely. Because mining occurs as a patchwork, with individual minepits (averaging 10-20 ha in size) being surrounded by uncleared forest, it is even more unlikely that such high mortalities would be associated with bauxite mining operations.

Alcoa recognises that it is important to minimise impacts on wildlife. As discussed in the CER, clearing operations in more extensive areas of dieback-free forest take place in summer and autumn. At this time, almost all mammal and bird species are not breeding and many reptiles are mobile and able to escape. Thus, a large number of vertebrate fauna species would be able to move away from clearing operations.

The actual numbers of animals killed, either directly or indirectly by mining operations has not been quantified. Whilst deaths of individual animals should always be minimised, the important question is whether this is having an impact on either individual species, or the composition and well being of faunal communities. Extensive research, discussed in the CER and elsewhere, has not identified serious long-term impacts on any fauna species.

1.3 *What research has been undertaken to assess the cumulative impact to native fauna from the loss of mature jarrah forest (cumulative includes activities such as timber harvesting, agriculture, and bauxite, gold, coal and mineral sands mining?*

Alcoa has undertaken and sponsored extensive research on the ecology of both the jarrah forest and rehabilitated mined areas. The objective of this research is to provide sufficient knowledge to allow the company to manage its own operations responsibly. Research on the effects of other land uses and forest management practices is the responsibility of other organizations.

A recent review paper by Abbott and Christensen titled *Application of ecological and evolutionary principles to forest management in Western Australia* (Australian Forestry, 57, pp109-122, 1994) addresses the question of ecological change wrought by Aboriginal and European use of the forest. The interested reader is referred to this paper for further information on this subject.

1.4 *How does bauxite mining affect the hydrology of the jarrah forest?*

The hydrological effects of the mining operations are discussed in sections 4.1.2 (p27-30) and 5.1.5 (p61-66) of the CER. The information provided is based on research and monitoring undertaken by Alcoa, the Water Authority and CSIRO over a period of about 20 years. A review published by the Water Authority (Loh, Hookey and Barrett 1984) is listed in the references (p140). The Water Resources Council's Steering

RESPONSES TO QUESTIONS ARISING FROM THE CONSULTATIVE ENVIRONMENTAL REVIEW

A. MINING RELATED IMPACTS

1. Flora and fauna conservation

1.1 *What are the likely permanent effects on the jarrah forest ecosystem from bauxite mining?*

The principal bauxite area in the Darling Range covers approximately 4,300 km² in a block extending for about 100 km south from the Brookton Highway towards Collie and for about 40 km east from the Darling Scarp towards Boddington. This represents about 27% of the publicly owned jarrah forest managed by CALM. Isolated bauxite deposits exist outside the principal bauxite area but these are generally too scattered to be economically mineable or are enclosed within conservation reserves.

The bauxite deposits occur on hillslopes, not in the more biologically diverse valley systems nor on the monadnocks. On average, the deposits underlie between 10% and 15% of the principal bauxite area, but this varies considerably depending on site conditions. In areas of particularly good bauxite development up to 30% of the landscape may be underlain by bauxite deposits or be required for haul roads and other ancillary works. These areas of high mining potential tend to be restricted to the western half of the principal bauxite area and more isolated pockets further east. The western part of the jarrah forest is generally the most heavily infected with dieback disease and has been most intensively disturbed by timber harvesting and other human activities.

Not all the bauxite within the principal bauxite area is available for mining. The presence of national parks and conservation reserves, and other constraints, significantly reduce the area which could ultimately be mined. If all the potentially mineable bauxite were eventually mined, the area impact would be as follows:

- Approximately 75-80% of the publicly owned jarrah forest would be largely unaffected by any bauxite mining activity.

- Approximately 20-25% of the publicly owned jarrah forest would comprise a mosaic of rehabilitated mine areas and unmined forest, with the proportion of mining-related disturbance ranging from about 5% to 30% of the landscape.

- The total area cleared for mining purposes would represent about 4% of the publicly owned jarrah forest, or 3% of the total jarrah forest (i.e. including that in private ownership).

The forest ecosystem is a combination of its various components and the processes by which they interact. Although our knowledge of any ecosystem is unlikely ever to be complete, with the reasonably detailed information currently available it is possible to

select key indicators which can be used to assess whether significant changes are occurring. These include:

- the presence or abundance of rare species
- specific functions such as nutrient cycling
- the presence or abundance of diverse taxonomic groups which fulfil a variety of ecological roles
- ecological indices which provide information on populations and communities.

All these indicators have been studied in detail both in rehabilitated mined areas and unmined forest. Obviously the existing rehabilitated areas are relatively young compared to the jarrah forest, but the ecological studies undertaken over the past 20 years indicate that key ecological processes such as plant water uptake, nutrient cycling, plant succession, microbial activity, soil development and fauna recolonisation are developing in accordance with the objective of re-establishing a self-sustaining jarrah forest ecosystem.

The results to date suggest that there will be some local changes but these will be relatively minor, and largely confined to the rehabilitated areas. Site factors on the rehabilitated minepits might result in the development of plant communities which are not completely identical to the site-vegetation types normally found in upland forest. In other words, the relative proportions of plant species may differ. However, all plant and animal species which normally occur in upland forest are likely to be present in the rehabilitated areas. Like in unmined forest, vegetation communities are expected to be dynamic and vary following fire and other disturbance. The fauna will be partly determined by the final plant species present, and it too will be dynamic.

There will be several net positive effects of mining, some direct, some indirect. Operation Foxglove, which is partly funded by Alcoa, is expected to result in significantly increased densities of mammal species, including several rare species. Extensive areas which were formerly dieback-affected will have been rehabilitated with understorey and possibly dieback resistant jarrah developed through research partly funded by Alcoa. The fauna populations of these rehabilitated dieback-affected areas will be significantly more abundant and diverse than prior to their rehabilitation. In rehabilitated mined areas, several rare or uncommon plant species may actually be more common than prior to mining. An example is *Eucalyptus graniticola*, which is known from only one plant. At the Alcoa-funded King's Park Rare Plant Propagation Unit, scientists have tissue cultured the species and it will be planted in suitable rehabilitated areas.

Given the restricted area of forest likely to be affected by mining, the effectiveness of current rehabilitation and dieback control measures and the existence of a comprehensive system of conservation reserves, Alcoa believes that its net impact on the jarrah forest ecosystem as a whole will remain small. This impact will be at least partly offset by the company's contribution to the reversal of existing forest degradation related to dieback spread and predation by feral animals.

Committee for Research on Land Use and Water Supply expects to publish an updated review in 1995.

1.5 *What is the potential for the jarrah forest ecosystem to collapse, as has been suggested is the case near Admiral Road at Byford?*

The collapse of a jarrah stand (where many of the jarrah trees die within a few months) is usually associated with the presence of the dieback fungus *P. cinnamomi* and a combination of site and weather conditions which strongly favour its growth and reproduction. In other cases drought stress may be involved. Observations in the forest suggest that dieback-related collapses occurred more commonly in the past, but few have been noted in the past decade. They are usually associated with particular sites where water tends to perch on more or less continuous caprock at shallow depth.

In the western region of the forest, dieback is widespread and most of the sites which were prone to collapsing are thought have been infected and to have collapsed already. However, some such sites may still remain. Comprehensive vegetation mapping is used to identify dieback-susceptible vegetation and potential high impact sites in and adjacent to proposed mining areas. This information is used to help plan the operations and develop appropriate dieback management procedures (refer also response to question A2.4).

1.6 *What studies have been carried out to quantify the number of fauna killed through forest clearing? How much would this increase through forest clearing?*

This question is addressed in the response to question A1.2.

1.7 *On what basis is it likely that habitat trees (and logs) adjacent to cleared forest will be retained in greater numbers in the future?*

A review in 1994 of dieback forest rehabilitation practice by a CALM/Alcoa working group recognised the potential for more habitat trees to be retained as part of the works programme, in line with CALM's current silvicultural prescriptions. An evaluation of the number of habitat trees required in forest adjacent to Alcoa's operations will be undertaken jointly with CALM.

1.8 *To what extent will the flora and fauna monitoring programs be subject to independent peer review, to ensure the statistical designs are valid and that they are sufficiently powerful to provide useful answers to questions relevant to management? How are the benchmark values or criteria derived?*

It is in Alcoa's interest for the results of the monitoring programs to be both credible and applicable to real management issues.

A formal review committee structure existed through the mid to late 1970s when the research and monitoring programs referred to in the CER were in the early stage of development. At that time the level of knowledge was low, priorities and objectives were ill-defined, and there was little informal networking between the different groups of scientists involved. None of these circumstances exists today.

The current research and monitoring programs were designed or improved by a team of highly qualified and experienced scientists whose work has been published widely in the scientific literature. They have ready access to equally well qualified and experienced statisticians within the company, and consult freely with research personnel and other specialists in government agencies, universities, consulting firms and CSIRO as necessary. All the programs are outlined in the annual and triennial Reviews of Environmental Research and Operations, which are reviewed by relevant government agencies.

Benchmark values for all the parameters measured in the flora and fauna monitoring programs are based on values measured in comparable neighbouring areas of unmined forest. These values may be determined from permanent reference plots, from published information, or from data exchanged with other researchers. By way of example, the benchmark value for plant species diversity was derived from permanent reference plots in the forest. The locations of these plots were selected in consultation with L.M. Mattiske and Associates. Dr. Mattiske is an acknowledged expert on jarrah forest flora and site-vegetation identification. The reference plots were allocated according to the amount of each site-vegetation type likely to be affected by future mining activities. Areas of high dieback impact or other major disturbance were avoided.

1.9 *Those priority plant species located in stream zones or river valleys may be affected indirectly by changes to water flow, or dieback status. What specific measures will the proponent take, in terms of both environmental management and monitoring, to protect these species?*

Seven priority plant species were located in the Willowdale area during pre-mining vegetation surveys. Only one species (*Aotus cordifolia*) occurs in streamzones and swamps. All streamzones in the Willowdale area have been mapped as dieback infected, including the area of occurrence of *Aotus cordifolia*.

Alcoa will maintain a high level of dieback management as outlined in the CER, and will take steps to minimise hydrological changes in the vicinity of known occurrences of the priority species. Specific measures are outlined in the response to question A2.4.

No bauxite occurs in the river valleys. As is currently the practice, minepit boundaries on the "breakaways" between the lateritic uplands and the steep valley slopes will be rationalised so that the risk of uncontrolled runoff into the valleys is minimised. Parts of individual orebodies will be left unmined where necessary to ensure the effective containment of drainage water.

1.10 *What is the rationale for concluding that the aquatic invertebrate fauna of the Willowdale area is likely to be similar to that of the other areas mentioned?*

The CER notes that detailed aquatic invertebrate fauna studies have been carried out at the Harris River, Hedges and Boddington Gold Mines, and in the Jarrahdale and North Dandalup River areas. The Jarrahdale study found minimal impacts on the invertebrate community in streams which had been mined for many years. This study, combined with detailed water quality monitoring data and improved environmental management techniques, led to the reasonable conclusion that mining operations would have little or no impact on aquatic invertebrates.

However, it is recognised that the aquatic fauna of jarrah forest streams do differ, and the relevance of previous studies to all species likely to occur at Willowdale North is not known at this stage. Therefore, Alcoa will conduct a baseline survey of aquatic invertebrates in representative streams which flow from the Willowdale North area and in a comparable unmined control area, prior to construction of the crusher facilities. This will be repeated at an appropriate time after mining operations have commenced, so that any mining related impacts can be detected and managed accordingly.

1.11 *In view of potential direct and indirect impacts of mining operations, road construction, etc. on hydrology and water quality, why does the proponent not plan to carry out monitoring of aquatic communities?*

This question is addressed in the response to question A1.10.

2. Dieback

2.1 *What effect does bauxite mining have on the downward migration of dieback into the valleys from upland infected areas?*

With the exception of the deeply incised valleys of major rivers and their immediate tributaries, moist valley floor sites throughout the jarrah forest are commonly infected by dieback - many have been for decades. In most circumstances the valleys are more likely to be sources of inoculum for infection of upslope forest rather than the reverse.

Bauxite mining can actually decrease the rate of downward spread of *P. cinnamomi* in some circumstances. During mining the infected soil from upland "spot infections" is removed and later replaced in the lower part of the rehabilitated area. The uninfected soil which was originally downslope of the spot infection is placed upslope where it is at much lower risk of infection.

The responses to questions A2.2 and A2.4 are also relevant to this question.

2.4 *What specific measures will the proponent take, both in terms of dieback hygiene measures, and in terms of monitoring, to protect the Yarragil swamp communities.*

Alcoa recognises that some of the site-vegetation types that occur within Yarragil swamp communities are susceptible to dieback. The most susceptible site-vegetation types are E, F, J, P, D, B, A and to a lesser extent W, Q, T and U. Within the Willowdale North area most of the valley floor vegetation except for the deeply incised valleys draining into the Murray River is already affected by dieback to some extent. Therefore, the priority will be to minimise intensification of the disease. This will be achieved by maintaining a high level of dieback management and by minimising changes in local hydrological conditions.

Areas of potentially high dieback impact are identified by botanical survey and site-vegetation mapping before mining. These are taken into account by a range of measures including careful planning of haul road locations, designing haul road drainage systems so that drainage water is directed away from dieback-susceptible and uninfected or lightly-infected but potentially high impact sites, scheduling nearby construction and mine development activities to the summer months, and scheduling ore extraction to minimise the time between clearing and rehabilitation of adjacent minepits.

Alcoa will liaise with CALM to determine what monitoring might be necessary in situations where mining is planned adjacent to valley systems containing site-vegetation types which are currently uninfected but susceptible to dieback.

3.0 Rehabilitation

3.1 *How does Alcoa justify expanding its operations when its rehabilitation programme appears to constitute a massive experiment on the jarrah forest ecosystem?*

Alcoa is committed to continuous improvement in all key performance areas of its operations including mine rehabilitation. While improvement opportunities are continually being sought, the basic rehabilitation procedures, including topsoil management, ripping, establishment of understorey, fertilising and dieback management, have been proved over many years. The effectiveness of these procedures in restoring the flora, fauna and function of the pre-mining forest has been demonstrated in the monitoring data presented on pages 75, 76 and 82 of the CER and in published research.

Forests are long-lived ecosystems which take many decades to fully develop. Alcoa's oldest rehabilitation, using the basic rehabilitation processes outlined above, could not be considered a mature forest as yet; but all the research and monitoring data indicate that current rehabilitation procedures are meeting the objective of re-establishing a self-sustaining jarrah forest ecosystem.

3.2 What guarantees are there that jarrah will successfully grow in rehabilitated areas? What criteria will be used to measure success?

The removal of the caprock layer during mining appears to create soil conditions in rehabilitated mined areas which favour jarrah survival. Routine monitoring of the survival of jarrah in rehabilitated mined areas occurs in 40 study sites. The average survival percentage of jarrahs growing in well-drained sites rehabilitated in 1978 and 1979 is 86% (range of 79% - 97%, monitored 1993). The average survival percentage of jarrahs growing in sites rehabilitated in 1988 is 91% (range of 88% - 95%, monitored in 1993).

The oldest jarrah trees growing in rehabilitated areas are 23 years old and these trees are growing well (mean co-dominant height of 20.35m in 1992 at an age of 21 years). Most jarrah trees in rehabilitation are much younger than this so their long-term growth potential is still being evaluated.

Because nitrogen is the main limiting nutrient in the jarrah forest and in rehabilitated areas, we have used the accumulation and cycling of nitrogen as an indication of the health and growth potential of trees in the rehabilitated areas. Where a nitrogen fixing legume understorey has been established (in all rehabilitation since 1977) the amount of nitrogen in the soil and above ground biomass has approached or exceeded that found in a mature jarrah forest. The rate at which this nitrogen is cycled through the system is also similar or greater in rehabilitated areas than in a mature jarrah forest. These data indicate that the system is healthy and will support the continued growth of jarrah trees.

Eucalyptus species from eastern Australia were planted alone or mixed with indigenous species in much of the rehabilitated areas in the 1960s, '70s and early to mid '80s. These species normally grow in soils more fertile than those found in the jarrah forest areas. The fact that these trees are growing well in the rehabilitated areas suggests that jarrah, which is adapted to less fertile soils, will continue to grow well.

Success of jarrah is likely to be measured using the site-index curves published in Abbott and Loneragan (1986). These curves are used to group jarrah trees into site quality indicators based on their height/diameter relationship. For a given diameter, taller trees indicate better site quality.

3.3 *Over half of the area cleared for mining at Willowdale remains unrehabilitated. Does it mean that, if the mining rate doubles, the area unrehabilitated doubles as well?*

Annual rehabilitation rates will increase to ensure that only areas essential for the maintenance of an efficient mining operation remain open. The area open will settle at around 850 ha after the start up of the next crusher facility in 1999. During the development and construction phase the area open will increase to a predicted level of around 1000 ha.

2.2 *How sure is Alcoa that dieback is not being spread by its activities within dieback free forest? Has this been independently audited?*

None of Alcoa's bauxite operations are being undertaken in forest which is completely free from dieback. Within the 10 year mining perimeters of the three bauxite mines, the overall incidence of dieback ranges from 28% to 64%, the latter being the figure for Willowdale.

Alcoa does not claim that its operations do not contribute to the spread of dieback. As discussed in section 5.1.7 (p68-74) of the CER, recent mapping indicates that the amount of spread which *might* be attributable to current mining activities is very small - in the order of 1% of some of the more extravagant predictions made in response to the 1978 ERMP.

The contribution of mining to the overall incidence of dieback in the jarrah forest is not known with certainty, but a reasonable estimate is in the range 0.1-1%, rather than say, 10%. These impacts are at least partially offset by the dieback forest rehabilitation program, in which Alcoa funds the rehabilitation of dieback affected forest adjacent to its operations irrespective of the cause of the infection. The bulk of the areas treated under the program were infected as a consequence of other activities well before any mining in the area - in many cases decades earlier.

Until 1994 all Alcoa's dieback mapping was conducted by contract dieback interpretation teams working under the direct supervision of CALM, based on aerial photography supplied by CALM. The data are readily available for independent auditing by CALM personnel.

2.3 *To what extent would Alcoa's operations affect the plans of the owner of Lot 471 to establish a seed orchard on his property, particularly through the spread of dieback?*

The catchment area of Cyprus Brook is already extensively degraded by dieback and has been for many years. Hence dieback spores almost certainly already exist in the stream water in Cyprus Brook. Preliminary ore information suggests that Lot 471 is separated from the nearest mineable orebodies by a distance of at least one kilometre, with intervening streams to the south and east. A conservation park (part of Lane-Poole Reserve) borders the property to the north and other private properties border it to the west and south. Mining therefore will have no effect on the property owner's plans to establish a seed orchard.

The property owner is advised to consider the access routes to his property, and the water from Cyprus Brook, as more likely sources of dieback inoculum.

By way of comparison, the Huntly Mine currently operates with a production capacity close to that proposed for Willowdale. At the end of 1993 a total of 3,959 ha had been cleared for the Huntly/Del Park operations. Of this 3,088 ha had been rehabilitated and 871 ha were still being used or in the process of being rehabilitated.

The area open at any time includes all long-term infrastructure currently not available for rehabilitation (e.g. the crusher site, office, workshops, power lines and conveyor). The remainder is active minepits and haul roads and areas being developed for mining. Sufficient minepits need to be kept open to maintain a consistent quality of bauxite feed to the refinery and meet operational constraints (e.g. restricted access to some pits in wet weather or noise considerations).

Environmental considerations include the need to clear orebodies scheduled for mining such that the risks of spreading dieback are minimised, yet opportunities for directly transferring fresh topsoil to another mined area in the process of being rehabilitated are maximised. Optimisation of all these factors requires that a substantial area be cleared and available for mining at any one time.

3.4 *Where are the seeds collected for direct seeding? Is there any environmental damage caused by this activity? What control is there by Alcoa on this activity?*

Eucalypt seed is collected from areas being logged or cleared for mining. Seed collectors are also encouraged to collect seed of other species from areas that will be cleared for mining, but dieback and safety issues are sometimes a constraint. Species in the first areas of rehabilitation to receive provenance-correct seed are beginning to set seed. Seed will be collected from these areas to supplement collections from the forest.

Alcoa has long-term contracts with five companies that collect and supply seed. Employees of these companies undertake training sessions on Alcoa's rehabilitation objectives, sustainable seed collection techniques and safety issues.

The native seed industry is regulated by CALM. There are strict licensing conditions in place to prevent environmental damage by seed picking activities, such as controls on entry to dieback affected areas. A licensing requirement is that records of species and quantities of seed collected are submitted to CALM quarterly.

3.5 *What studies have been conducted and conclusions reached regarding public recreation needs, landscape perceptions and community attitudes about forest values, management activities and strategies in south-west forest areas.*

The perimeter of Alcoa's operations at all three mines, after 32 years of operations at Jarrahdale, 23 years at Huntly/Del Park and 11 years at Willowdale, encloses a total area representing less than 1.5% of the jarrah forest. For this reason the company's involvement in most of the issues raised in this question is somewhat limited.

However, Alcoa has commissioned professional surveys of public opinion for many years. One of the questions in that survey has asked for views on what constitutes proper rehabilitation of the jarrah forest.

Respondents, who statistically represent the greater metropolitan population, were given an open-ended set of choices such as rehabilitating to make more water available, rehabilitating to make it more visually attractive, returning it to the original forest, or any other type of rehabilitation that they could think of. A consistently overwhelming proportion indicated a preference for rehabilitation to return the forest to its original state. Sampling over the whole of 1993 (the last full year of this survey question) averaged an 82.5% selection of this option. The response has been so consistent that this question is no longer included in the company's public opinion surveys.

In 1992, a senior officer from CALM's Recreation & Landscape and Community Education branch was seconded to Alcoa to examine bauxite mine rehabilitation practices with specific reference to recreation, scenic and cultural resource management. The secondment was for a three month period at the conclusion of which a report was prepared and presented to Alcoa and CALM.

In essence the report considered that these issues were generally adequately addressed by the mine rehabilitation objective to re-establish a self-sustaining jarrah forest ecosystem. Some opportunities were identified and some suggestions were made regarding revegetation practices which could be modified to further enhance scenic or recreational values at specific locations. The concepts discussed in the report were accepted by Alcoa and are in the process of being entrained in the planning and rehabilitation procedures.

Specifically in relation to the Willowdale Mine, the company has commissioned consultants to conduct a survey of recreational users of the forest in and around Lane-Poole Reserve. Their views about recreational needs and mine rehabilitation objectives will be sought.

The broader aspects of this question relating to community attitudes about forest values and management activities and strategies, would be more appropriately directed to CALM. The department published a draft report in February 1994 titled *Management Strategies for the South-West Forests of Western Australia - A Review*. After a public review process, assessment by the EPA and further reviews by a Ministerial Appeal Committee and Scientific and Administrative Committee, a final report *Forest Management Plan 1994-2003* was published in 1994. The interested reader is referred to these publications for further information on this subject.

3.6 *Would Alcoa be prepared to develop and implement a comprehensive landscape management program designed specifically for its mine operations in the jarrah forest?*

Section 5.1.1 (p51-55) of the CER refers to the work that is currently underway to improve the integration of bauxite mining with forest management planning in the

Willowdale North area. Criteria for the management of the landscape values will be developed jointly with CALM within this process, bearing in mind that mining will have a significant but largely temporary effect on visual landscape values in the immediate area of the operations. The integrated planning process and any criteria developed for landscape values will have application to all mine operations in the jarrah forest.

3.7 *What independent assessment has been carried out to confirm that Alcoa's staff are implementing the best rehabilitation procedures available? In reality there are likely to be compromises between this and other objectives of the Company. The degree of compromise may be of concern.*

It is in Alcoa's interest for rehabilitation to be successful. The importance the company attaches to its performance in this area is reflected in the fact that the quality of mine rehabilitation is included as a key performance area in the Mining Group's business plan. District Officers of CALM visit each mine on an irregular basis in an informal inspection capacity and the Mining Operations Group (refer p51-53 of CER) visits each mine at least once each year to discuss specific issues and inspect potential problem areas or field trials of proposed new techniques.

The CALM-Alcoa Working Arrangements include a prescription for mine rehabilitation which incorporates a number of success criteria for the re-establishment of vegetation on the mined areas. These are measured on every rehabilitated minepit nine months after seeding. A summary of the results is included in the Reviews of Environmental Research and Operations submitted annually to the State Government. The rehabilitation performance criteria currently under development are likely to incorporate independent audits by CALM at a number of stages between initial rehabilitation and transfer of full management responsibly to CALM.

4.0 Forest Values

4.1 *To what extent does fragmentation of the forest through bauxite mining impact on the ecosystem of the jarrah forest?*

Much of the information contained in the response to question A1.1 is relevant to this question also. It is not repeated here.

Fragmentation potentially has a number of adverse effects including loss of certain fauna habitats, loss of rare plant species and introduction of weeds. There are potential positive effects also. For example, the density of some fauna species tends to increase along edge zones between disturbed and undisturbed areas.

Fragmentation is most likely to occur through the genetic isolation of fauna populations, particularly rare mammals. It is known that fauna recolonise rehabilitated bauxite areas at different rates. Until a species returns its local population may become effectively fragmented. However, most species return within the first 5-10 years, and

all are expected to have returned by year 20. All officially gazetted rare fauna species which occur in upland jarrah forest have recolonised rehabilitated areas. Once a species has returned, genetic isolation of populations or fragmentation will no longer occur for that species.

Some current rehabilitated areas adjacent to farmland have higher densities of some weed species than unmined forest controls. These are monitored and the need for control assessed. Weed densities have been observed to decline as the native vegetation develops, particularly after canopy closure.

It is important to bear in mind that *active* mining areas occupy a very small proportion of the forest (about 0.1% across all three mines). Most areas are cleared, mined and rehabilitated within three years. There is no valid comparison between the effects of permanent fragmentation such as might result from agricultural or urban development, and the transient fragmentation resulting from bauxite mining. Furthermore, pre-existing partial fragmentation resulting from dieback infections, which occupy in total an area 3-4 times greater than that which will ever be mined, are alleviated by the dieback forest rehabilitation program funded by Alcoa.

4.2 *How much and what sort of waste is generated from clearing of the forest for mining, after commercial timber and firewood have been harvested? How much useable timber is destroyed by burning off the waste? What options are there for utilising this waste as a resource?*

Timber harvesting contractors supervised by CALM currently salvage all merchantable product from Alcoa's minesite clearing. This consists of milling timber, transmission line poles, mining props, farm fencing materials, orchard and vigneron props, material used in erosion control and landscaping, firewood, and selected material for chipping. Some stumps and hollow logs are stockpiled for future return during the rehabilitation process.

Only material which is uneconomic to harvest using current equipment and technology is burnt. It consists mainly of fire damaged, diseased or malformed trees and small diameter jarrah saplings, unmillable marri and sheoak, and banksia. The volume of material involved has not been quantified.

CALM, Alcoa and other interested groups are continually searching to find viable uses for the waste material. Chipping of the green residue for particle board manufacture is a promising recent development. The Wesfi company has successfully used chip from small diameter jarrah and marri blended with softwood chips to produce medium density fibreboard. This high quality product has potential to satisfy a growing domestic and overseas market. Its commercial viability and the suitability of waste from minesite clearing as a source of chips are being investigated.

5. Conservation and Recreation Reserves

5.1 *On what basis does Alcoa consider that most of the most extensive site vegetation types are well represented in the conservation estate?*

The comments in the CER relate to those parts of the jarrah forest of interest for bauxite mining. They do not necessarily apply to the whole jarrah forest. The comments were based on information published in the forest management strategy documents referred to in the response to question A3.5, and work undertaken for Alcoa by L.M. Mattiske and Associates. The interpretation of representation on a regional basis was undertaken by Dr. L. Mattiske (former publishing name Heddle) who has had 20 years of site-vegetation mapping experience in the jarrah forest.

The representation of the site-vegetation types was assessed by comparing the results at Willowdale with the publications by Heddle et al. (1980a, 1980b) and the current representation of the site-vegetation types in the reserves in the Northern Forest Region (refer CALM's *Regional Management Plans 1987-97*). It is important to note, however, that the *Regional Management Plans 1987-1997* have been superseded by the *Forest Management Plan 1994-2003* published in 1994. Proposed additions to the conservation reserve system are summarised on p43-44 and on the maps included with the latter document.

The main site-vegetation types that occur in association with the bauxite deposits are S, T and P.

Using the S site-vegetation type as defined by Havel (1975a) as an example:

(i) This type tends to occur on sandy-gravelly soils on the western areas of the Darling Range. Although local variations are found in response to the soils, rainfall and topography, there is substantial representation of the S type in the reserve system.

(ii) Heddle et al. (1980a) summarised the S type as a dominant site-vegetation type in Eagle Hill, Gooralong, Serpentine, Plavins, Teesdale, Karnet, Bell, Samson and Surface conservation areas (now parts of Monadnock and Serpentine National Parks and Lane-Poole Reserve). Further representation of this site-vegetation type also occurs south of Willowdale in the southern forest areas. The reserves mentioned above cover a similar distribution to the three main bauxite mines (Jarrahdale, Huntly and Willowdale) and therefore any phyto-geographical distributions that occur within the site-vegetation type as a result of climate and local site conditions would be represented in the reserves.

The variation inherent within the S site-vegetation type has been addressed by Mattiske in the recent mapping of the jarrah forest and hence the development of the site-vegetation types SP, ST and SW in recent mapping for Alcoa and others.

As an example, SP occurs on the end of the spectrum with sandier soils and is similar to the P type in that the overstorey supports a mixture of Sheoak (*Allocasuarina fraseriana)* and Jarrah (*Eucalyptus marginata)*; however the understorey does not

Decisions on an appropriate methodology for evaluating the adequacy of the conservation reserve system in the jarrah forest are the prerogative of the Department of Conservation and Land Management (CALM), the government agency which has been allocated the responsibility of managing the jarrah forest on behalf of the community.

Alcoa has funded most of the more detailed mapping in the jarrah forest since the 1970s and has carried much of the research load in this area. The company is therefore in a position to provide information if necessary. However, Alcoa does not necessarily support the notion that the adequacy of the conservation reserve system should be reviewed simply because further botanical surveys have allowed a more detailed classification of site-vegetation types than existed previously.

It is very difficult to "preserve" ecosystems, because an ecosystem includes plants and animals which are constantly changing (i.e. it is dynamic). These changes are also influenced by factors such as the regularity of burning and seasonal conditions. The preferred word would be "conserve".

5.4 *Will bauxite mining in the recreational areas of the Lane-Poole reserve result in the downslope movement of dieback into less infected, higher quality forest?*

The Willowdale Mine currently operates adjacent to the Samson Conservation Park under an environmental management plan agreed with CALM and the Lane-Poole Reserve Advisory Committee. This plan includes a comprehensive pre-mining assessment of the flora, fauna and dieback status of the area. It has been successful in minimising impacts of mining on the reserve. A similar plan will be developed for mining in and adjacent to the recreational areas of the Lane-Poole Reserve.

Most of the remaining better quality forest in the Park forest block is in deeply incised valleys abutting the main valley of the Murray River. These steep, well-drained valley sites tend to impart a higher degree of dieback resistance to the vegetation. Because of this and experience elsewhere, Alcoa is confident it can extract the bauxite on the degraded lateritic uplands without significantly affecting the health of the remaining better quality forest in the part of the recreation zone of interest for mining.

5.5 *What measures does Alcoa propose to minimise impacts of bauxite mining on recreational users? Would it consider no mining during peak periods, such as public holidays and school holidays?*

This issue is discussed in sections 5.1.3 and 5.1.4 of the CER (p55-60). Alcoa's use of the forest is transient and as such has mainly a timing effect on access by other users. Although some ore exists relatively close to recreation and tourist attractions, through consultation, the use of buffers, selective ore scheduling and appropriate mining techniques, the impacts on use of these attractions are expected to be minor.

Ceasing mining for extended periods would be counterproductive in the sense that it would simply prolong the duration of mining in that particular area. It may also encourage the incursion of recreationists into open minepits, which would be undesirable from a safety viewpoint.

Specific measures will be developed in consultation with CALM, the Lane-Poole Reserve Advisory Committee and relevant user groups when mining adjacent to areas of high recreational use is being considered.

6. Water Resources

6.1 *Why does Alcoa consider that it is acceptable to mine within the catchments of Samson Dam, the Samson Pipehead Dam and the Waroona Dam?*

Alcoa has been mining bauxite in the Darling Range for 32 years and for much of that time one or other of its mines has been operating in water supply catchments. Streams draining the mining areas are carefully monitored by Alcoa and monitoring is also undertaken by Water Authority personnel. Alcoa's data are summarised and reported annually to the State Government in the Reviews of Environmental Research and Operations.

The results from the monitoring programs show that Alcoa's operations have not had a significant effect on the quality of water resources. The company is confident it can maintain this performance in the Willowdale North area.

6.2 *Would the bauxite mining occur within the catchment of Cyprus Fern Brook? If so, what measures does Alcoa propose to protect the water quantity and quality, and, in particular, the trout breeding assets that have been installed by the owner of Lot 471?*

The bauxite reserves in the northern part of the Willowdale North area are not yet well defined. However, it is likely that some mining will occur in the catchment of Cyprus Brook. When the bauxite deposits in the area have been better defined by drilling and are under consideration for inclusion in a draft 5 year mine plan to be submitted to the State Government's Mining and Management Programme Liaison Group, Alcoa will consult with the property owners in the area to help develop a management program which will minimise any potential impacts of the operations.

The company has worked successfully in much closer proximity to private property than is likely to occur with Lot 471. The limited geological information currently available suggests that the nearest potentially mineable orebody is at least one kilometre from the boundary of Lot 471.

6.3 *How would Alcoa's mining activities affect the stream water supply to Lot 626 Willowdale Road?*

As indicated in section 5.1.5 (p61-66) of the CER, mining in a complete catchment could be expected to lead to an initial increase in streamflow which would then decline back to around normal levels within 10 years. However, these changes would be relatively minor compared to year to year variations in streamflow resulting from different amounts and patterns of rainfall, or compared to permanent clearing operations, e.g. for agriculture.

In the case of the stream flowing through Lot 626, there will be only a small area of mining in its catchment in the foreseeable future. The perimeter of the approved 5 year mine plan near the property is the northern side of Willowdale Road. Most of the catchment is south of Willowdale Road. After the 5 year plan area is mined, the operations will move to Willowdale North. The effect of the mining operations on the stream water supply to Lot 626 over at least the next 15-20 years is therefore expected to be minimal.

Depending on the intensity and extent of treatment, dieback forest rehabilitation could reduce water yields to a level more typical of less heavily infected forest.

6.4 *On what basis does Alcoa consider that the mine management and planning strategies used in its northern operations are applicable to the Willowdale Mine area, particularly in relation to water resources? Will 20 bores to be drilled in 1994 be adequate to show that there would be no salinity impacts from bauxite mining at Willowdale North, or is this part of an ongoing programme?*

The mine management and planning strategies proposed for future mining at Willowdale are based on 11 years of experience at Willowdale itself as well as experience from the northern operations. More importantly in relation to water resources, they are based on a sound understanding of the basic hydrological processes and terrain attributes which determine catchment response.

Twenty-two boreholes, two more than proposed in the CER, have since been drilled in Willowdale North. Their average volumetric total soluble salt content was 0.08 kg/m^3 and the average groundwater salinity was 147 mg/l TSS. These are exceptionally low salinity levels by comparison with averages for the high rainfall zone of the jarrah forest as a whole. Very low soil and groundwater salinities were entirely predictable given the rainfall, terrain characteristics and low stream baseflow salinities existing in the Willowdale North area. No further salinity drilling will be undertaken in Willowdale North.

7.1 *Please comment on the following statement: "Bauxite mining, as practised by Alcoa, is the epitome of unsustainable activity".*

The World Commission on Environment and Development in its 1987 report, *Our Common Future*, concluded that the world must pursue simultaneously the goals of

economic development and environmental protection, through a process it termed sustainable development. Sustainable development can be broadly defined as development that meets the needs of the present generation without compromising the ability of future generations to meet their needs.

The extraction of minerals is compatible with this concept of sustainability provided rehabilitation after mining restores an appropriate land use capability. Mining can be viewed as a temporary land use which does not compromise other land uses in the long term. The Commission did not say that non-renewable resources, like fossil fuels and minerals, should not be used. While bauxite is a non-renewable resource, the aluminium which is the eventual product of bauxite mining is either put to a permanent use, or is used and recycled. In fact, one of the great benefits of aluminium is that it can be recycled indefinitely using a small fraction of the energy input required to produce the primary metal.

Economic development, including bauxite mining, generates community prosperity which provides both intra- and inter-generational benefits. Economic development creates a store of cultural, scientific, educational and other accomplishments, along with physical infrastructure, which future generations inherit.

7.2 *Is there likely to be pressure placed on the government in 50 years time or so to relinquish bauxite resources that have been previously "sterilised" for environmental or social reasons?*

Any attempt to predict circumstances 50 years hence it speculative at best. Alcoa's corporate values are such that it would not seek to gain access to previously "sterilised" bauxite reserves unless it felt confident that the factors causing the sterilisation no longer applied. For example, if a certain bauxite deposit had previously been sterilised because it was too close to a noise sensitive location such as a private residence, it would be entirely reasonable to reassess the situation if new mining technology were subsequently developed which would allow that same deposit to be mined with a much lower noise impact.

In the case of the agreed conservation reserves in Alcoa's mineral lease, access for purposes other than ore transport will not occur while their conservation values remain. This agreement was formally ratified by an amendment to the Alumina Refinery Agreement Act in 1986. Any change to it would require the approval of the Parliament of Western Australia.

7.3 *What scope is there for Alcoa to make more efficient use of the bauxite resource, such as lowering its alumina cut off grade, thereby slowing its rate of advance through the jarrah forest?*

It is in Alcoa's interest to maximise the recovery of ore from any area in an attempt to minimise both environmental impact and development costs. The alumina cut off grade has been lowered over the years to a point where any further reduction would compromise the economic viability of the operations. It should be noted that alumina

cut off grade, while being important, must be balanced with several other parameters which affect economic recovery of alumina from the bauxite ore.

7.4 *What environmental criteria are considered by Alcoa alongside economic and other criteria, when making decisions to mine particular areas, ore bodies, or parts thereof?*

Environmental criteria are considered and evaluated on an ongoing basis and at a range of scales. On a regional scale, these include Alcoa's agreement not to mine the bauxite in any of the System 6 conservation reserves endorsed by the Reserves Review Committee. Alcoa also made a commitment in the 1978 ERMP that bauxite mining will not take place in the eastern, lower rainfall portion of its mineral lease until research shows that the operations can be conducted without significantly increasing the salinity of water resources. This commitment remains.

Alcoa undertakes assessments of fauna, flora and dieback distribution about 10 years ahead of mining. This information is used to determine dieback management strategies, the identification of rare fauna habitats and the location of rare or endangered plants. Mine plans are modified where appropriate to minimize the effect of mining on priority species or dieback-susceptible vegetation types identified in the surveys. Sites containing rare or endangered plants as well as significant areas of granite outcrops (the borders of which are known to be sites of rich floral and faunal diversity) are protected from disturbance.

Where stream crossings are required, construction methods designed to minimise clearing and any other potential impacts are utilised. The crossings are removed and rehabilitated after use unless required by CALM for ongoing management purposes or some other special need for ongoing access exists. The number of stream crossings is kept to a minimum.

Clearing of forest for mining is kept to a minimum with haul roads constructed through orebodies wherever possible. Clearing schedules are developed taking into account dieback management constraints and the need to transfer fresh topsoil under dry soil conditions in order to maximise the range of species re-established after mining.

The proximity of Alcoa's mining operations to other forest users and property owners is also taken into account. Access to the mining area by the general public is considered, with alternative access determined where necessary. Recreation use is also catered for, where necessary, in the rehabilitation program. The potential impact of noise from blasting, mobile equipment and fixed plant is carefully considered. Where necessary, ore extraction is scheduled so that no mining occurs too close to neighbouring residences during night shifts.

Alcoa's overall objective is to extract as much of the available bauxite as possible, consistent with responsible management of the operations both socially and environmentally. To do otherwise would represent a poor utilisation of the State's mineral resources and unnecessarily expand the perimeter of the active mining area,

with consequent impacts on other land uses. However, whole orebodies or parts of orebodies have been abandoned for a range of reasons including the following:

- proximity to private property, a heavily used recreation facility, a cultural heritage area (e.g. Marrinup P.O.W. Camp) or a public water supply reservoir;
- slopes too steep for safe operation or effective water management during or erosion control after the operations;
- obtrusive visibility from a major road (e.g. Albany Highway);
- long-term research site (e.g. Mundlimup near Jarrahdale);
- excessive clearing required for low tonnage of ore (e.g. small orebody requiring excessively long haul road for access; ore too shallow);
- proximity to the boundary of a conservation reserve where site conditions did not allow effective water management.

8. Noise and Traffic

8.1 *In general, the report is lacking in detail on noise, to the extent that it is not possible to assess the proposal at this time. The report relies on a low incidence of complaints regarding noise as a basis, without demonstrating quantitatively that the expansion will comply with the requirements. Some of the measured noise level data on page 85 of the report is not sufficiently authoritative. The following is a list of items related to the proposal which need to be defined, for both the existing and proposed operations, in order to carry out the assessment:*

(i) Number, times and days of shift;
(ii) number and type of major mining equipment items;
(iii) locations of nearest residences not owned by the proponent in proximity to the proposed mining areas, crusher sites, local roads, major roads, and conveyors;
(iv) predicted noise levels or contours encompassing the nearest residences;
(v) number and times of blasts;
(vi) number, routes and times of trucks associated with the proposal;
(vii) number, routes and times of vehicles associated with the proposal on local roads;
(viii) predicted increases in traffic noise levels associated with the proposal;
(ix) times of operation of the conveyor;
(x) authoritative measured noise levels and assessment of the conveyor noise under typical worst case conditions.

The CER addresses the noise issues which past experience has shown to be of concern to neighbours. Extensive data have been collected on blast noise in particular and are summarised and reported annually in the Reviews of Environmental Research and Operations. The data on less significant noise issues presented in the CER were intended to be indicative rather than authoritative, i.e. consistent with Alcoa's understanding of the relative significance of the various issues and the level of assessment assigned to this proposal by the EPA.

The additional information requested is outlined below.

(i) Currently, 312 of the 730 available 12 hour shifts per year are utilised for production. These rotate over all days and nights of the week. The proposal is to further utilise an additional 288 of these shifts following a similar rotation. This will result in 600 of the available shifts being utilised per year for production. The shift patterns commence at 0700 hours for day shift, and 1900 hours for night shift.

Development and rehabilitation functions currently work day shifts only, every day of the week. This will continue in the future. The expansion will be catered for by additional equipment in these functions.

(ii) The major items of fixed plant will be the existing mobile crusher, the existing and a new conveyor drive, and a conveyor transfer point where the new conveyor extension joins the existing conveyor (refer Figure 6, p19 of CER). Little additional mobile mining equipment will be required. The existing equipment (listed below) will be worked on a larger number of shifts. There will be two additional scrapers, one additional grader and possibly one less blast hole drill.

9 x 85t haul trucks
1 x 10m³ excavator
3 x 10m³ wheeled loaders
1 x large ripping dozer (e.g. Komatsu 575)
2 x earthworks dozers (e.g. Komatsu 475, Caterpillar D10)
1 x rubber tyred dozer (e.g. Caterpillar 824)
3 x scrapers
1 x graders
2 x blast hole drills
3 x water trucks
10 pieces small ancillary equipment

(iii) A map showing the locations of the nearest residences not owned by Alcoa has been forwarded to the DEP. Some of the small properties in isolated areas bordering the forest are occupied on a transient basis only. Several properties have temporary accommodation such as caravans or huts.

(iv) Monitoring and acoustic modelling recently completed by Herring Storer Acoustics indicate that the nearest residence to the west of the current operations could experience noise levels of up to 40 dB(A) under downwind conditions. The major noise source to this residence is the conveyor drive, but there is an additive effect from other sources including the crusher. The modelling studies indicate that when the crusher moves to Willowdale North, fixed plant will have little noise emission to the nearest residences.

One property in the middle of the current mining area could experience noise levels of up to 55 dB(A). At present this location is mainly influenced by dozing and scraping noise which will cease when nearby mining and rehabilitation activities move further away. Operations adjacent to this property have been conducted in agreement with the property owner.

It is not possible to give predicted noise contours for future mining areas because orebody boundaries and haul road locations are not determined until a particular group of bauxite deposits are included on a draft five year plan for review by the Mining and Management Programme Liaison Group (MMPLG). The review process ensures that noise considerations are given due consideration. Final mine plans are subject to approval by the Minister for Resources Development on advice from the MMPLG.

The modelling studies referred to above suggest that excavating, loading and hauling can generate noise levels in excess of 40 dB(A) at a distance of about one kilometre. Haul trucks are the major noise source. However, Alcoa has clearly demonstrated its ability to mine close to private property after negotiation with neighbours about such issues as the scheduling of the operations (e.g. on night shifts ore may be extracted from minepits which are located further away), the method of mining (e.g. use of a large dozer to rip caprock rather than blast) and the location of haul roads.

The company will continue to maintain appropriate buffers between its operations and neighbours except where there is a clear agreement to the contrary with particular neighbours. The width of these buffers will be discussed with the neighbours and will vary according to factors including ore density, topography, aspect, wind direction and the particular land use on individual properties.

(v) Currently, the Willowdale Mine blasts on 70 - 90 occasions per annum. Firing times are predominantly between 4 p.m. and 5 p.m. hours each day, excepting Sunday; although on occasions the time may be brought forward depending upon weather conditions.

As is detailed on p83 of the CER, improved ripping technology will significantly reduce the number of blasts required in noise sensitive areas. A large bulldozer suitable for ripping caprock has already been purchased and is undergoing field trials.

(vi) The number of haul trucks operating within the mining perimeter will not change - they will operate over a larger number of shifts. The haul road system is and will remain completely separate from the public road network.

Currently an average of 22 trucks servicing the mine use Willowdale Road each week. Most arrive via the South Western Highway from locations to the north of Waroona. These comprise fuel tankers, delivery vehicles and contractors' equipment required for seasonal clearing operations and road building. Truck movements occur predominantly between 8 a.m .and 5 p.m. Monday to Friday. A further 27 heavy vehicles associated with timber harvesting and minor forest produce removal also access the general mining area each week via Willowdale Road. The amount of woodcutting and clearing activity varies through the year, peaking during the drier months.

The number of trucks will increase with the expansion but not in proportion to the change in production. A reasonable estimate is that truck movements will increase by up to 30%.

(vii) At present about 440 light vehicle movements (employees, visitors, couriers and contractors) occur on Willowdale Road each week. Most vehicles travel via the South Western Highway from Waroona and points further north, although a minority originate from Bunbury, Harvey and Yarloop. A further 30-35 light vehicle movements per week service woodcutting operations in the general mining area.

It is envisaged the number of mining-related light vehicle movements will increase to about 580 per week once the mine is operating at its full expanded capacity. Light vehicles servicing woodcutting operations in the mining area could increase to around 50-60 per week (seasonally).

The great majority of the light vehicle movements occur at shift changes (7 a.m. and 7 p.m.) and through normal business hours.

(viii) The number of vehicle movements associated with the mine is small in relation to the total traffic on the South Western Highway passing through Waroona. No increase in peak noise levels is expected. The slight increase in traffic movement will marginally increase average noise levels if all the traffic is directed through Waroona. However, a proposal is being developed to provide alternative access to the Willowdale North crusher site which will detour traffic away from the Waroona town centre.

(ix) Both current and future operation of the conveyor will be concurrent with the production shifts as outlined in point (i) above. The conveyor extension will be further removed from private property than the existing conveyor, and the new crusher site will be more than 6 km from the nearest private residence compared to 1.7 km for the current crusher site.

(x) The proposal does not involve any change in the distance between the closest residence and the conveyor. As documented in the CER (p84), noise levels at 800 m from the conveyor (200 m closer than the nearest private residence) were close to the background level. These noise readings were measured by certified noise officers using noise meters calibrated to the relevant Australian Standard (ANSI S1.4). Further measurements taken by Herring Storer Acoustics have been reported to the DEP.

8.2 *Where will the crusher be located after Willowdale North? What consideration will be given to noise management in terms of site selection?*

The next crusher location after Willowdale North is yet to be determined. It is likely to be south east of the existing crusher site and as such will be in a largely unoccupied area of the State Forest. Due consideration will be given to noise management at the time of site selection.

8.3 *How many complaints have been lodged regarding blasting noise since operations began at Willowdale? What is the procedure for handling and following up complaints?*

Since 1983 Willowdale Mine has carried out 151 production blasts. Less than 8% of these have resulted in comment being lodged. Alcoa has a documented procedure which records, analyses and follows up when necessary, any call relating to a blast. Neighbours have been encouraged to comment on blast noise regardless of the noise level. This has enabled the mine to continue to improve its blast management system. A significant proportion of the calls received are in fact from mine employees who live on properties in the surrounding area and understand the importance of gathering the data.

8.4 *Under what conditions would blasts be released under potentially adverse weather conditions?*

All Alcoa's blast activities involve consideration of blast history, shot design and the use of a blast acoustics model which forecasts the noise levels that will be experienced at any location if the blast is initiated. The predictions are tested by firing a small pilot blast. Only if the correlations are sound for that blast, and the predicted levels are within our internal standard of 115dB linear (Australian Standard limit 125 dB), is the blast initiated.

8.5 *On what basis does Alcoa consider that truck and loader noise is generally not a concern for most neighbours? Has Alcoa solicited comments from all of the likely affected residents in the area? Are there noisy activities currently carried out at night that potentially affect neighbours that could be carried out in the day time?*

Alcoa's 32 year history of mining in the Darling Range has shown few concerns regarding noise from truck and loader operations. Where this has been of concern, mining in the vicinity has been limited to day shifts, and the problem has generally been alleviated. The advent of new mining technology should further decrease the noise resulting from truck and loader activities. Contact has already been made with the property owners adjacent to the Willowdale North mining area and an ongoing communication program will address such concerns should they arise.

8.6 *Is Alcoa prepared to maintain a 500 m buffer around Lot 626 Willowdale Road?*

The use of buffer zones is dependent on land use on a particular property, topography, aspect, ore density, public access and prevailing wind conditions. These issues and consultation with the land owner and the MMPLG will determine the extent of any such buffer distance around Lot 626 and will be undertaken as part of the normal mine planning process.

8.7 *What plans are there to upgrade Nanga Brook Road?*

Nanga Brook Road is a public road and whether or not it is upgraded is a matter for the Shire of Waroona to consider. If alternative access is provided to the Willowdale

North crusher site (refer question A8.1), it could involve using part of Nanga Brook Road. In this case Alcoa would consult with the Shire of Waroona and Main Roads Department to determine what upgrading of that part of the road was required.

8.8 *What are the current and proposed speed restrictions along Willowdale Road?*

Willowdale Road is a gazetted public road and is therefore under the control of the Main Roads Department. It is currently not speed sign-posed and therefore has the same restrictions as any similar public road. Alcoa has no plans to request any alteration to this situation.

9. Amenity and Community

9.1 *Alcoa's mining activities will substantially impact on the amenity of the Willowdale North area particularly recreational areas such as Waroona Dam, Icy Creek Bush Camp, Nanga Bush Camp and Lane-Poole through noise, dust, visual intrusion and disruption to access roads. How does Alcoa justify this? Would there be any compensation or benefit to the recreational users of the area during or at the end of this activity?*

Alcoa does not support the statement that its impact on amenity values will be substantial; but impacts will occur for a restricted period of time - ranging up to several years depending on the bauxite distribution in the vicinity of particular locations and the mining sequence adopted.

The approach that will be taken to minimise these impacts is discussed in general terms in sections 5.1.1, 5.1.3, 5.1.4, 5.1.10 and 5.1.12 of the CER. More detailed programs will be developed as more information becomes available on the bauxite distribution near the areas of high recreational use and they come under consideration for inclusion in the 5 year mine plan.

The company believes its operations can be managed in a way which will leave amenity values in Willowdale North at least equivalent to those existing now. Some of the approaches under consideration are outlined in section 5.1.3 of the CER. Community input will be sought through surveys and discussions with the Lane-Poole Reserve Advisory Committee and key user groups.

9.2 *Many of the people who live in the area place great value on the beauty, peace and quiet which they currently enjoy. What sort of impact can these people expect from the bauxite operations? Why should they be forced to endure these impacts?*

Alcoa understands that some local property owners may feel that the presence of mining operations is unacceptable under any circumstances because of possible disruption to some of the attributes which attracted them to the area. This view must be balanced against the very substantial economic benefits which accrue to the state and nation from the operations. It must also be balanced against Alcoa's own rights as

embodied in various Agreement Acts ratified by the Parliament of Western Australia. Alcoa was granted the mineral lease which includes the Willowdale North area 34 years ago. Many property owners would have purchased their land within or adjacent to a pre-existing mineral lease.

Alcoa has a long history of working co-operatively with neighbours to resolve differences whenever possible, and will continue to operate in that manner. Some of the approaches which will be used are outlined in section 5.1.1 and 5.1.3 of the CER and in the responses to previous questions.

9.3 *What mechanisms are in place to redress and compensate land owners for damage caused and loss of facilities and enjoyment of their environment? Will their environment be improved after Alcoa has moved on?*

Alcoa's operations have rarely caused any damage or loss of facility to adjacent land owners. In the event that this was to occur, the company would recompense the land owner or restore the facility, as would be expected by any responsible business or individual who caused such damage. It is noted, however, that some property owners attribute damage to mining activity when other factors such as poor foundation design are the primary cause. When such cases result in disputes, Alcoa relies on independent professional advice before making any decisions.

The transient nature of mining operations, the use of buffers, careful scheduling, orebody design and other mining technique will largely minimise any loss of enjoyment to adjacent land owners. As a large portion of the mining will occur in dieback-affected forest, Alcoa's post mining rehabilitation, in conjunction with the dieback forest rehabilitation program, will enhance the health and amenity of degraded forest areas. In some cases mining may lead to the installation of mutually beneficial facilities or the improvement of existing facilities.

9.4 *With Alcoa's mining operations comes more people into the area and possibly more accessibility to private properties. This could represent a threat to security of the local residents. Please comment.*

The proposed access ways to the new crusher site will utilise existing roads or roads along which few, if any, private properties exist; so increased public access to private properties is not envisaged. In fact, areas of the forest in which the company operates are secured for safety and dieback management purposes. Public access through the mining area other than on selected public roads is reduced rather than increased, except for the company's own employees and contractors. Access issues will be discussed with individual property owners.

9.5 *To what extent would Alcoa's operations adversely affect plans for a potential tourist operation on Lot 471?*

A diverse range of possible activities has been mentioned in relation to Lot 471 in this and previous questions. Preliminary geological information suggests that there will be no mining within one kilometre of the boundary of this property. If more detailed drilling changes this picture, the property owner will be advised as soon as possible. As a general observation, normal commercial prudence should be a consideration by landholders contemplating investment within or adjoining an active mining lease.

9.6 *How would the potential upgrading of Nanga Brook Road affect the picturesque nature of the area?*

If any upgrading of Nanga Brook Road were to occur in providing access to the new crusher site, the engineering specifications, design and construction methods would be developed in conjunction with relevant government agencies including CALM. This would ensure that the scenic value of the road was maintained.

9.7 *To what extent and over what period of time will Alcoa's operations affect the Nanga Dell Farm? Has Alcoa considered the impact on the owner's business, which is dependent upon the natural attributes of the area? What measures does Alcoa propose to minimise these impacts or compensate the owner for financial loss? Would Alcoa consider a 1 km buffer around the farm to lessen these impacts?*

Alcoa is engaged in detailed discussions with the owners of the Nanga Dell Farm. An amicable agreement is expected.

9.8 *To what extent are near neighbours and the community involved in mine planning, particularly with regard to issues that directly affect them? Could the Mine Management Planning and Liaison Group be opened up in some manner to incorporate community concerns?*

Neighbours are consulted on issues affecting them directly and are invited to an annual open day in which the proposed 5 year mine plan is displayed and discussed. All immediate neighbours in the Willowdale North area who mine personnel have been able to contact have been or will be invited to tour the operations so that they may gain a better appreciation of what it involves and the environmental protection measures used.

In cases where broader community issues have been involved, such as the mining operations near Dwellingup in the early to mid 1980s, consultation has been of a more formal nature and involved a representative community group.

Alcoa believes the public environmental assessment process now in progress, and the consultation processes mentioned above, provide ample opportunity for input to relevant aspects of mine planning by neighbours and local communities who could be directly affected by the operations.

9.9 *What reporting on monitoring results, complaints and change to environmental management is done by Alcoa? Is Alcoa prepared to make this information more accessible to the public and, if so, how could this occur?*

As indicated throughout the CER and in responses to previous questions, Alcoa submits annual and triennial Reviews of Environmental Research and Operations to the State Government. The Triennial reviews are more comprehensive and are placed in the EPA library for perusal by the public. In more recent years Alcoa has also provided copies to the local authorities and district libraries nearest the operations. This practice will continue.

10. Aboriginal Sites

10.1 *There is no mention of specific consultation with Aboriginal people to identify any additional sites of Aboriginal heritage significance. For example, in addition to recorded archaeological and ethnographic sites, there may be other landscape features ("sacred sites") which are important to Aboriginal people and may be impacted by the proposal. Is specific consultation with Aboriginal people required to adequately document any such sites? If so, will Alcoa arrange for such consultation to take place?*

Section 4.3.4 of the CER states that field archaeological and ethnographic surveys would be undertaken. The archaeological surveys have now been completed and Alcoa has received a draft report. The ethnographic studies are currently being conducted, and will include consultation with Aboriginal people to identify any sites of Aboriginal heritage significance. Both the archaeological and ethnographic surveys are being conducted by McDonald, Hales and Associates using methods reviewed by the Department of Aboriginal Sites.

B. REFINERY-RELATED IMPACTS

1. Noise

1.1 *As with the mining section, the report is lacking in detail on noise, to the extent that it is not possible to assess the proposal at this time. The report relies on a recorded low incidence of complaints regarding noise as a basis, without demonstrating quantitatively that the expansion will comply with the requirements. The following is a list of items related to the proposal which need to be defined, for both the existing and proposed operations, in order to carry out the assessment:*

- *(i) number, routes and times of trucks associated with the proposal;*
- *(ii) number, routes and times of vehicles associated with the proposal on local roads;*
- *(iii) predicted increases in traffic noise levels associated with the proposal;*
- *(iv) number, routes and times of trains associated with the proposal;*

(v) predicted increases in train noise levels along the railway, including in Bunbury;
(vi) locations of nearest residences not owned by the proponent; and
(vii) authoritative measured and predicted noise levels or contours encompassing the nearest residences.

The information requested is outlined below.

(i) At present, nine 40t truckloads of lime are transported to the refinery each day from Monday to Saturday. The trucks travel from Kwinana via dual carriageway on Rockingham Road, Patterson Road, Ennis Avenue, Mandurah Road and Pinjarra Road, thence onto the South Western Highway. They are evenly spaced between 6 a.m. and 2.15 a.m. At full production (3.3 Mtpa), the expanded refinery will require 11 truckloads of lime per day, Monday to Saturday. These trucks will be evenly spaced between 6 a.m. and 3.45 a.m.

General freight and other road-transported materials (e.g. distillate and flocculant) require an average of four trucks per day, two of which also service the Willowdale Mine. These and an average of three light (courier/mail) trucks per day access the refinery via the South Western Highway from either Bunbury or the metropolitan area. This traffic occurs mainly during normal business hours, Monday to Friday. There will be little change following the expansion - possibly an average of one extra truck per day.

During the eight month peak construction period an average of 10 additional trucks per day will access the refinery site. For the remaining 10-12 months of the construction period there will be an average of about five additional trucks per day. This traffic will occur during daylight hours and will follow the same routes as the general freight.

(ii) Light vehicle traffic to and from the refinery will undergo an increase following expansion, as shown in the following table.

Light Vehicle Movements - Wagerup Refinery (1)

Period	To Refinery		From Refinery	
	SW Hwy North	SW Hwy South	SW Hwy North	SW Hwy South
06:30 to 07:30	140 to 160 (+20)	42 to 46 (+4)	30 to 50 (+20)	13 to 14 (+1)
15:00 to 16:30			100 to 110 (+10)	29 to 32 (+3)
18:30 to 19:30	30 to 50 (+20)	13 to 14 (+1)	30 to 50 (+20)	13 to 14 (+1)
Total additional light vehicle traffic	50 (2)	5	50	5

Notes: (1) Light vehicles classified as cars, station wagons, light commercial vehicles and motorcycles.
(2) Imbalance in traffic entering and leaving the refinery is caused by vehicle movements outside the above time brackets. These have been included in the total additional light vehicle traffic.

The net increase in light vehicle traffic on South Western Highway, expressed on a daily basis, will thus be 100 vehicles north of the refinery and 10 vehicles south of it. This represents an increase of approximately 2 % over the 1991/1992 Average Annual Daily Traffic (AADT) counted just north of Waroona for traffic north of the refinery, and approximately 0.3 % over the 1991/1992 AADT counted north of Harvey for traffic south of the refinery. The above data is the most recent and nearest to the proposal available from the Department of Main Roads.

(iii) Based on modelling studies by Herring Storer Acoustics, predicted increases in traffic noise associated with the proposal are negligibly small.

(iv) All trains will continue to run to and from the refinery and the Port of Bunbury via Picton Junction and the main SouthWest regional line. Alumina trains will continue to run Monday to Saturday. The average number of alumina trains per day will increase from three to 4.5 (maximum five). Average train size will increase from 33 to 40 wagons.

The number of caustic soda trains will increase from an average of five to seven per week, with a maximum of two per day. Train size will increase from 18 to 22 wagons.

Train Arrival Times

Train	Current Schedule	Future Schedule
Alumina:		
arr. Wagerup	03:40, 11:30, 18:45	Every 5 hours 20 min.
arr. Bunbury	06:45, 15:15, 23.20	Every 5 hours 20min.
Caustic Soda:		
arr. Wagerup	13:15 (23.55)	13:15 (23:55)
arr. Bunbury	05:00 (18:00)	05:00 (18:00)

(v) The nearest non-Alcoa residence to the rail loop at the refinery is off the South Western Highway, approximately 500m from the loop. An Alcoa-owned residence is 200m away along Bancell Road. The additional train movements will result in an increase in the LAeq (24 hour) noise level 15m from the line of 2 dB(A) i.e. from 59 dB(A) to 61 dB(A), with no change in the maximum level of 88 dB(A). Noise levels at the nearest residences will remain well within the recognised criteria established by the NSW State Pollution Control Commission (LA max. 80dB(A) and LAeq (24 hour) 55 DB(A)).

Along the main South West rail line there will be a 0.3 dB(A) increase in the LAeq (24 hour) noise level at 15m. This is negligibly small. The maximum noise levels will not change.

The nearest residence to the rail line into the Port of Bunbury is approximately 200m away. The noise levels predicted for this residence are a maximum of 69 dB(A) and

LAeq (24 hour) of 36 dB(A). Although no residences exist close to the line, there are some properties that border it. For a traffic rate of 11 trains per day, the contour of the 80 dB(A) maximum and LAeq (24 hour) of 55 dB(A) is at a distance of 40m from the line.

(vi) A map showing the locations of the nearest residences not owned by Alcoa has been forwarded to the DEP.

(vii) Measured and predicted noise levels of the nearest non-Alcoa residences are included in the consultant's report forwarded to the DEP. The proposal is predicted to cause a very minor (1dB(A)) increase in noise levels at Boundary Road. However, noise measurements and modelling results indicate that the existing P.A. system, the calciner blower pipework, and a number of other sources, require additional noise suppression work. This work will be undertaken before the additional capacity is brought on line.

1.2 *Noise from the refinery's public address system affects residents at night time under certain wind conditions. Also certain noisy activities are understood to take place at the refinery at night. Is it possible for Alcoa to identify these tasks and manage the noise in a way that does not affect the neighbours?*

The two sources of noise known to have caused concern in the recent past are the public address system and the blowers associated with the calcination process. Alternative means of reducing noise from these sources are currently under review, after which appropriate noise control measures will be implemented. A consultant has been contacted to review the general issue of noise levels around the refinery (refer response to question B1.1).

2. Dust

2.1 *Is Alcoa aware of the alumina dust that blows off trains leaving the refinery, and the nuisance it causes to affected residents? What procedures can be implemented to minimise these impacts?*

The refinery is aware of this issue. As indicated in the CER, the problem is thought to have mainly been associated with trains loaded at Pinjarra. Upgrading of the loading facilities at Pinjarra was completed at the end of November 1994. The upgrading work is expected to largely eliminate the overfilling problem which was the main cause of the dust accumulation on the wagons.

2.2 *Northerly and north-westerly winds blow red mud dust into private residences located south of the refinery. Are these locations monitored, and what procedures will be implemented to reduce these impacts?*

A continuous sampler was installed on the south-eastern corner of the residue storage area in 1993, to sample dust loads from northerly and north-westerly winds. Before

1993 less frequent sampling occurred using a mobile sampler. The *average* dust level recorded in the south-eastern automatic sampler during 1993 was very similar to background levels; but strong winds do sometimes cause dust to be generated off the residue areas. Most of the strong winds are from the east or south-west, but they include the occasional north-westerly.

Residue area dust control measures have been and will continue to be improved as new techniques are developed and implemented. The dust control measures now in place are discussed in section 5.3.4 (p115-117) of the CER.

2.3 *What is the composition of the dust emitted from the refinery? Is this detrimental to the environment and human health?*

The main type of dust associated with an alumina refinery is calcined alumina dust. Calcined alumina (or aluminium oxide) is the principal product of the refinery. Small quantities of it become airborne during various production, transport and transfer operations.

Reviews of clinical studies on the inhalation toxicology of alumina dust have led the U.S. Occupational Safety and Health Administration and similar organisations to conclude that alumina dust is nothing more than a nuisance dust with no unique toxicological properties. As a consequence, the exposure standard applied by international, national and state authorities is the same as that for other inert or nuisance type materials. Many substances commonly used in agriculture and building materials, such as limestone and gypsum, fall into this category.

The red coloured dust which sometimes emanates from the residue storage area under strong wind conditions is primarily fine sand and silty material consisting of hydrated iron oxide, alumina, clays and other inert mineral compounds. It may also contain small quantities of sodium bicarbonate (a component of baking soda), lime and other alkaline compounds. The sodium bicarbonate is formed by the reaction of residual caustic soda from the refining process with carbon dioxide in the air.

Sodium bicarbonate becomes alkaline on contact with moisture and in sufficient quantity can become an irritant to mucous membranes. Studies at Kwinana by the W.A. Department of Agriculture found no adverse effects of residue dust on horticultural crops other than appearance.

2.4 *The DEP has received a submission indicating that dust or gaseous emissions from the refinery operations may be responsible for serious respiratory problems in a particular family located near the refinery. Please comment.*

Alcoa considers it important to investigate any complaint from a neighbour and would be particularly concerned to investigate a complaint where a possible health issue was involved. The company is not familiar with the situation described in this question and finds it difficult to respond in a meaningful way on the basis of the limited information provided.

We are not aware of any emissions from the refinery which would lead to serious respiratory problems. If such emissions did exist, it would be reasonable to expect that similar health problems would be prevalent among employees who work on the plantsite. This is not the case.

This issue will be investigated further following direct communication with the family concerned.

3. Odours and gaseous emissions

3.1 *There is insufficient information on atmospheric emissions in the CER document to allow an accurate assessment of the impacts from gaseous emissions. Please provide (in tabular form) information on existing and proposed emission levels, together with summarised data on performance and exceedances to date against standards.*

Air emissions were summarised in the CER, with reference to the annual and triennial Reviews of Environmental Research and Operations for those seeking greater detail on past performance. In measuring and assessing performance against licensed emission limits and other sources of guidance (such as the NHMRC National Guidelines), emphasis has traditionally been placed upon the concentration of key pollutants in emissions, since this is the form in which licence limits, guidelines and objectives are generally expressed.

It is recognised however that the aggregate loading of emissions to the environment can also be an important indicator of the potential for environmental impacts. The table below summarises the mass loadings, emission concentrations (mean and limits), and number of exceeding emissions measured for the pollutants nitrogen oxides (NO_X) and particulates. The other significant air emission from the refinery, carbon dioxide, is dealt with extensively in the discussion of greenhouse gas emissions in the CER. Sulphur dioxide is emitted very infrequently and consequently a mass emission rate is neither calculable nor significant.

Emissions of Air Pollutants and Performance Against Licensed Emission Levels
(1993/1994 as base year)

Pollutant	Mass Emission Rate (1)(tonnes/annum) Production Scenario:- Current	2.65 Mtpa	3.3 Mtpa	Emission Limit (2) (mg/m^3)	Mean Monitored Emission	Exceeding Emissions (%) (3)
NO_x:						
calciners	152	218	274	350	91	nil
boilers	895	1244	1404	"	244	11
gas turbine	--	183	183	70	n/a	n/a
oxalate kiln	< 1	< 1	< 1	350	4	nil
liquor burn	40	40	40	"	n/a (4)	n/a
Total	1087	1685	1901			
Particulates:						
calciners	48	70	87	250	29	nil
oxalate kiln	4	7	7		90	nil
liquor burn	32	32	32		n/a (4)	n/a
Total	84	109	126			

Notes:-

(1) Mass emission rates computed from mean monitored concentrations for existing units plus design specification concentrations for proposed units. Discharge rates calculated from mass balance on combustion process plus conveyancing air, less water of hydration and water formed in combustion process.

(2) For NO_x there is no licensed limit. The NHMRC recommended limits of 350 mg/m^3 (boilers) and 70 mg/m^3 (gas turbine) are used as a base for comparison. (Expressed on dry air basis, NTP, equivalent NO_2, referenced to 7% and 15% O_2 respectively).

(3) Percentage shown for NOx is for the limited number of monitoring determinations performed, which is regarded only as indicative of actual (continuous) performance.

(4) Kwinana liquor burner data used as a guide. Mean NO_x concentration 100 mg/m^3, mean particulate concentration 80 mg/m^3, 24 monthly determinations.

3.2 *Is the fuel oil, which is stored on site for emergency use, of the low sulphur type?*

As indicated on p92 of the CER, the emergency fuel oil supply contains 3.2% sulphur. This is a moderately high rather than low sulphur type fuel oil, which is considered adequate for the Wagerup situation where the refinery is the only major industrial facility in the area, and where the oil is an emergency fuel only.

3.3 *Is Alcoa aware that pungent odours released from the refinery are affecting neighbours during certain atmospheric conditions? What monitoring is done for odours, and what management procedures can be implemented to reduce the impacts with the neighbours?*

Only one complaint about odours has been received in recent years and this proved to be unsubstantiated. The source of the odour appeared to be the Yarloop sawmill. Odours from alumina refineries are the result of a complex interaction of gaseous emissions at extremely low concentrations. No monitoring system capable of detecting these emissions with anywhere near the sensitivity of the human nose exists.

Alcoa has a program of monitoring and R&D to identify and characterise the sources of odours and develop measures to control them. The program is based at the Kwinana refinery. Any practicable developments applicable to the Wagerup situation will be adopted.

3.4 *What are the implications for the proposed expansion in terms of national Greenhouse Gas emission targets?*

This subject is discussed in some detail in section 5.2.3 (p94-98) of the CER. The additional carbon dioxide emissions represented by this expansion will have a negative effect on achievement of the Australian interim planning target. An increase of approximately 0.2% on the 1990 national total carbon dioxide emission will occur. However, this will be accompanied by increased efficiency of energy use and lower production normalised emission rates.

Were the increased output of alumina represented by the proposed expansion to occur overseas, it is very likely that it would do so at significantly greater carbon dioxide emission rates, and thereby represent a greater negative impact on global reduction targets. That is because of Wagerup's position as a low energy consumer when compared to the worldwide average, coupled with the use of natural gas rather than coal or oil as the primary energy source.

Depending on the end use of aluminium produced from Wagerup alumina, a further contribution to lowering net global greenhouse gas emissions will accrue due to the energy advantage of aluminium in transport and other weight sensitive applications. These factors are beyond the scope of this document, but life cycle studies are proceeding in a number of organisations including Alcoa to authoritatively establish greenhouse emissions data based on aluminium end use.

Emission reductions due to aluminium end use will benefit the countries using the aluminium, while its production will negatively impact on target achievement in producer countries. As yet no internationally accepted means of accounting for these tradeoffs has been devised. Nor has the Australian Government yet adopted a position on how such tradeoffs should affect the interim target and attainment schedule.

4. Water Supply

4.1 *How sure is Alcoa that the diversion of 1100 Ml/yr from the South Samson Drain will not cause an environmental impact downstream?*

This issue was addressed in section 5.2.6 (p103-104) of the CER. There are a number of aspects of the current and proposed patterns of water extraction from the South Samson Drain which give cause for confidence that downstream environmental impacts will not be appreciable. These are outlined below.

(i) At present and after expansion, water extraction will only occur during the winter, when drain flow is at its highest. The amount of water extracted will be such as to leave a substantial amount (approx 92% of the mean June - September flow) for maintenance of baseflow.

(ii) The South Samson Drain is an artificial watercourse, where both water inputs and extraction are dominated by human intervention. Irrigation water can be diverted into the drain from a number of sources. Likewise, extraction of water occurs for a variety of purposes. Irrigation has been practised in the past and continues to be a major beneficial use of drain water. Water extraction takes place for both irrigation and stock watering. The further changes which will occur after refinery expansion will not represent a significant change to a natural watercourse, but rather an incremental modification to an already largely artificial flow regime.

(iii) As an artificial watercourse, the ecology of the drain is dominated by opportunistic colonisers able to readily adapt to newly available habitat. These tend to be robust plant and animal species which are widely distributed in streams and drains in the region. Consequently they are unlikely to suffer other than minor changes in abundance and distribution following alterations to streamflow as will occur here.

(iv) Any reduction in flow from the drain will be associated with reduced input of nutrients into the Peel-Harvey estuarine system. This contrasts with the effects of water resources developments in the Darling Range, which result in substantially larger reductions in the flow of good quality water into the system.

4.2 *What measures has Alcoa instigated in recent years to conserve and recycle water?*

Every practicable measure was taken in the original design of the refinery to conserve water. All runoff from the plant and residue storage area is collected, stored and reused. So too is drainage water from the residue area. Even the effluent from the sewage lagoon is added to the cooling pond for use in the refinery. No water is lost except by evaporation.

5. Utilisation of natural resources and benefits to the State

5.1 *What public discussion has taken place about the merits of using scarce resources such as natural gas and lime to make alumina? Are there better uses for these resources?*

There is no scarcity of either natural gas or lime in Western Australia. The State is abundantly endowed with these two natural resources, and Alcoa has no expectation that either will become scarce over the lifetime of its operations.

To Alcoa's knowledge the community has not indicated a priority of uses for either natural gas or lime. Alcoa is unable to respond to particular individuals' personal definitions of "better" and must look to Government and its instrumentalities for any reservation of particular resources for defined "better uses".

It is worth noting that were it not for the guaranteed base load of gas consumption provided by Alcoa, the Dampier to Perth gas pipeline would not have been built until much later, if at all. More of the gas from the North West Shelf would have been exported as a raw material without any value adding in Western Australia.

5.2 *Please comment on the following statement: "Under the current economic system there would be more long term benefit to Alcoa's shareholders to take the money and run, whereas the long term for society as a whole may be better served by a low rate of mining while values are low."*

This question seems to assume that there is a correlation between profitability and economic benefit. That is not the case. The attached data on economic inputs show that there has been an almost-uninterrupted increase over the past 10 years in the economic value that Australia and Western Australia have derived from Alcoa's operations. During this period the company's profitability has fluctuated considerably. In effect, it requires an irreducible amount of money to convert bauxite to alumina, whereas the market value of that alumina is variable, and the company's profit is the "shock absorber" that transfers most of the negative economic effects of downturns to the shareholders rather than to the community.

Alcoa sells alumina and aluminium in Australia and overseas. It also purchases goods and materials and pays interest and dividends in Australia and overseas. The difference between overseas earnings and overseas expenditure represents Alcoa's contribution to Australia's balance of payments - a critical factor in creating new national wealth. Alcoa's net contribution to Australia's balance of payments has average $3.8 million every day of the year for the past five years.

CONTRIBUTION TO BALANCE OF PAYMENTS
(ALCOA OF AUSTRALIA)

	Overseas Receipts	Overseas Payments	Net Bop Contribution
1984	$ 964m.	$ 275m.	$ 689m.
1985	$ 931m.	$ 351m.	$ 580m.
1986	$ 860m.	$ 219m.	$ 641m.
1987	$1182m.	$ 220m.	$ 962m.
1988	$1608m.	$ 363m	$1245m.
1989	$2387m.	$ 733m.	$1654m.
1990	$2530m.	$ 925m.	$1605m.
1991	$2118m.	$ 742m.	$1376m.
1992	$1852m.	$ 744m.	$1108m.
1993	$1866m.	$ 511m.	$1355m.

Input to the Western Australian economy through wages to W.A. employees, payment of W.A. Government charges, and the purchase locally of goods and services, have risen to more than $900 million annually.

INPUTS TO W.A. ECONOMY

	WA Net Payroll	WA Gov't Charges	WA Bought Goods	WA Bought Services	Total Input
1984	$ 88m.	$ 47m.	$137m.	$166m.	$438m.
1985	$ 95m.	$ 40m.	$184m.	$237m.	$556m.
1986	$ 87m.	$ 47m.	$112m.	$211m.	$457m.
1987	$ 93m.	$ 49m.	$128m.	$225m.	$495m.
1988	$104m.	$ 57m.	$182m.	$225m.	$568m.
1989	$121m.	$ 72m.	$290m.	$209m.	$692m.
1990	$128m.	$ 79m.	$233m.	$293m.	$733m.
1991	$148m.	$ 81m.	$422m.	$335m.	$986m.
1992	$152m.	$ 85m.	$368m.	$296m.	$901m.
1993	$171m.	$ 98m.	$323m.	$322m.	$914m.

5.3 *What are the benefits to the State of mining and processing the same bauxite resource over 100 years, as opposed to 50 years (at double the rate)?*

Alcoa is unable to identify any benefits that the State would obtain by prolonging bauxite mining through artificially restraining the company's response to market demand. A number of risks are, however, apparent in such a scenario.

(i) Increased access to a resource provides better economies of scale, and, other market forces being equal, yields a more profitable operation. Higher levels of

profit inevitably lead to increased social benefits across a whole range of factors. There is ample evidence that communities with marginal or loss-making enterprises exhibit negative characteristics ranging from lower health standards through to greater environmental degradation.

(ii) The experience of the past three decades shows a continuous increase in productivity, particularly when comparing more modern refineries such as Wagerup with older facilities such as Kwinana. The competitiveness of the smaller W.A. refineries is likely to decline with time as newer refineries are established overseas; particularly those in developing countries with lower wage structures.

(iii) Huge amounts of alumina are contained in clays throughout the world, including the United States of America, which has no operating bauxite mines. If a breakthrough in winning alumina from these clays were developed, northern hemisphere economies would be inclined to use their own resources rather than ship alumina from distant points like Western Australia. In this scenario, the State would be seriously disadvantage by such a breakthrough if in 50 years time alumina from the remaining bauxite reserve became unsaleable.

Under even the most optimistic expansion scenario the State has at least 50 years to plan for the eventual depletion of the Darling Range bauxite reserves. It is the responsibility of governments to make the wisest possible investment of the substantial taxes and royalties generated by the operations during their lifetime.

5.4 *Is part of Alcoa's rationale to expand its alumina operation due to a belief that energy prices will rise in the next 50 years, and that it would not be able to produce alumina and aluminium as cheaply then as now?*

No. Alcoa has established a position as the major supplier of alumina in the world, accounting for some 15% of the world market from the three WA refineries. There are distinct advantages in maintaining this pre-eminent position, and as the world market grows, strategically the company needs to maintain or improve its competitive position. The history of long-range energy forecasts (i.e. past about five years) is so unreliable that none of Alcoa's planning is based on such factors.

5.5 *What preference does Alcoa give to the use of supplies and services produced within the state, as opposed to interstate and overseas? What is the extent of overseas supplied products consumed by Alcoa, and would this increase proportionately with the proposed expansion?*

Where goods or services meet the company's criteria, which do not include point of origin (partly because of Australia's obligations as a member of GATT), Alcoa prefers to buy from Western Australian suppliers. Apart from the company's responsibilities as a corporate citizen of W.A., it simply makes good commercial sense to develop strong customer-supplier relationships and that is generally easier to achieve with local suppliers.

The response to question B5.2 includes data which show Alcoa's national operations as an element in Australia's balance of payments. In 1993 Alcoa bought only $289 million worth of materials and services from overseas, compared with gross foreign sales of $1,866 million. After the expansion there would tend to be a slight lessening of the proportion of overseas purchases, since overseas materials other than caustic soda tend to be one-off capital items whereas local purchases tend to be recurrent items. However, fluctuations in the price of caustic soda also affect the ratio of domestic to overseas purchases on a year to year basis.

6. Environmental policy on supplies

6.1 *What is Alcoa's policy in regard to the environmental impacts created by manufacturers of commodities used by the company?*

Contracts for procurement of raw materials are conducted by Alcoa in accordance with conventional commercial ethics and practice. Although there is no formal policy relating to the environmental performance of individual suppliers, Alcoa's corporate values are such that it would be concerned if unacceptable environmental impacts occurred in the provision of services or materials to the company.

All medium to large-scale industrial activities in Western Australia are subject to the provisions of the Environmental Protection Act and operate in accordance with pollution control licences issued by the DEP. In normal circumstances Alcoa would therefore assume that these activities were being conducted in an environmentally acceptable manner.

In cases where a particular operation may not be subject to the same level of regulatory attention, or where substantial environmental risks may be involved, Alcoa would consider the need to conduct an independent environmental assessment. For example, it has audited the practices of its waste disposal contractors.

6.2 *How does Alcoa rationalise the procurement of lime from a supplier that is destroying some of the last remaining seagrasses in Cockburn Sound, particularly when it recently had the opportunity to procure lime from other companies with more environmentally benign land-based deposits?*

Alcoa has held discussions with Cockburn Cement Limited, has attended a meeting of the Coastal Waters Alliance and discussed their concerns, obtained independent information from a number of scientists involved in seagrass studies and examined Cockburn Cement's 1994 CER and the EPA's Report and Recommendations to the Minister for Environment. The company has also undertaken studies of alternative land-based suppliers. The following points are relevant.

(i) The shellsand dredging operations are being undertaken in Owen Anchorage, not Cockburn Sound. Most of the seagrass losses in Cockburn Sound occurred in the 1970s and were not in any way associated with shellsand dredging operations.

(ii) Although there has been a significant loss of seagrass in Cockburn Sound itself, there are more than 14,000 ha of seagrass beds off the metropolitan coastline.

(iii) Alcoa is satisfied that Cockburn Cement has responded positively and effectively to the EPA's requirement that it prepare a comprehensive environmental management plan (EMP) for its future operations. The EMP will be published in February 1995.

(iv) The EMP will, if implemented, represent a significant advance in environmental monitoring, assessment and rehabilitation relating to seagrass and may well serve as a model for other resource industries.

(v) Contrary to the implication in this question, lime resources of comparable quality are not readily available. Furthermore, the provision of lime from alternative land-based sources is unlikely to be more environmentally benign, particularly in view of the major transport issues involved.

Alcoa notes that this matter has been reviewed in considerable detail by the relevant decision-making authorities, and on the basis of the foregoing, sees no justification for intervention on its part. The EMP will be subject to public review and further assessment at the end of the proposed 5 year program. Alcoa will follow the progress of the EMP with interest.

7. Bauxite residue

7.1 What specific uses for the residue areas have been considered other than pasture? What has been the reaction of the local community regarding these uses?

Alcoa, in association with relevant government agencies, has commenced a process to develop a closure strategy or long-term management plan for the residue deposits which satisfies the W.A. Government and the local community. These plans are in an embryonic stage including the consideration of future land use. The views of the community are actively being sought on this and other issues.

Demonstrating rehabilitation of the deposits and alternative land uses is one of Alcoa's primary residue management objectives. However, all residue storage areas at Wagerup are still active so opportunities are limited in the short term. At Pinjarra refinery 25ha has recently been rehabilitated to demonstrate and evaluate a range of vegetation types including pasture and native species as well as more intensive soil improvement and species selection trials. The demonstration area will be made available for public tours and feedback will be sought.

Future land use plans must be compatible with the physical nature of the deposits and not result in excessive maintenance or future liability; however, Alcoa believes that a flexible approach which identifies a range of compatible and sustainable future land uses will best serve the community.

7.2 What are the levels of radioactivity in the residue, and how does this relate to allowable dosages to human health? How would these levels affect alternative land uses?

Darling Range rocks and soils including bauxite contain trace quantities of thorium and uranium. During the refining process in which bauxite is converted to alumina, the radioactive minerals tend to stay with the fine bauxite residue material. Hence their concentrations in the residue mud fraction are proportionately higher than in the parent bauxite. Alcoa has monitored the radiation levels in the refinery and on the residue deposits and the values are similar to background levels measured in parts of the Darling Range.

If a person's exposure to this bauxite-related radiation is treated as an incremental dose, and assuming normal times of exposure for refinery workers, the calculated dosage is below the World Health Organisation recommended level for members of the general public of 1 millisievert per year.

Possible additional radiation exposure is one issue that must be weighed up before deciding an appropriate future land use for residue deposits. It is possible that land use which results in 100% occupancy by people, such as residential development, may not be recommended (other factors also mitigate against this particular end use). The radiation levels are too low to be of concern for agriculture land uses or for use of residue for amending agricultural soils in accordance with the Department of Agriculture's Code of Practice.

7.3 *Is there still a loss of bird life in the caustic lakes at the refinery and is this likely to change with the proposed expansion?*

Residue storage operations at all three refineries use 'dry stacking' as distinct from the original process of wet slurry impoundment. From an environmental point of view this has reduced the overall area of land utilised for residue storage. It has also reduced the wet surface areas potentially available for bird landings by approximately 80% at each location.

During the 1969-79 period of wet residue storage, recorded bird deaths at Kwinana ranged from 23 to 83 annually. Records for 1994 indicate four deaths at Kwinana and similar low numbers at Pinjarra and Wagerup. The new process water storage facility at the residue area will contain water of relatively low alkalinity which is not expected to cause a significant increase in the currently low number of bird deaths.

8. Buffer zones

8.1 *What work has been done to show what is an appropriate buffer zone for the refinery? i.e. noise, dust gaseous emission modelling.*

Rather than determine an arbitrary buffer zone distance, refinery environmental management practice is aimed at adherence to ambient air quality standards or

neighbourhood noise regulations where legislatively established, or to internally generated standards based upon existing standards elsewhere where no W.A. standard exists.

Noise modelling has recently been undertaken as part of the action required to respond to question B1.1. Because natural gas is a relatively clean fuel which when burnt has no emissions of SO_2 or other noxious gases, atmospheric dispersion modelling has been considered unnecessary except as an aid in the location of ancillary plant such as the liquor burner.

8.2 *How does this buffer zone relate to recognised standards for similar industries?*

The concept of "recognised standards" for buffer zones is contentious. Alcoa has referenced the Victoria EPA document *Recommended Buffer Zones for Industrial Residual Air Emissions, Publication AQ2-86 (1986)* in the absence of any comparable Western Australian recommendations. The Victorian EPA recommendation is for a 1000m buffer for an alumina refinery. Buffer requirements for bauxite residue storage areas are not specified in the document.

The *Environmental Protection (Kwinana) (Atmospheric Waste) Policy 1992* entrains the establishment of a three kilometre buffer between the prescribed industrial zone and residential development at Kwinana. The same EPP accepts a 200m buffer between bauxite residue storage operations and potential future residential development. Alcoa has always contended this latter distance is grossly inadequate.

8.3 *What are the compatible and incompatible land uses within this buffer zone?*

Assuming a hypothetical buffer zone of 1000m as per the recommendation of the Victorian EPA, all of the surrounding land at Wagerup is used for agricultural purposes and Alcoa believes this is fully compatible with its operations.

There are no residences other than those owned by Alcoa within 1000m of the main plant area. One residence is approximately 1000m from the north-western end of the bauxite stockpile and four are within 1000m of the rail loop (although all five residences are much closer to the South Western Highway and railway than they are to either the plantsite or the rail loop into the plantsite).

8.4 *How much of the land within the appropriate buffer zone is owned by Alcoa?*

Using a hypothetical buffer zone of 1000m for the plantsite, only a small area south of Bancell Road is within the buffer zone and not owned by Alcoa. Three additional non-Alcoa properties are within 1000m of the rail loop.

One non-Alcoa property lies between the southern embankment of the residue storage area and Bancell Road. The nearest boundary to non-Alcoa property in this area is

approximately 300m. However, the nearest private residence not owned by Alcoa is 1300m away from the nearest residue embankment.

8.5 *What measures are in place and planned to prevent the inappropriate use of land within the buffer zone?*

A comprehensive land management plan is currently being developed for Alcoa's Wagerup land holdings. Its primary objective is the identification of land uses which maximise opportunities for best use of the land whilst minimising the potential for conflict with social, agricultural, conservation and industrial objectives for the district generally. This will inevitably protect against the establishment of inappropriate land uses on land owned by Alcoa. The company has no means of influencing land use on private properties owned by others, other than providing advice to property owners and planning agencies.

9. Other community impacts

9.1 *On what basis does Alcoa support local business?*

Alcoa's current Wagerup and Willowdale operations purchase goods and services from local businesses at an annual rate of $5.7 million. These include: earthworks, material cartage, haul road construction, office and facilities cleaning services, vehicle servicing and parts, gardening & landscaping services, and minor maintenance/construction services & materials.

The company provides direct employment for 200 people from the Shire of Waroona and 120 people from the Shire of Harvey. It also uses contractors who employ approximately 75 local people to service their Alcoa contracts. This in turn creates further demand for local employment and cash flow to the communities.

Expansion of Wagerup's capacity would see significant increases in these levels of local business support and employment in an ongoing sense as well as during the construction phases.

9.2 Does Alcoa encourage its staff to locate in the local area?

Alcoa encourages new employees to locate in the district at the time of being offered employment. This is achieved by outlining community facilities and housing options available in the Waroona and Harvey areas. An information booklet developed by the Shire of Waroona is also given to each new employee.

Wagerup Refinery and Willowdale Mine also source new employees from these local areas provided they meet the position specifications. To assist this, position are advertised in the Waroona and Harvey community newspapers. Alcoa also selects employees for apprenticeships and work experience only from the Waroona and

Harvey area, again provided the position requirements are satisfied. Temporary and casual employees also are sourced only from local areas.

9.3 *To what extent does Alcoa's operations affects quality of life and property values in the area now and in the future?*

Alcoa has favourably contributed to the quality of life in the local communities in the following ways:

i) commercial support for local businesses, leading to improved commercial and retailing facilities in some instances;
ii) significant contributions of money and resources to community groups and facilities, such as sporting clubs, welfare groups, schools, libraries and conservations groups;
iii) attracted new residents to the local shires - 320 Alcoa employees and their families live in the Waroona and Harvey shires;
iv) many Alcoa employees are active members of local community groups, such as Rotary, Lions and sporting clubs.

Data is currently unavailable which could quantify the impact of Alcoa's presence in the local area on property values. However, it is reasonable to assume that with increasing population and business activity, demand for property would increase and hence values would rise. As indicated in the CER, the rate of population growth in the Shire of Waroona in the 15 years after land was purchased for the refinery was quadruple that for the preceding 15 years.

9.4 *What is the procedure for handling and following up complaints on issues such as noise, dust and odours generated for the refinery?*

Wagerup has a documented complaint procedure. This is used by all employees when a complaint is received external to the company. When the details of the complaint have been recorded, the complaint is then passed to the manager of the area which is the source of the problem. The Environmental Manager is also informed. The findings of the investigation are reported back to the complainant by either the Area Manager or Environmental Manager.

9.5 *Please comment on the statement: "Local residents have had to endure all the problems associated with the refinery and its impact on the community and in return have received a few token gifts".*

Alcoa considers the contributions outlined in the responses to questions 9.1 - 9.3 above and in section 2.2 of the CER to be substantial rather than "token". The company actively seeks to minimise any negative impacts of its operations by surveying its employees and local residents, reacting expediently to complaints and other feedback, and continuously improving its environmental management performance.

Appendix 5

List of submitters

LIST OF SUBMITTERS

Bunbury Port Authority

Department of Conservation and Land Management

Water Authority of Western Australia

Shire of Harvey

Mining and Management Programme Liaison Group

Conservation Council of Western Australia

Mrs S Edwards

Jeanette and Nigel Sinclair

Anne and Garry Lalor

Warwick Boardman

Alisoun Devlin

Peter Taylor

Margaret McKay

Bernie Masters

Peter and Cheryl Borserio

Frank Wood

Appendix 6

Principal environmental issues of concern in the Public Submissions

Bauxite mining

- Flora and fauna conservation:
  - conservation (ecological diversity, forest fragmentation);
  - down-slope and stream-zone vegetational impacts;
  - dieback management; and
  - impacts onaquatic fauna.
- Rehabilitation:
  - preservation of ecological diversity;
  - sustainability and completion criteria;
  - jarrah re-establishment;
  - seed collection;
  - rate of rehabilitation;
  - social considerations;
  - fauna habitats; and
  - monitoring and auditing.
- Water resources:
  - water harvesting;
  - mining in catchments for public water supplies (Samson Dam, Samson Pipehead Dam and Waroona Dam) ;
  - salinity impacts; and
  - impacts on water supplies to private properties (Lots 471, 626).
- Noise:
  - mine operations;
  - overland conveyor; and
  - blasting;
- Dust:
  - overburden removal;
  - haul roads;and
  - blasting.
- Public impacts:
  - impact on private properties and community facilities (buffer zones, noise and dust issues);
  - public safety;
  - roads;
  - traffic;
  - recreation; and
  - community consultation.
- Bauxite resource utilisation:
  - optimisation and use of the bauxite resource;
  - relinquishment of previously sterilised areas; and
  - consideration of environmental criteria in mine planning decisions.
- Interaction with other forest users:
  - timber industry interaction;
  - waste timber utilisation;
  - gravel supplies; and
  - recreational activities.

Refinery impacts

- noise:
  - public address system;
  - fans and blowers; and
  - road and rail traffic
- dust:
  - bauxite;
  - red mud residue; and
  - alumina.
- gaseous emissions:
  - odours;
  - nitrogen oxides; and
  - greenhouse gases.
- buffer zones:
  - identification; and
  - zoning changes.
- groundwater and surface water protection
- residue disposal:
  - development of long term solution; and
  - alternative uses.

Appendix 7

Environmental Conditions for existing Wagerup operations

Ass # 317

Bull # 423

State # 095

WESTERN AUSTRALIA

MINISTER FOR ENVIRONMENT

STATEMENT THAT A PROPOSAL MAY BE IMPLEMENTED (PURSUANT TO THE PROVISIONS OF THE ENVIRONMENTAL PROTECTION ACT 1986)

WAGERUP ALUMINA REFINERY EXPANSION

This proposal may be implemented subject to the following conditions:

1 The proponent shall adhere to the proposal as assessed by the Environmental Protection Authority and shall fulfil those commitments made in the 1978 Environmental Review and Management Programme and its Supplement which are still relevant, and the commitments made in the 1989 Consultative Environmental Review (copy of consolidated commitments attached).

2 To ensure that mining schedules for the proposal are integrated with forest management schedules, the proponent shall liaise closely with the Department of Conservation and Land Management throughout the life of the project, to the satisfaction of the Minister for Environment.

3 Within 12 months of the commencement of the expanded operations, the proponent shall commence development of a 'walk-away' solution for the bauxite residue disposal sites used for this refinery, and shall report annually on progress towards developing such a solution, to the satisfaction of the Minister for Environment. This solution shall be subsequently implemented, to the satisfaction of the Minister for Environment. The time when this solution is to be implemented shall be determined by the Minister for Environment on the advice of the Minister responsible for administering the Alumina Refinery (Wagerup) Agreement Act 1978.

A 'walk-away' solution means that the bauxite residue disposal sites shall either no longer require management at the time the proponent ceases refining operations, or if further management is deemed necessary, the proponent shall make adequate provision so that the required management is undertaken with no liability to the State.

4 The proponent shall consider the minimising of 'greenhouse' gas emissions as a major factor in the selection of energy generation options, and shall advise the Minister for Environment of the conclusions and findings.

5 To minimise social disruption to the Waroona district, the proponent shall establish formal liaison and monitoring processes with the Shire of Waroona, to the satisfaction of the Environmental Protection Authority upon advice from the Social Impacts Unit.

6 The proponent shall be responsible for decommissioning and removal of the plant and rehabilitating the site and environs of the expanded facility, to the satisfaction of the Environmental Protection Authority. At least six months prior to decommissioning, the proponent shall prepare for the expanded facility and its site, a decommissioning and rehabilitation plan, to the satisfaction of the Environmental Protection Authority.

7 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 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.

Published on

- 8 MAR 1990

12th FLOOR, ALLENDALE SQUARE, 77 ST GEORGE'S TERRACE, PERTH, W.A. 6000 TELE...

PROCEDURES

Where the proponent is required to provide reports to the Minister for Environment, it will be adequate to incorporate such reports within those required under the Alumina Refinery (Wagerup) Agreement Act 1978, and the Minister responsible for administering that Act shall forward the relevant information to the Minister for Environment in order to meet the conditions.

Bob Pearce, MLA
MINISTER FOR ENVIRONMENT

- 8 MAR 1990

WAGERUP ALUMINA REFINERY EXPANSION - COMMITMENTS

All but one of the major environmental management commitments made in the supplementary Environmental Review and Management Programme of 1978 are still considered relevant. Alcoa believes its commitment to dieback research is adequately covered in Item 6.4, repeated below as 9. There is no continuing justification for dieback research to be considered separately. Additional or modified commitments are proposed in the areas of residue disposal, dieback management and forest conservation. A restatement of the major environmental management commitments is given below. The proposed changes (printed in heavy type) mainly reflect the importance placed on these issues in Alcoa's current environmental management programme.

(1) In addition to the 10-year mining plans to be submitted to the State under Clause 5 of the Wagerup Agreement, Alcoa will also prepare and submit to the State mining and management programmes which will specify such matters as the areas which it is proposed to mine, the method of mining, and the proposed methods of rehabilitation in accordance with procedures to be agreed between Alcoa and the State. Alcoa undertakes to consult closely with the State on the preparation of these programmes and not to implement these programmesuntil agreement to them has been reached with the State or they have been determined by arbitration.

(2) **Bauxite** mining will not take place in the eastern, lower rainfall portion of Alcoa's lease, until research shows that mining operations can be conducted without significantly increasing the salinity of water resources.

(3) Alcoa undertakes to formulate its detailed rehabilitation proposals to best suit the land use priorities established by the State for the particular mining area concerned.

(4) Alcoa will monitor the success of all its rehabilitated mined areas in co-operation with the Department of Conservation and Land Management and, if necessary, is prepared to carry out further treatments **up to the time when it is agreed that CALM should resume full management responsibility.**

(5) **Alcoa will forego the bauxite resources in the Jarrah forest conservation areas agreed in consultation with the State's Reserves Review Committee and specified in the Alumina Refinery Agreement Amendment Act, No 99 of 1986, for as long as their conservation values remain. Mining adjacent to the conservation areas will utilise site-specific environmental management procedures agreed in consultation with the Mining and Management Programme Liaison Group. These will include particular consideration of dieback management and mine rehabilitation requirements.**

(6) **Alcoa will implement a comprehensive dieback management programme designed specifically for its mine operations in the Jarrah forest.** This will include the rehabilitation of dieback-affected areas adjacent to its mine operating areas, in accordance with procedures agreed with State agencies, and irrespective of the cause of introduction of the disease.

(7) **Alcoa will prepare detailed design reports on future residue disposal areas and submit them to the Water Authority of Western Australia for approval. The design reports will include consideration of slope stability, seepage control, groundwater monitoring and construction and operating procedures. Results from monitoring programmes will be reported to the Water Authority at intervals determined by agreement with the Authority.**

(8) **Alcoa will develop long-term management plans for the residue deposits including consideration of surface drainage, seepage control, groundwater management, slope stability, surface rehabilitation, aesthetic impact and future land use. Such plans will be formulated in consultation with relevant State agencies and will include agreement with the State on responsibilities for any ongoing management requirements after decommissioning of the refinery. Concept plans will be formulated by 1994 and reviewed periodically**

thereafter. Alcoa will recover and treat **or reuse alkaline** solutions in the residue disposal areas until such times as it is demonstrated that such solutions do not pose an environmental hazard.

(9) Alcoa is committed to an ongoing research programme into all aspects of its operations that have the potential to adversely affect the environment, and into those environmental characteristics that could be adversely affected by its operations.

(10) **Alcoa will submit a brief review of its environmental research and management programme to the Department of Resources Development on an annual basis. Copies will be made available to relevant State agencies and the Shire of Waroona. A more detailed review will be prepared on a triennial basis.**

(11) Alcoa will co-operate in a joint community services monitoring programme in conjunction with the State and the Shire of Waroona to monitor socio-economic effects of the project and provide input for community services planning.

(12) Alcoa will dismantle its facilities at the termination of mining and refinery operations and carry out reasonable restoration measures at the sites of those operations providing such facilities are not required for other purposes.

BULDDBWAGERUP:clb

Appendix 8

Consolidated list of proponent's commitments

Consolidated list of proponent's commitments

Mine planning and forest management

(1) In addition to the 10-year mining plans to be submitted to the State under Clause 5 of the Wagerup Agreement, Alcoa will also prepare and submit to the State mining and management programmes which will specify such matters as the areas which it is proposed to mine, the method of mining, and the proposed methods of rehabilitation in accordance with the procedures to be agreed between Alcoa and the State. Alcoa undertakes to consult closely with the State on the preparation of these programmes and not to implement these programmes until agreement to them has been reached with the State or they have been determined by arbitration.

(2) Alcoa will plan and manage its mining operations to minimise disturbance to biologically diverse areas fringing major rock outcrops and stream zones. Appropriate buffers will be maintained between these areas and minepit boundaries. Stream crossings will be constructed in a manner which facilitates their removal and rehabilitation after use, unless required for ongoing forest management or other purposes agreed with the State's Mining and Management Programme Liaison Group (MMPLG).

(3) Alcoa will continue its programme of biological surveys and support of activities contributing to the conservation of rare, endangered and priority species existing within the vicinity of its mining operations.

Water resources

(4) Bauxite mining will not take place in the eastern, lower rainfall portion of Alcoa's lease, until research shows that mining operations can be conducted without significantly increasing the salinity of water resources.

Mine rehabilitation

(5) Alcoa undertakes to formulate its detailed rehabilitation proposals to best suit the land use priorities established by the State for the particular mining areas concerned.

(6) Alcoa will monitor the success of all its rehabilitated mined areas in co-operation with the Department of Conservation and Land Management (CALM) and, if necessary, is prepared to carry out further treatments up to the time when it is agreed that CALM should resume full management responsibility.

Forest conservation

(7) Alcoa will forego the bauxite resources in the jarrah forest conservation areas agreed in consultation with the State's Reserves Review Committee and specified in the Alumina Refinery Agreement Amendment Act, No 99 of 1986, for as long as their conservation values remain. Mining adjacent to the conservation areas will utilise site-specific environmental management procedures agreed in consultation with the MMPLG. These will include particular consideration of dieback management and mine rehabilitation requirements.

(8) Alcoa will defer mining indefinitely the bauxite resources in the facilities section of the recreation zone of the Lane Poole Reserve as defined in Figure 10 of the 1994 Consultative Environmental Review. Ore extraction in the remaining areas of the recreation zone will exclude the steep slopes of the Murray River valley and will be undertaken in accordance with site-specific environmental management procedures agreed with the State's MMPLG after consultation with CALM and the Lane Poole Reserve Advisory Committee.

Dieback management

(9) Alcoa will implement a comprehensive dieback management programme designed specifically for its mine operations in the jarrah forest. This will include the rehabilitation of dieback-affected areas adjacent to its mine operating areas, in accordance with

procedures agreed with State agencies, and irrespective of the cause of introduction of the disease.

Residue disposal

(10) Alcoa will prepare detailed design reports on future residue disposal areas and submit them to the Water Authority of Western Australia (WAWA) for approval. The design reports will include consideration of slope stability, seepage control, groundwater monitoring and construction and operating procedures. Results from monitoring programmes will be reported to WAWA at intervals determined by agreement with WAWA.

(11) Alcoa will develop long-term management plans for the residue deposit including consideration of surface drainage, seepage control, effluent treatment and discharge, groundwater management, slope stability, surface rehabilitation, aesthetic impact and future land use. Such plans will be formulated in consultation with the State's Residue Planning Liaison Group and will include agreement with the State on responsibilities for any ongoing management requirements after decommissioning of the refinery. Initial concept plans will be formulated by the end of 1994 and reviewed periodically thereafter. Alcoa will recover and reuse, or treat and discharge, alkaline solutions draining from or flowing off the residue storage areas until such times as it demonstrated that such solutions do not pose an environmental hazard.

Environmental research

(12) Alcoa is committed to an ongoing research programme into all aspects of its operation that have the potential to adversely affect the environment, and into those environmental characteristics that could be adversely be affected by its operations.

(13) Alcoa will submit a brief review of its research and management programme to the Department of Resources Development on an annual basis. Copies will be made available to relevant State agencies and the Shire of Waroona. A more detailed review will be prepared on a triennial basis.

Social impact

(14) Alcoa will co-operate in a joint community services programme in conjunction with the State and the Shire of Waroona to monitor socio-economic effects of the project and provide input for community services planning.

Decommissioning

(15) Alcoa will dismantle its facilities at the termination of mining and refinery operations and carry out reasonable restoration measures at the sites of those operations providing such facilities are not required for other purposes.

Noise monitoring

(16) Noise monitoring undertaken for assessment purposes in association with the commitments outlined below will be undertaken by a recognised acoustical consultant, in consultation with the Department of Environmental Protection (DEP). Ongoing monitoring will be undertaken by Alcoa personnel appropriately trained in the measurement of environmental noise.

(17) Noise levels will be monitored periodically at designated reference points and reported in the Review of Environmental Research and Operations submitted annually to the Department of Resources Development, and distributed to relevant state and local government agencies.

Noise management - current operations

(18) Alcoa will commission additional studies to verify predicted noise levels in the vicinity of the Wagerup Refinery and Willowdale Mine operations. Where these studies confirm that noise abatement is necessary, a program will be developed to reduce noise emissions by all practicable means as defined in the Environmental Protection Act 1986. This program

will aim to comply with the draft (1995) environmental noise regulations under the Environmental Protection Act; or should they differ, with the environmental noise regulations promulgated subsequently. A copy of the noise control program, together with timelines for the completion for the measures specified in it, will be forwarded to the DEP by 31 July 1995. The program will be implemented by 30 November 1996 and a report demonstrating its effect will be forwarded to the DEP by 31 December 1996. The report will contain details of proposed reference points for future noise monitoring purposes.

Noise management - proposed expansion

(19) Alcoa will design the mining and refining plant and bauxite conveyor systems associated with the expansion to meet the draft (1995) environmental noise regulations under the Environmental Protection Act, and operate them in accordance with the environmental noise regulations promulgated subsequently.

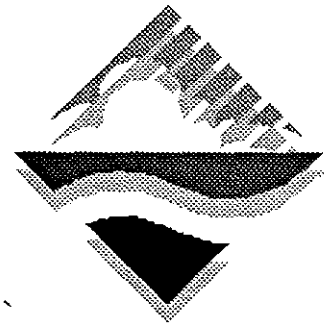
(20) Alcoa will commission an authoritative assessment of noise emissions associated with its mobile mining operations at Willowdale, and will reach agreement with the DEP by 31 December 1995 on a practicable noise management procedure for future mining operations in the vicinity of noise sensitive premises. Details of the noise management plan for operations within areas subject to the noise management procedure, including any noise monitoring to be undertaken and reporting of results obtained, will be included in subsequent five year mining and management plans submitted annually to the MMPLG.

Noise management - transport

(21) Alcoa will review the proposed extension of the hours of its contracted lime trucking operation in consultation with the Shires of Waroona and Murray, taking into account relevant factors including safety, noise, cost and traffic density. The results from this review will be communicated to the DEP by 31 July 1995. Future contractual arrangements will incorporate an appropriate reference to a recognised vehicle noise standard such as ADR 28/01.

Appendix 9

Assessment by the Department of Environmental Protection of Herring Storer noise report



DEPARTMENT OF ENVIRONMENTAL PROTECTION

POLLUTION PREVENTION DIVISION

ASSESSMENT OF LIKELY NOISE IMPACT OF PROPOSED EXPANSION OF THE ALCOA WAGERUP REFINERY AND WILLOWDALE MINE

Report No. EN 07/95
March 1995

INTRODUCTION AND SUMMARY

This report presents the results of an assessment of the likely noise impacts of the proposed expansion of the Alcoa Wagerup Alumina Refinery and the Willowdale Mine. This assessment is based partly on the Consultative Environmental Review (CER) report of October 1994 prepared by the proponent, Alcoa of Australia Limited, but primarily on additional information provided by the proponent including two acoustic reports prepared by Herring Storer Acoustics. This additional information was prepared in response to a request by the Department of Environmental Protection (DEP) for information further to that provided in the CER report.

The assessment is dealt with in three sections, Mining, Refinery and Transportation. The mining and refinery operations are assessed in terms of both the existing noise regulations and the current (1995) draft of a proposed set of new noise regulations.

The assessment indicates that there are likely to be breaches of the existing noise regulations occurring in relation to the mining operations, the overland conveyor between the mine site and the refinery, and the refinery itself. If not addressed in an effective manner, these exceedances would be likely to continue under the proposed expansion.

This issue is dealt with in this assessment through recommendations which would require a series of noise management plans to be prepared to cover mining operations, conveyor noise and the refinery. These are designed to cause the noise levels of existing operations to be reduced to comply with the proposed noise regulations by the time of startup of the expanded operations and to similarly control the proposed operations.

Significant noise impacts are also identified in relation to transportation operations, in particular the train movements between Wagerup and Bunbury and the trucking of lime at night through the towns of Pinjarra and Waroona. The recommendations in this report include a study into rail noise, to identify the extent of noise impact and options for practical ameliorative measures.

MINING

The assessment of noise from the Willowdale Mine expansion is contained in the report by Herring Storer Acoustics (HSA) Reference 2936-95029, dated February 1995, with additional information in the letter to the DEP from Alcoa of Australia Ltd, dated 10 February 1995.

Noise Criteria -

The noise criteria in Section 3.0 of the HSA report mention both the existing Noise Abatement (Neighbourhood Annoyance) Regulations 1979, which are currently the prescribed standard for noise under the Environmental Protection Act 1986, and also proposed regulations to come under the EP Act. Using the Neighbourhood Annoyance regulations, the HSA report defines the area around the residences nearest the mine as Category A1, for which the Assigned Outdoor Neighbourhood Noise Level would be 30 dB(A) at night. In administering these regulations there is some discretion for an inspector not to take action where the Assigned level is exceeded by less than 5 dB(A).

In relation to the proposed regulations, the HSA report quotes somewhat higher levels given in a 1993 draft, which are fixed for all types of areas. These levels have been used by the DEP on Licence Conditions where noise conditions were considered appropriate. However, the Willowdale Mine has no noise conditions on its Licence. The 1993 draft regulations also presented a number of problems which would render their administration difficult. As a result, the current position of the DEP in relation to draft regulations has altered from the 1993 draft, with the effect that the Maximum Allowable Noise Level for this type of area at night would be 35 dB(A).

For the purpose of this assessment of the proposed mining operations, (since the proposed regulations are likely to be in place by the time the proposed operations commence), the relevant criterion will be the night time level of 35 dB(A), reflecting the current position of the DEP. The noise emission of the existing overland conveyor will be assessed against both the current regulations (30 dB(A) criterion) and the proposed regulations (35 dB(A) criterion).

Shift hours -

The information provided by the proponent indicates that the number of shifts will increase from 312 per year to 600. These will be 12-hour shifts 7 days a week, changing at 7.00 am and 7.00 pm. The operation of both the mine site and the conveyor will therefore occur on many more of the nights than in the present situation.

Nearest Residences -

The proponent has provided a detailed map showing the locations of nearest residences, as requested. Apart from the townships of Waroona and Yarloop, this map shows approximately 32 residences situated to the north, west and south of the existing and proposed mining areas and a further 7 houses adjacent to the refinery.

Mining Operations -

The existing mining operations have been modelled by Herring Storer Acoustics and the noise contours presented in their report in Sheets 1 and 3 are, with a few exceptions, accepted as accurate predictions for the conditions modelled, that is, calm conditions and a 2 m/s wind from the north-east, respectively. These maps show the 35 dB(A) contour at a distance of approximately 4 km south-west of the mining operations and the 30 dB(A) contour at a distance of 5 km. The contours in this area cover fairly open country in the downwind direction and can be regarded as representing a worst case. (It should be noted that while Sheet 3 of the HSA report states that the

wind is from the north-*west*, this was indicated in discussions with the consultant to be a typographical error and the correct direction is north-east). It is noted that the 35 dB(A) contour to the north of the conveyor is missing from Sheet 3 of the HSA report, however the 2 residences in the area about 1.5 km north of the conveyor are considered likely to be within the 35 dB(A) contour, especially given the discussion below regarding conveyor noise. As a result there are 7 residences taken as being within the 30 dB(A) and 35 dB(A) contours.

The proponent's approach to this, as described in the letter, is that "the company will continue to maintain appropriate buffers between its operations and neighbours except where there is a clear agreement to the contrary with particular neighbours. The width of these buffers will be discussed with the neighbours and will vary according to factors including ore density, topography, aspect, wind direction and the particular land use on individual properties." The proponent however, does not indicate over what distance a residence would be regarded as a justifying a negotiated solution. The only reference to a distance in the letter is to suggest that "excavating, loading and hauling can generate noise levels in excess of 40 dB(A) at a distance of about one kilometre." This is based on the HSA report. Further, there is considered to be less flexibility available to Alcoa in negotiating alternative operating hours in the future, since the proposal entails the utilisation of almost all of the available shifts.

If the inference to be drawn from this is that Alcoa would only negotiate with residences within 1 km, then such a situation would not be acceptable. The principle should be that Alcoa will negotiate with any residence where the noise levels predicted under worst-case conditions are likely to exceed the current draft regulations. As the proponent cannot at this stage indicate the location of future mining operations or specify an acceptable approach to identifying residences potentially affected by its operations, the following is proposed:

(i) Where any mining operations are proposed within 4 km of any residence not owned by Alcoa, a noise prediction shall be carried out under worst-case conditions for sound propagation, by a recognised acoustical consultant, to identify any likely exceedance of the regulations.

(ii) Where any likely exceedance is identified, Alcoa shall develop a noise management plan for the proposed operation which shall provide details of the following:

- source sound power levels of major items of mining eqiupment;
- modifications to operations to achieve compliance with the regulations;
- nominated reference noise monitoring points where noise is dominated by the mining operations;
- predicted noise levels at these points;
- a proposed monitoring program for these points and affected residences; and
- arrangements for purchase or other measures in relation to any residences where compliance cannot be achieved.

(iii) A copy of the noise management plan shall be forwarded to the DEP prior to mining operations commencing in any such area.

(iv) Where a noise management plan is in place, a noise monitoring program shall be conducted, in consultation with the DEP.

Blasting -

In relation to criteria for airblast overpressure (noise), the DEP position as given in current Licence Conditions is a level of 125 dB(linear) peak which is not to be exceeded for any blast, and a level of 120 dB(linear) peak which is not to be exceeded for more than 10% of blasts. These levels were based on a draft Australian Standard which was never adopted by Standards Australia and are typically 5 dB higher than those used in other states. At these levels, there is a high likelihood of complaints. The DEP experience in relation to airblast overpressure is that where the levels meet criteria of 120 dB(linear) peak for any blast and 115 dB(linear) peak for no more than 10% of blasts, then the likelihood of complaint is minimised.

The Willowdale Mine controls its airblast overpressure levels by means of an advanced prediction method combined with a monitoring program which provides some assurance that Alcoa's internal standard of 115 dB(linear) peak will not be exceeded under given meteorological conditions. Both the use of the prediction method and the adoption of an internal standard of 115 dB(linear) peak are commendable measures which the DEP supports. The Licence Conditions for the Willowdale Mine do not cover blasting, however there was a requirement for quarterly reporting of blast monitoring results under the State Agreement Act. This was discontinued at the end of 1993 as a result of Alcoa's monitoring data which indicated that airblast overpressure levels were effectively controlled. The results for the last quarter of 1993, obtained from DEP files, show only 2 blasts above 115 dB(linear) peak and both of these were below 120 dB(linear) peak.

There have been some complaints/comments about blasting which are indicated in the proponent's letter to have occurred in relation about 8% of the production blasts. The two main factors which would determine the level of complaint are the accuracy of the prediction model and the policy of the mine management in deciding whether marginal blasts should proceed. With the experience now gathered in the use of the model the ability to anticipate complaint should be excellent, and with the strict the application of blasting policy, management should be able to virtually eliminate future complaints.

Two factors will assist in this:

- Mining will generally occur further away from residences, in particular the Yarloop townsite.

- The proposed use of a large bullodzer to rip caprock should significantly reduce the need for blasting.

In view of the above, it is recommended that the use of the blast prediction model be retained in the future mining areas, based on the internal criterion level of 115 dB(linear) peak. Monitoring of all blasts should continue with results to be made available when requested. A quality goal of the company should be a zero-complaint result in relation to blasting.

Overland Conveyor -

Noise emission from the overland conveyor which runs from the mine site to the refinery was not adequately addressed in the CER for the expansion. Supplementary information provided by the proponent in the letter to the DEP attempts to reassert the information originally provided in the CER. Both this and the original data are rejected for the following reasons:

- The measurements referred to in the CER were made during the day, and not at night under worst-case conditions for sound propagation.

- The data recorded at a distance of 400 metres were higher than those at 200 metres, in opposition to the normal reduction of sound level with distance from a "line source" such as a conveyor.

- Conveyor noise is normally constant over time, yet the reported sound levels fluctuated widely, typically over a range of 8 to 11 dB(A). No explanation was given for this in the CER or the letter.

- Some measurements were taken with the meter set for the "linear peak" response, which while relevant for impulsive noise such as airblast overpressure, is totally irrelevant in the case of a constant conveyor noise.

- No assessment of possible tonal noise characteristics was made in the CER.

- The letter claims the measurements were made "using noise meters calibrated to the relevant Australian Standard", then cites ANSI S1.4. This is actually an American Standard for sound level meters. It is not accepted in Australia because it specifies a different microphone response pattern.

The only measurement of conveyor noise which is afforded any credibility in this assessment is that contained in the HSA report, from which the sound power level was determined for modelling purposes. This indicates a sound power level of 102 dB(A) for a section of conveyor approximately 2 km long.

The nearest residences are located just over 1 km to the south of the conveyor, where it passes along the crest of a hill. Assuming the conveyor noise at the residences is influenced only by this section of the conveyor, the DEP estimates the noise level at the nearest residences, with a light breeze blowing from the conveyor towards the houses, to be approximately 40 dB(A).

This level would exceed the 30 dB(A) criterion for an area classed as A1 under the current regulations. Further, the spectrum of conveyor noise measured by HSA indicates the possible presence of a tonal component in the 125 Hz octave band. Should it be the case that the noise appeared to be tonal at the residences, then the tonal noise penalty of 5 dB(A) to be added to the predicted noise level would result in the adjusted level being 15 dB(A) in excess of the levels specified in the current Regulations.

In terms of the proposed regulations, the predicted noise level of 40 dB(A) would exceed the 35 dB(A) criterion by 5 dB(A). From the data currently available, it is not possible to estimate the tonal correction which would apply under the proposed regulations, however assuming a 5 dB(A) adjustment for tonality, the exceedance may be 10 dB(A).

There is consequently a strong argument that the noise of the existing conveyor operations may exceed both the current and proposed regulations.

The primary concern in relation to possible noise annoyance is that the proposed expansion will cause the conveyor to operate over many more nights than it does in the present situation. As a consequence, it is recommended that:

(i) Alcoa shall conduct, via a recognised acoustical consultant, a detailed study into the potential impact of the conveyor noise, including:

- noise measurements and predictions for the residences within 1.5 km of the conveyor, under worst-case conditions for sound propagation;

- assessment of possible tonal components in the conveyor noise; and
- recommendations for appropriate noise control measures to ensure conveyor noise complies with the 35 dB(A) criterion.

(ii) Alcoa shall implement such noise controls as are necessary to ensure compliance prior to commencement of the proposed operations.

(iii) Noise monitoring shall be carried out by a recognised acoustical consultant following completion of the noise control measures, in consultation with the DEP, to ensure compliance, the results of the monitoring to be reported to the DEP prior to the commencement of the proposed operations.

REFINERY

The noise criteria to be used in this assessment will be both the Noise Abatement (Neighbourhood Annoyance) Regulations 1979, (the current prescribed standard for noise under the EP Act) and the proposed regulations as currently drafted. As indicated in the discussion above on criteria for noise of mining operations, the 1993 draft regulations under the EP Act do not reflect the current position of the DEP. The current draft would specify Maximum Allowable Noise Levels of approximately 35 to 40 dB(A) for this area, depending on the proximity of residences to the South-Western Highway.

The noise level contours presented in Sheets 1 and 2 of the HSA report show the noise levels predicted for the existing refinery, for calm conditions and for a light northerly breeze, respectively. As the proposed upgrade is only likely to increase noise levels by 1 dB(A) above the existing levels, this contour map serves to illustrate both scenarios.

The contours on Sheet 2 represent a worst case in terms of the residences to the south of the refinery, including the Yarloop townsite. These predictions show the 35 dB(A) contour encompassing that part of the Yarloop townsite north of Johnston Road and 4 residences to the south of the refinery. The noise levels at these 4 residences would lie in the range 42 to 50 dB(A). With a southerly breeze, the residence about 1.5 km to the north of the refinery would also be expected to receive noise levels of approximately 45 dB(A).

The HSA report also demonstrates that the noise character is tonal at 500 Hz (Appendix 3 of the HSA report), which would increase its annoying effect.

Under the current Noise Abatement (Neighbourhood Annoyance) Regulations 1979, the nearest residence in the area to the south of the refinery, off Bancell Road, could be classed as A1, for which the Assigned Outdoor Neighbourhood Noise Level would be 30 dB(A) at night. If the predicted level of 50 dB(A) is adjusted by adding 5 dB(A) to account for its tonal effect, the adjusted level of 55 dB(A) exceeds the Assigned level by 25 dB(A). In terms of this nearest residence, therefore, the existing operations of the refinery result in a substantial breach of the current legislation.

Residences in Yarloop which are well away from the South-Western Highway would be classed as A2 under the current regulations, for which the Assigned level would be 35 dB(A) at night. The predicted levels of typically 35 to 45 dB(A) in these areas, when adjusted for the tonal component, would exceed the regulations by 5 to 15 dB(A).

Residences along the Highway would be classed as B1 or B2, with Assigned noise levels of 40 or 45 dB(A) at night. For those residences in the town south of the 40 dB(A) contour, the predicted noise levels may be acceptable, while for those along the Highway north of the 40 dB(A) contour, the predicted noise levels may exceed the Assigned levels by up to 10 dB(A).

The current draft of the proposed regulations would specify Maximum Allowable Noise Levels for these areas of 35 dB(A) to 40 dB(A) at night. Again, the predicted noise levels, when adjusted for tonal components, would exceed these levels to a significant extent at the nearest residences and the impact would extend over a considerable number of residences in the Yarloop townsite.

This impact was acknowledged in the HSA report and in the letter from the proponent. The HSA report identifies some of the major noise sources contributing to this impact, which provides the starting point for a noise management plan. It is accepted that the time frame for implementation of such a plan would extend beyond the anticipated life of the current regulations, thus the proposed regulations should be used as the goal for noise reduction measures.

Accordingly it is recommended that a noise management plan be developed for the refinery, involving the following elements:

(i) Development of a program of noise control measures designed to reduce noise emissions to comply with the current draft of the proposed regulations. A copy of the plan, including detailed timelines for the completion of the measures specified in the plan, shall be forwarded to the DEP by 30 June 1995.

(ii) This plan should also address the related issue of noise from the Public Address system in the refinery, as identified in the HSA report.

(iii) Implementation of the program of engineering noise control measures and other appropriate measures to ensure compliance with the current draft regulations shall be completed before startup of the expanded refinery.

(iv) A report demonstrating compliance shall be forwarded to the DEP prior to startup, the report to contain details of proposed reference points (where noise is dominated by the refinery) for future noise monitoring purposes.

TRANSPORTATION

The purpose of addressing transportation noise is to identify the extent of areas adjacent to the main road and railway routes which may be affected by road/rail noise and whether the affected areas may increase as a result of the proposed expansion.

The assessment of transportation noise is based on the proponent's letter dated 10 February 1995 and a report by Herring Storer Acoustics (HSA) dated 13 February 1995. The five areas of study are:

- Rail traffic using the line within the refinery.
- Rail traffic using the line south of the refinery.
- Rail traffic into Bunbury port.
- Road traffic along South-Western Highway.

- Road traffic along Willowdale Road.

Rail Noise Criteria -

The criteria which the DEP would recommend for rail noise (as used by HSA) are:

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

The maximum acceptable levels are 5 dB(A) above these levels. These are based on the "Environmental Noise Control Manual" of the EPA of New South Wales, Page 163-1. In addition to the above, the DEP recommends a target level for planning purposes of 65 dBL_{Amax}.

Westrail is understood to be considering railway noise criteria to be incorporated into its Environment Management Manual but has not as yet published its noise standards or control policies. The current draft noise regulations do not cover railway noise.

Noise From Rail Traffic on Refinery Loop -

The baseline noise levels used in the HSA report are accepted as the basis for this assessment. They are taken from measurements conducted at 15 metres from a typical freight line, as follows:

- Maximum level, L_{Amax} = 88 dB(A)
- "Average" level, $L_{Aeq,2min}$ = 81 dB(A)

The proponent's letter indicates that rail traffic on the refinery loop will increase from 5 to 7 trains per day as a result of the proposed expansion. The HSA report predicts noise levels at the nearest residence 400 metres to the south, resulting from 7 trains per day on the rail loop, to be as follows:

- Maximum level, L_{Amax} = 66 dB(A)
- "Average" level, $L_{Aeq,24h}$ = 39 dB(A)

The method of calculating the reduction in noise level from the baseline levels at 15 metres back to 400 metres is not stated in the HSA report. The predicted level at 400 metres distance is accepted for the case of a northerly wind (blowing towards the residence) which acts to increase the L_{Amax} level to a greater extent than the $L_{Aeq,24h}$ level.

The predicted level is well within the 80/55 dB(A) criteria for $L_{Amax}/L_{Aeq,24h}$, and is marginal in relation to the target level of 65 dBL_{Amax} for planning purposes. The fact that the target planning criterion may be exceeded at distances of up to 400 metres needs to be recognised by local Councils in considering potential residential developments along the railway.

Noise From Rail Traffic Between Wagerup and Bunbury -

The HSA report assesses the impact of the proposed expansion in terms of the likely increase in noise levels at 15 metres from the railway. It concludes that the maximum level of 88 dB(A) will not change, while the "average" level will increase from 67.7 $dBL_{Aeq,24h}$ at the existing rate of flow of 34 trains per day to 68.0 $dBL_{Aeq,24h}$ at the predicted rate of 36 train movements per day, an increase of only 0.3 dB. The HSA report describes this increase as negligible.

There appears to be an error in the HSA report in relation to the number of train movements used in the predictions. The use of 7 train movements per day on the Wagerup loop is accepted, as each arrival/departure constitutes one movement. However, once on the Wagerup-Bunbury line, each train constitutes 2 movements, one going and the other returning. The numbers of movements on the Wagerup-Bunbury line should therefore be 34 existing movements, comprising 6 movements for alumina trains, 2 movements for caustic soda trains and 26 other movements. The maximum levels of predicted train movements would be 10 movements for alumina, 4 for caustic soda and 26 other movements, causing a total of 40 movements per day.

The predicted increase in $L_{Aeq,24h}$ noise level for the increase from 34 to 40 train movements is calculated to be 0.7 dB(A). While it is accepted that even this revised predicted increase in noise level is small, of greater interest is the extent of the area either side of the railway which is potentially affected by the noise. Using the HSA baseline data for train noise levels at 15 metres distance, the DEP has estimated the affected area, for the existing and proposed rail traffic, as follows:

		Distance From Track - Metres	
		Existing Traffic (34 trains/day)	Proposed Traffic (40 trains/day)
Maximum Level, L_{Amax}	= 80 dB(A)	38m	38m
"Average" Level, $L_{Aeq,24h}$	= 60 dB(A)	57m	64m
"Average" Level, $L_{Aeq,24h}$	= 55 dB(A)	135m	153m

These estimates assume:

(i) The L_{Amax} level reduces by 6 dB(A) for each doubling of distance from the track.

(ii) The $L_{Aeq,24h}$ level reduces by 4 dB(A) for each doubling of distance from the track.

The most critical result above is the $L_{Aeq,24h}$ criterion of 55 dB(A), which increases from 135m to 153m as a consequence of the proposed increase in rail traffic. The $L_{Aeq,24h}$ criterion of 60 dB(A) has been included above as an indication of the extent of area subject to unacceptable noise. The estimated distances of 57m and 64m for the existing and proposed traffic, respectively are less than the distances related to the $L_{Aeq,24h}$ criterion of 55 dB(A), but are still greater than the L_{Amax} criterion. As noted above in relation to the Wagerup rail loop, the L_{Amax} criterion of 65 dB(A) as a planning target may be exceeded at distances of up to 400 metres.

At this stage there are no data to indicate how many residences are included in the affected area, or how many additional residences are in the predicted 18m increase in the affected area. As a first step it must be recognised that, while rail transport has environmental advantages over road transport, noise being one of these, rail traffic does at present affect an area up to 135 metres wide on both sides of the railway between Wagerup and Bunbury, and this area will increase as traffic increases.

Secondly, consideration needs to be given as to who should take responsibility for amelioration of these impacts as far as is practicable. The traffic component originating from Alcoa's Wagerup refinery constitutes approximately 24% of the existing traffic and up to 30% of the proposed traffic on this line. As a major user, therefore, Alcoa could be regarded as having at least a part responsibility in this area. Westrail, however, as operator of the line must clearly carry the major responsibility for its noise impact. While Westrail is considering a series of policy measures in

relation to freight noise, at this stage there are no specific details in terms of either the noise level at which they would take effect or in terms of the measures themselves.

Thirdly, the affected areas identified above need to be used by local Councils as a planning measure to ensure new residences are not constructed in these areas without the incorporation of appropriate architectural solutions.

Taking the above considerations together, it is recommended that:

(i) Westrail and Alcoa conduct a joint study to:

- assess the numbers of residences or other noise-sensitive premises along the Wagerup-Bunbury line within the noise contours representing $L_{Aeq,24h}$ criteria of 55 dB(A) and 60 dB(A); and
- identify and cost options for noise control measures aimed at minimising noise levels at or inside these premises.

(ii) A report on the study shall be forwarded to the DEP prior to startup of the proposed expansion.

(iii) Westrail shall draw up planning guidelines for local Councils along the Wagerup-Bunbury line to minimise residential encroachment and to ensure that where noise-sensitive uses are proposed within the affected area, appropriate architectural solutions are incorporated.

Rail Traffic Into Bunbury Port -

The HSA report conclusion that rail traffic into the Bunbury port will not result in a significant impact because there are no residences within 200 metres of the line is accepted in the light of the estimates made above. However, the train movements used by HSA again appear to be in error, as the 11 trains per day represent 22 movements in and out of the port. Recalculating the the extent of the affected area as above, on obtains distances of 41 metres for the $L_{Aeq,24h}$ criterion of 60 dB(A) and 97 metres for the 55 dB(A) criterion, on both sides of the track.

When these results are coupled with the 400 metre distance to the 65 dBL_{Amax} planning criterion, it is clear the railway noise is a factor which needs to be recognised by the City of Bunbury in considering proposals for future development on any of the properties which encroach within this area.

Road Traffic Criteria -

The HSA report quotes the Main Roads Department policy for design of new roads as the relevant criteria. These are based on $L_{A10(18h)}$ values of 68 dB(A) or 63 dB(A) in cases where a significant increase in noise is predicted to occur. The DEP endorses these criteria as levels above which the MRD should take preventative action, with the following reservations:

(i) In the planning of new residential areas near roads, an $L_{A10(18h)}$ level of 56 dB(A) should be used, to represent a level at which no more than 10% of the population would be "highly annoyed" by the traffic noise.

(ii) Where the traffic stream includes a large number of heavy vehicles at night, the $L_{A10(18h)}$ is not an appropriate descriptor and suitable criteria need to be used to assess the likelihood of sleep disturbance.

In the present case, the assessment involves increases in traffic movements on existing roads, thus the assessment takes into consideration both the existing noise levels and the predicted increases. An increase in the $L_{A10(18h)}$ of 2 dB(A) is regarded as significant where the $L_{A10(18h)}$ is already above 55 dB(A).

Traffic along South-Western Highway -

The HSA report predicts an $L_{A10(18h)}$ level of 69 dB(A) at 10 metres from the Highway, increasing to 69.3 dB(A) as a result of the expansion. The predicted increase of 0.3 dB(A) is not considered significant in itself. However, it should be recognised that the area affected by traffic noise ($L_{A10(18h)}$ above 56 dB(A)) will increase from an estimated 150 metres to 160 metres on both sides of the road. This needs to be recognised by the relevant local Councils in considering residential development proposals along the Highway.

The most noticeable effect of the proposal will be the extending of the trucking times for lime from Kwinana, from 6.00 am - 2.15 am to 6.00 am - 3.45 am. The main areas where this will impact are in the towns of Pinjarra and Waroona. It is therefore recommended that the proponent evaluate alternatives that either maintain or reduce the present trucking hours.

Traffic Along Willowdale Road -

The traffic noise levels predicted in the HSA report are well within the $L_{A10(18h)}$ criterion of 56 dB(A) for planning purposes when extrapolated to the nearest residences some 200 metres from the road. Since the vast majority of this traffic will pass during the day or at shift change times, the noise impact is considered insignificant.

John D. Macpherson

John Macpherson
Environmental Officer
Pollution Prevention Division
9 March 1995

Alcoa Wagerup 240295JMc

Appendix 10

Proponent's response to Department of Environmental Protection's noise assessment, and resultant commitments

ALCOA OF AUSTRALIA LIMITED
A C N 004 879 298
Cnr. Davy and Marmion Streets, Booragoon, Western Australia

ALCOA
AUSTRALIA

11 April 1995

The Chief Executive Officer
Dept. of Environmental Protection
Westralia Square
141 St. George's Terrace
PERTH WA 6000

Attention: Mr. S. Sadleir

Dear Shane,

WAGERUP EXPANSION CER - NOISE ISSUES

We have reviewed the Department's report of March 1995 in consultation with Herring Storer Acoustics, and concluded that Alcoa should make additional commitments in relation to the proposed Wagerup Expansion. We propose a separate commitment relating to the management of noise from the existing operations.

The commitments are shown in italics below. We recognise that they are not as specific as the recommendations in John Macpherson's report. However, we believe a more generalised response is appropriate in view of the paucity of actual data (versus model predictions), the uncertainty surrounding future noise regulations, and the absence of corroborating information except in relation to blasting and specific aspects of the refinery operations.

Alcoa is concerned that an unnecessarily restrictive approach in relation to the mobile mining operations could result in significant losses of bauxite reserves in parts of the forest where the existing forest quality is generally poor. This particularly applies to Willowdale North, where the existing dieback impact is severe, and where the combined effects of mine and dieback forest rehabilitation are likely to be most beneficial. Losses of bauxite reserves in these areas will bring forward mining in areas of better quality forest. For this reason we believe it is essential that noise issues be considered in a broader context within the existing mine planning review and approval process overseen by the MMPLG.

The train frequency data supplied in the HSA report of February 1995 is correct. Wagerup's current production is transported to Bunbury in three trains per day averaging 33 wagons in length. This will increase to an average of 4.5 trains per day averaging 40 wagons in length when production reaches 3.3 Mtpa. The additional caustic requirements will be met by additional wagons per train. On average, we expect the total train traffic on the main South Western Railway to increase from 34 to 37 trips per day.

85282 INFO

P.O. Box 252, Applecross, W.A. 6153 Telephone: (09) 316 5111 Facsimile: (09) 316 5228 Telex: AA93910

WAGERUP REFINERY AND WILLOWDALE MINE
NOISE MANAGEMENT COMMITMENTS

Noise monitoring undertaken for assessment purposes in association with the commitments outlined below will be undertaken by a recognised acoustical consultant, in consultation with the DEP. Ongoing monitoring will be undertaken by Alcoa personnel appropriately trained in the measurement of environmental noise.

Current Operations

Alcoa will commission additional studies to verify predicted noise levels in the vicinity of the Wagerup Refinery and Willowdale Mine operations. Where these studies confirm that noise abatement is necessary, a program will be developed to reduce noise emissions by all practicable means as defined in the Environmental Protection Act 1986. This program will aim to comply with the draft (1995) environmental noise regulations under the Environmental Protection Act; or should they differ, with the environmental noise regulations promulgated subsequently. A copy of the noise control program, together with timelines for the completion of the measures specified in it, will be forwarded to the DEP by 31 July 1995. The program will be implemented by 30 November 1996 and a report demonstrating its effect will be forwarded to the DEP by 31 December 1996. The report will contain details of proposed reference points for future noise monitoring purposes.

Proposed Expansion

Alcoa will design the mining and refining plant and bauxite conveyor systems associated with the expansion to meet the draft (1995) environmental noise regulations under the Environmental Protection Act, and operate them in accordance with the environmental noise regulations promulgated subsequently. Noise levels will be monitored periodically at designated reference points and reported in the Review of Environmental Research and Operations submitted annually to the Department of Resources Development, and distributed to relevant state and local government agencies.

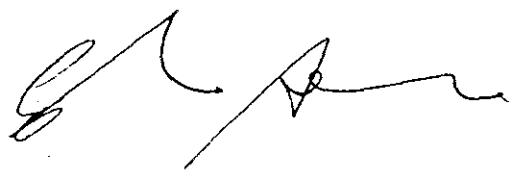
Alcoa will commission an authoritative assessment of noise emissions associated with its mobile mining operations at Willowdale, and will reach agreement with the DEP by 31 December 1995 on a practicable noise management procedure for future mining operations in the vicinity of noise sensitive premises. Details of the noise management plan for operations within areas subject to the noise management procedure, including any noise monitoring to be undertaken and reporting of results obtained, will be included in subsequent five year mining and management plans submitted annually to the MMPLG.

Alcoa will review the proposed extension of the hours of its contracted lime trucking operation in consultation with the Shires of Waroona and Murray, taking into account relevant factors including safety, noise, cost and traffic density. The results from this review will be communicated to the DEP by 31 July 1995. Future contractual arrangements will incorporate an appropriate reference to a recognised vehicle noise standard such as ADR 28/01.

We agree there appears to be a need for an authoritative assessment of train noise at noise sensitive locations along the South Western Railway. However, we believe this assessment and any action which might follow it are a matter for resolution between the DEP, Westrail and the relevant local government and planning authorities.

We hope Alcoa's well established record of managing its operations responsibly gives the DEP confidence that the commitments outlined below will lead to an effective resolution of the noise issues.

Yours sincerely,



GRAHAM SLESSAR
Environmental Manager, W.A. Operations

cc: Mr. R. Sippe, DEP
Mr. D. Gardner, DRD

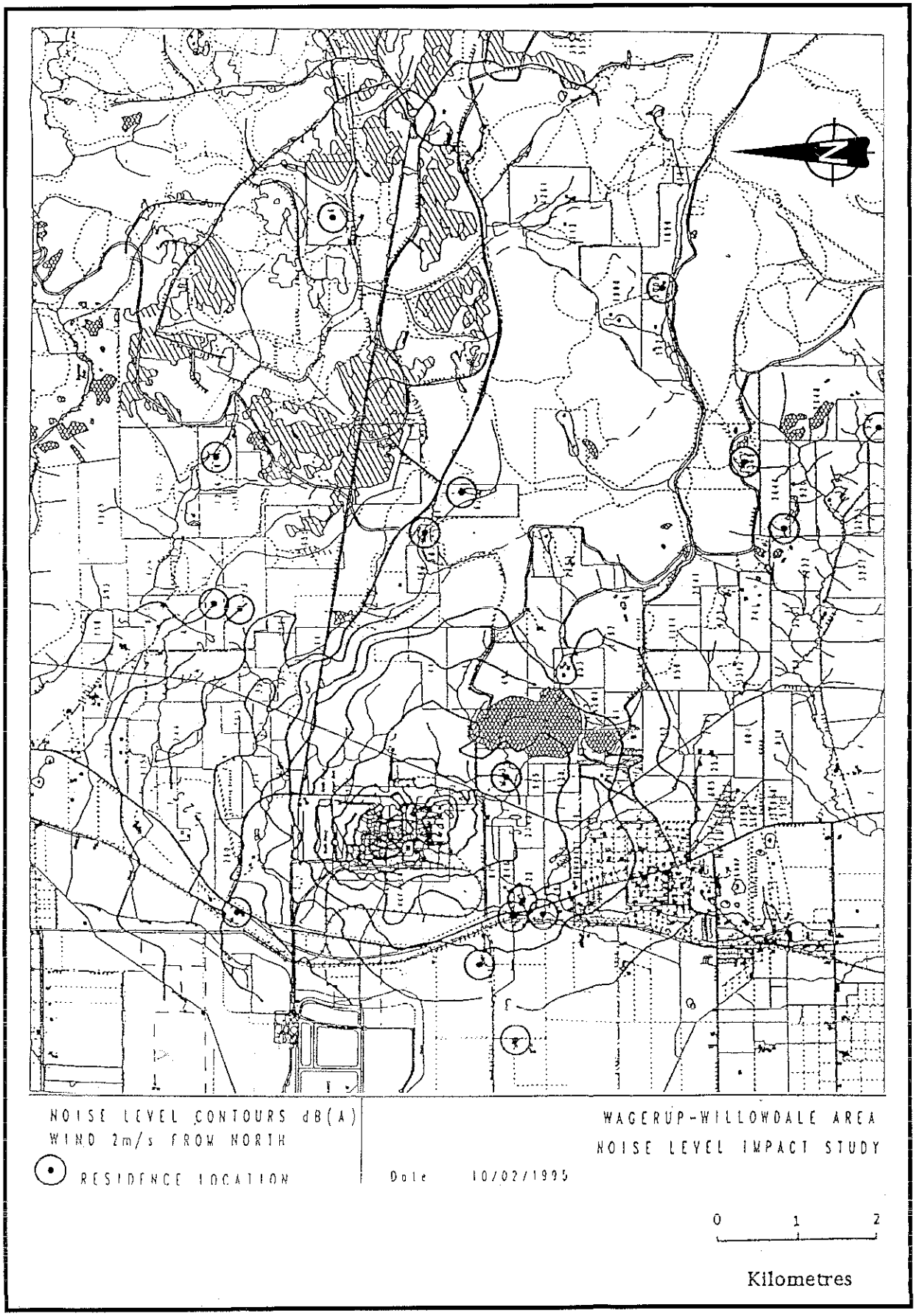


Figure 6. Noise level contours for worst case scenario around the Wagerup Refinery with a light northerly breeze. (Source: HSA report)

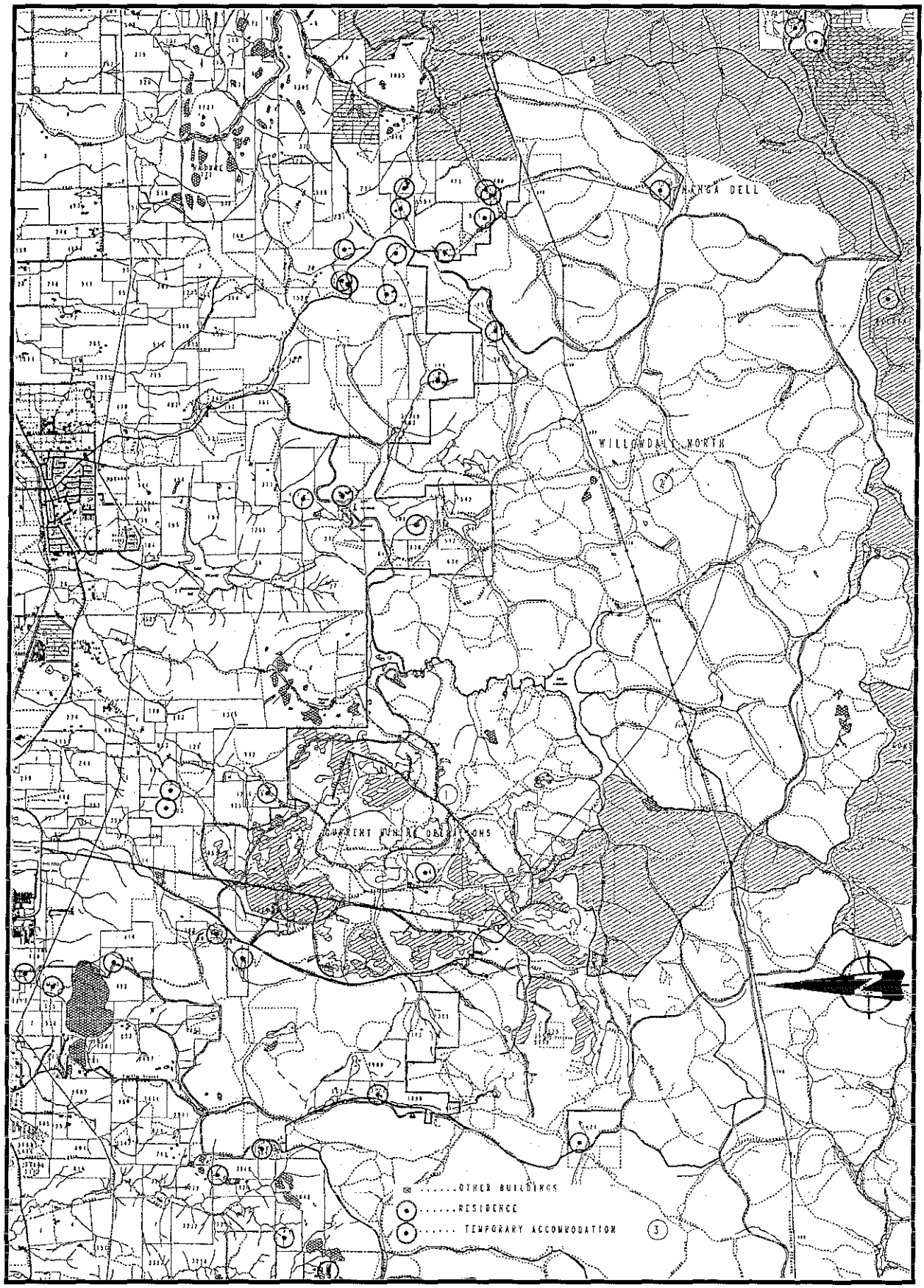


Figure 5. Location of private residences in close proximity to current and future bauxite mining operations for the Wagerup alumina refinery. (Source: proponent's response to submissions)

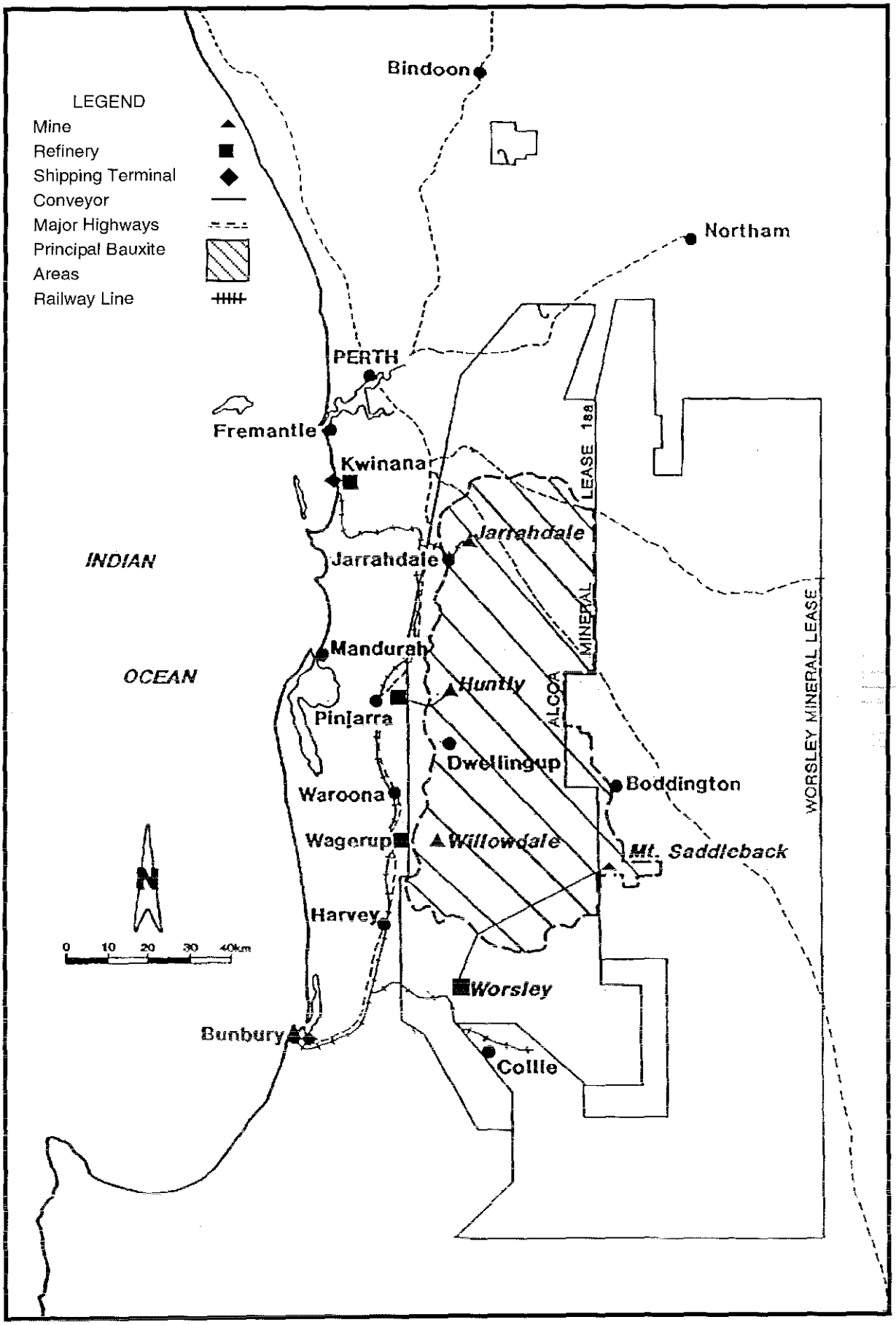


Figure 1. Bauxite mining and alumina refinery operations in WA. (Source: Figure 1 of the CER)

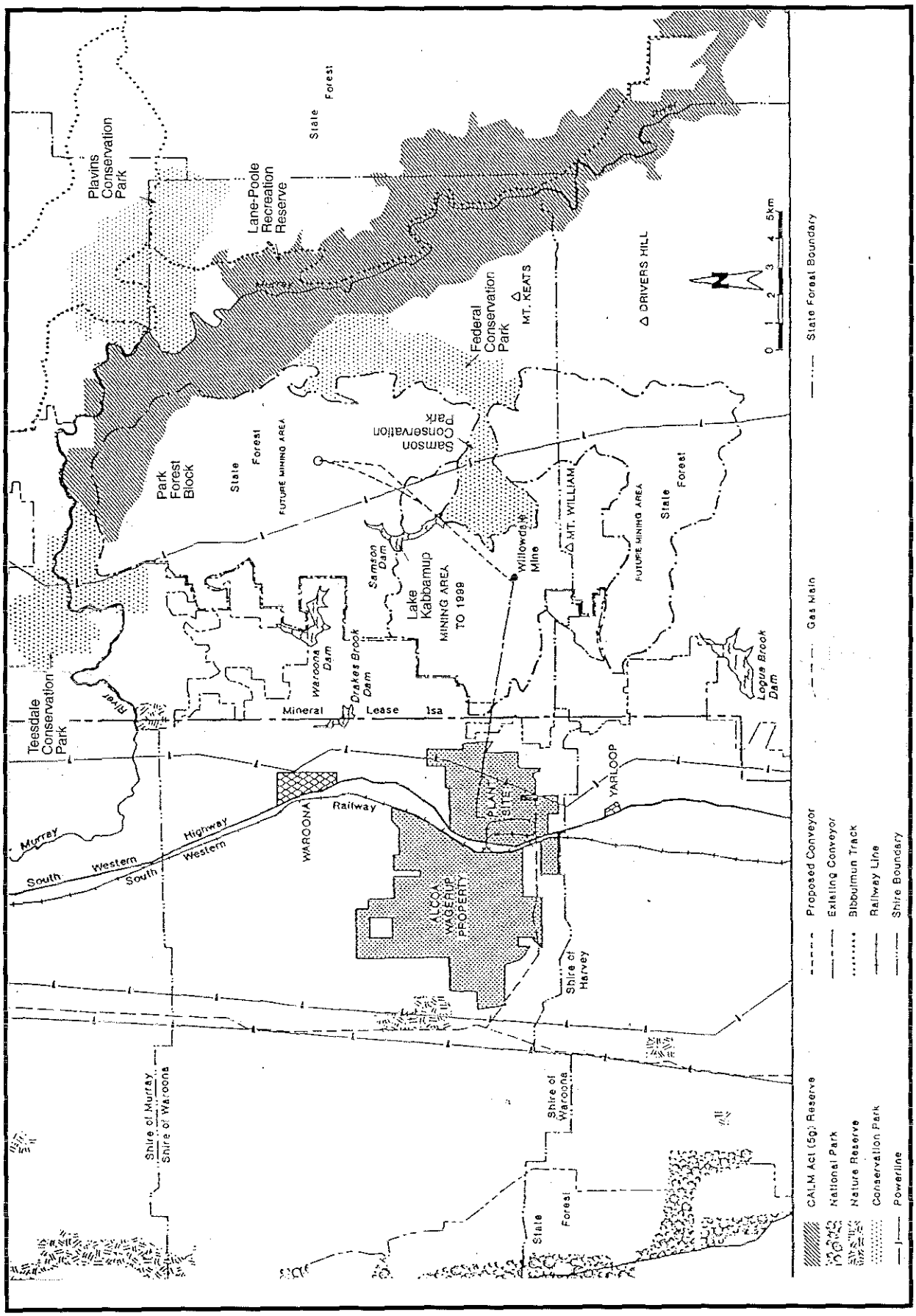


Figure 2. Location map, Wagerup refinery and Willowdale minesite. (Source: Figure 2 of the CER)

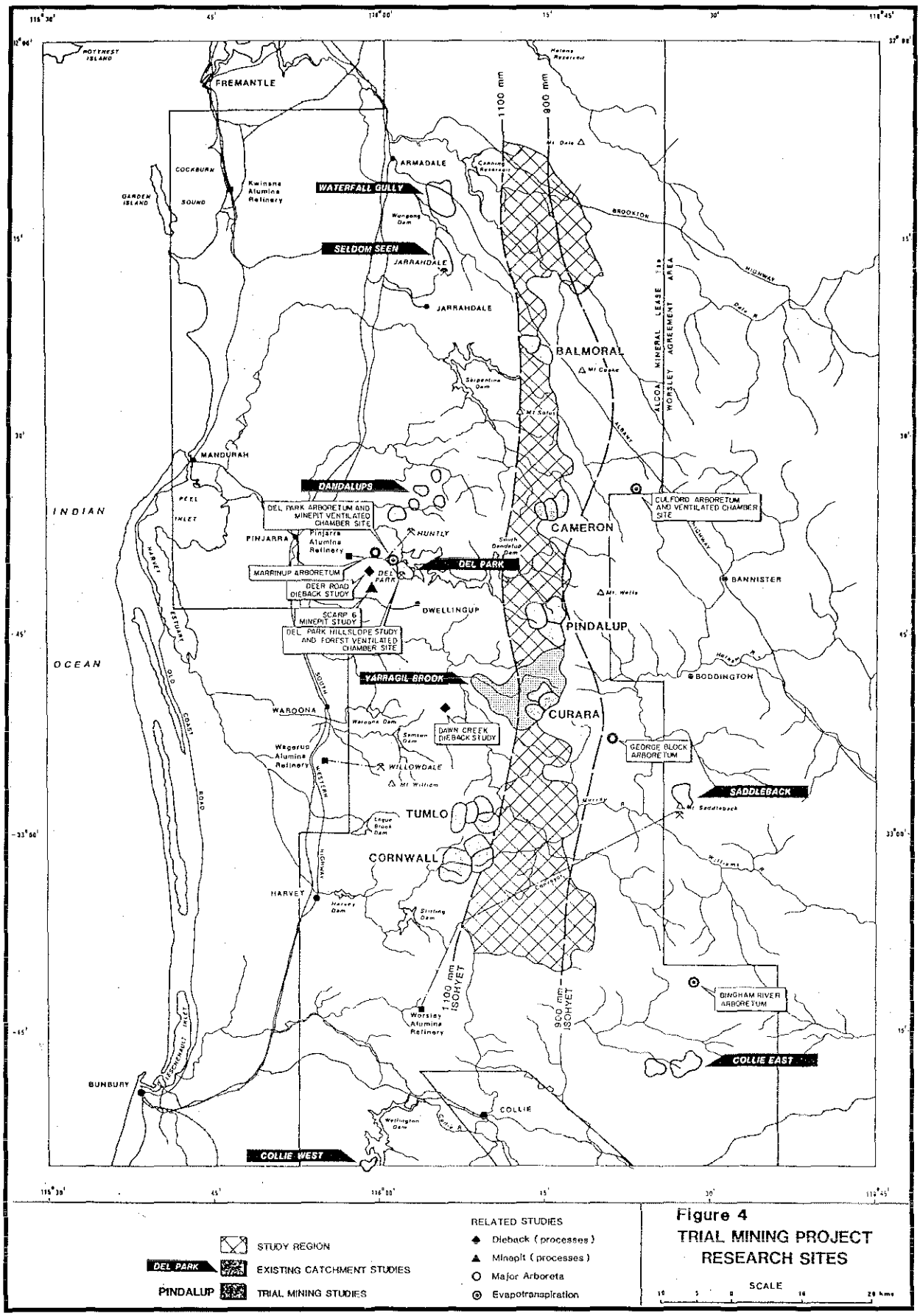


Figure 4
TRIAL MINING PROJECT RESEARCH SITES

Figure 3. Rainfall isohytes in relation to current bauxite mining activities and potential trial mining areas. (Source: Low et al, 1985)

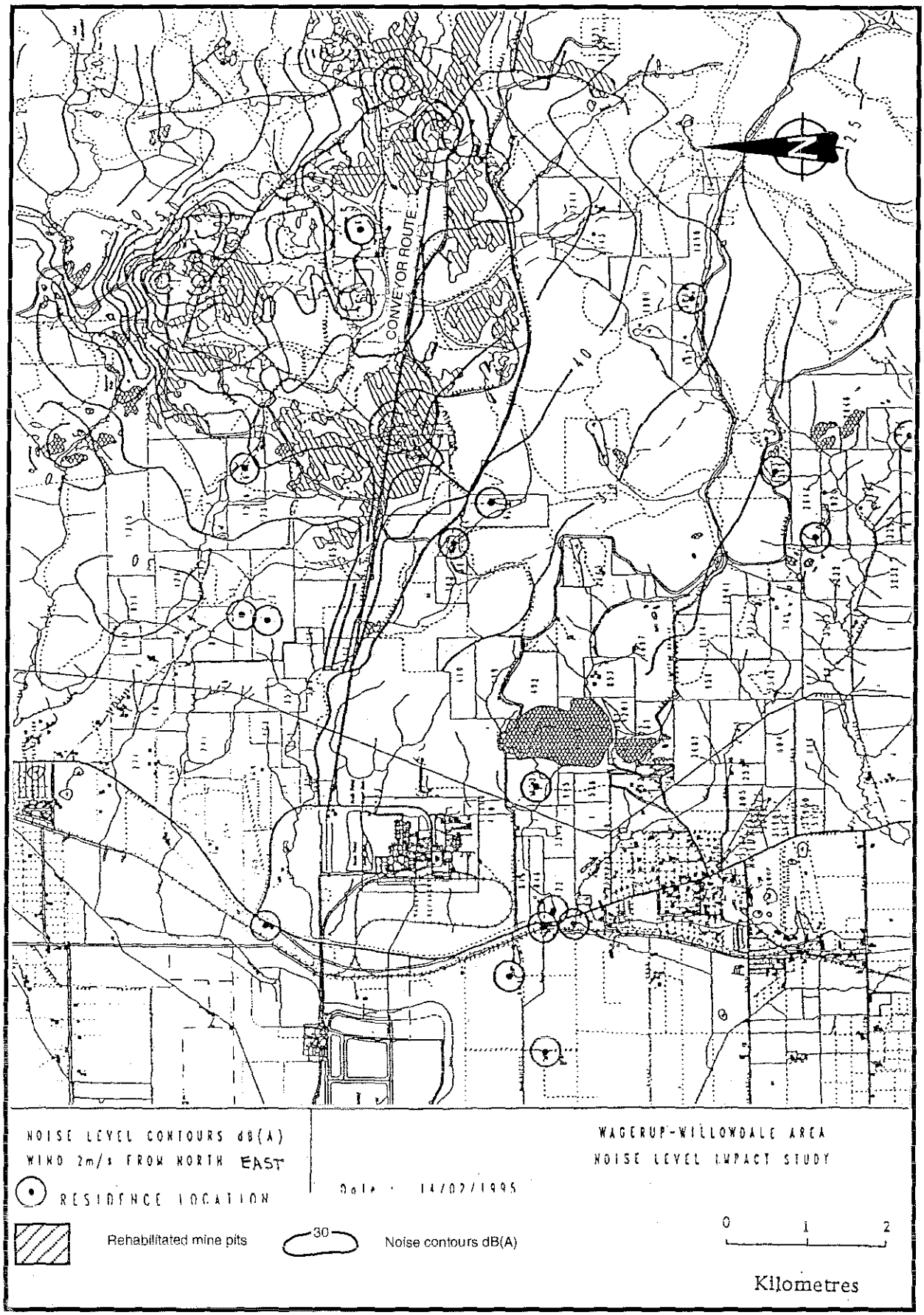


Figure 4. Noise level contours for worst case scenario around the Willowdale mine site with a light north easterly breeze. (Source: HSA report)