Wagerup Alumina Refinery - Increase in Production to 4.7 Mtpa; and Wagerup Cogeneration Plant

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Alcoa World Alumina Australia

Report and recommendations
of the Environmental Protection Authority

Environmental Protection Authority
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Environmental Impact Assessment Process Timelines

Date	Progress stages	Time (weeks)
23/7/04	**Level of Assessment set (following any appeals upheld)**	
16/5/05	**Proponent Document Released for Public Comment**	**42**
25/7/05	**Public Comment Period Closed**	**10**
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23/12/05	**EPA report to the Minister for the Environment**	**7**

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Summary and recommendations

Alcoa World Alumina Australia (Alcoa) proposes to expand the Wagerup Refinery through construction of a third production unit. The proposed production increase to approximately 4.7 million tonnes per annum of alumina is to be achieved by a combination of new equipment and an upgrade of existing equipment in order to achieve an increase in both capacity and efficiency. The Refinery currently operates at about 2.4 million tonnes per annum.

Alcoa also proposes to establish a Cogeneration plant at the Refinery site to provide electricity and steam for the Refinery, and for electricity supply into the South West Interconnected System (SWIS).

Section 44 of the *Environmental Protection Act 1986* requires the Environmental Protection Authority (EPA) to report to the Minister for the Environment on the environmental factors relevant to the proposals and on the conditions and procedures to which the proposals should be subject, if implemented. In addition, the EPA may make additional recommendations. The EPA is also required to have regard for the principles set out in section 4A of the Act. This report provides the EPA's advice and recommendations to the Minister for the Environment pursuant to Section 44 of the Act.

Alcoa has also applied for approval under Regulation 17 of the *Environmental Protection (Noise) Regulations 1997* to allow the emission of noise from the Refinery to exceed the standards in the Regulations. This report also provides the EPA's advice and recommendations to the Minister for the Environment on Alcoa's application pursuant to Regulation 17.

Relevant environmental factors and principles

The EPA concluded that the following environmental factors relevant to the proposals required detailed evaluation in the report:

(a) Air pollutant emissions;

(b) Predicted ambient air quality and Health Risk Assessment;

(c) Potential for health and amenity impacts due to short-term ground level concentrations;

(d) Land use management in proximity to the refinery;

(e) Noise; and

(f) Greenhouse gas emissions.

The following principles were considered by the EPA in relation to the proposal:

(a) The precautionary principle;

(b) Principles relating to improved valuation, pricing and incentive mechanisms; and

(c) The principle of intergenerational equity.

There are a number of other factors which are relevant to the proposal, but the EPA is of the view that the information set out in Appendix 3 provides sufficient evaluation.

Conclusions

There have been numerous studies relating to emissions from the Wagerup refinery and health issues reported in the area, undertaken since the installation of a liquor burner in 1996.

The studies and investigations carried out to date have consistently shown that predicted and measured ground level concentrations of compounds emitted from the refinery meet established national and international air quality health standards. The studies and investigations have not demonstrated any specific causal link between:

- individual compounds, or mixture of compounds emitted from the refinery; or
- particular refinery sources,

and health issues reported in the area.

As part of the Environmental Review and Management Program process for assessment of the proposed expansion, Alcoa commissioned a Health Risk Assessment (HRA) of emissions from the refinery. Consistent with previous studies, the HRA indicated that predicted ground level concentrations from both current emissions and predicted expansion emissions should not result in chronic health impacts or increased cancer risk to the surrounding community. Even with conservative assumptions and uncertainty estimates applied, the HRA indicated ground level concentrations of pollutants should not cause adverse health impacts. The findings of the HRA were generally consistent with those for other alumina refineries, with established national and international air quality standards being met within close proximity to refineries.

The Department of Health has advised that on the basis of the HRA, emissions from the refinery should not present an abnormal public health risk for the general community.

Nature of the health issues

Previous investigations including analysis of complaint information, have indicated that periodic short-term ground level concentrations, above those occurring in the area for the majority of time, may occur under certain meteorological conditions. This appears to be particularly the case during winter months to the south and south-west of the Refinery. Whilst not considered to present a health risk to the general community, based on medical views presented to the EPA, such periodic short-term ground level concentrations may contribute to health symptoms in some individuals with sensitivities to chemicals.

Parameters such as odour and irritation thresholds provide an indication of the potential for health symptoms in individuals from short-term exposures to chemicals. Ambient air quality monitoring which has been undertaken in the area to date by Alcoa and government agencies has consistently found levels to be below recognized

odour and irritation threshold limits. Based on the monitoring, it would appear that where individuals are experiencing health symptoms, it is at very low chemical levels.

The Wagerup Medical Practitioners Forum concluded that health symptoms being experienced by some people in the area include those that are consistent with a clinical syndrome referred to as Multiple Chemical Sensitivities (MCS) syndrome.

While there are varying views regarding MCS syndrome there is a general theme that reported health problems may be triggered in one of two ways:

- acute or definitely characterisable event, either a single episode or multiple episodes over a short period of time after which triggering of symptoms and observed sensitivities occur at very low levels of chemical exposure; or
- repeated or continuous lower-level exposures over a period of time may lead to sensitisation.

Given the incidence of reported health issues in the period following the installation of the liquor burner in 1996, this may have been a fundamental trigger for such health issues. If this is the case, then it may be that people in the area who have become sensitised will continue to experience health issues even if emissions from the refinery are further reduced.

Furthermore, there may be people who, if they moved into the area, could be susceptible to exposure to periodic short-term concentrations arising under certain meteorological conditions. While the percentage of the general population who may be susceptible to such chemical sensitisation has not been scientifically quantified, the EPA has received advice that it may be in the order of a few percent.

The previous investigations and reviews which have been carried out into operations and impacts of the Refinery, including the three year inquiry by the WA Legislative Council Standing Committee on Environment and Public Affairs, have made various recommendations to address the reported health issues in the area. The findings and recommendations of these previous reviews have been implemented to varying degrees, although some key aspects are still continuing. To date, a formal health survey of residents in the area has not been carried out to document current health or any perceived change in health status since emission reduction measures have been implemented at the Refinery. Also, while Alcoa has implemented a land management strategy for the area, there is currently no formal statutory land management policy or strategy for the area. Neither is there a formal independent process available to people who feel they are affected by operation of the refinery so as to provide reasonable opportunity to relocate from the area without personal disadvantage.

This presents both policy and ethical questions as to whether expansion of the Refinery should be considered while there continues to be unresolved health issues related to chemical sensitivities. Hence any decision needs to be made in the context of a number of considerations, including environmental, economic, social and health factors. Some of these come within the legislative scope of the EPA's assessment, and the EPA has considered these to the extent it can within this assessment. Some considerations, particularly certain economic and other matters, are outside the EPA's

assessment and are matters for Government to consider in its decision making process.

The primary factor for EPA consideration is air quality and potential health impacts.

The Department of Health has advised the EPA it considers that it would be inappropriate to arbitrarily introduce new "protection of MCS" guidelines for emissions, some order of magnitude below current National/International air quality health standards, to address the issues outlined above. (Setting new, arbitrarily low guidelines for emissions may not prevent continued occurrence of health issues for people affected.) It also advised that it would be inappropriate to declare a large "no residents" zone of influence around the Refinery as, while some people have been impacted, the majority of residents are not experiencing health issues. The Department also advised, with qualifications, that it was supportive of the expansion proposal if appropriate safeguards are introduced to protect and monitor the health of the community. The necessary safeguards include:

1. *"The establishment of an adequate buffer zone around the refinery.*
2. *That a set of principles are adopted to enable individuals who experience health concerns within the buffer to have adequate compensation to enable them to relocate from the area.*
3. *That the proposed community surveys are mandated to ensure that the impacts are readily identifiable."*

With respect to the proposed buffer zone, the Department of Health stressed that the justification for the zone in this instance was to allow for those individuals who may be impacted to be sensitively managed. It was not proposing that all residents be removed from the zone as this would be unnecessary. While not prescribing a definite zone, it considered that it should be a minimum of 5 km.

The EPA has reviewed other jurisdictions, nationally and internationally, to determine whether there are specific approaches which have been adopted for addressing chemical sensitivity issues. The review could not determine any specific guidelines, regulations or policy approaches being adopted elsewhere to specifically account for chemical sensitivities from industrial emissions below established air quality health standards. Similar to the policy approach applied in WA, other jurisdictions have required industries to meet established air quality standards, and implement 'best-practice' pollution control measures to minimise emissions.

The EPA therefore concurs with the Department of Health that it would not be appropriate, and nor would it be consistent with other jurisdictions, to set arbitrary lower criteria below established air quality health standards. The EPA also concurs with the Departemnt that the most appropriate approach to addressing such issues is through sensitively managing, via an independent process, people who currently feel they are affected, and reducing and ultimately eliminating the potential for new people being affected.

Reductions in emissions and current extent of health issues

Alcoa has implemented a number of changes to operations and equipment at the refinery since 1998 to reduce emissions. As part of this, odour emissions from the plant are estimated to have been reduced from around 3,300,000 Odour Units per second (OU/s) in 1996 when the liquor burner was operating without the current pollution control equipment, to about 1,350,000 (OU/s).

Alcoa has also implemented a land use management strategy to purchase properties in proximity to the refinery where it considers people may be affected by operation of the refinery (referred to as Area A). Alcoa has also established zones (referred to as Area B) covering the townships of Yarloop and Hamel which are designated as economic management zones within which it purchases properties from people seeking to relocate. Areas A and B cover most properties within 5 km of the refinery. This has lead to some people relocating from the area over past years where they have felt affected.

As indicated above, there has not been any formal health survey carried out of residents in the area to document current health or any perceived change in health status since the emission reduction measures have been implemented at the Refinery. From complaint information which is available, however, the number of properties currently experiencing health issues in the Wagerup area is reducing (relating to either the reductions in emissions or people moving out of the area), and there are currently few new properties raising complaints relating to health issues.

Requirements under which expansion of the refinery could be considered

The EPA considers that it would be preferable in situations where there have been health concerns in proximity to industrial operations, that expansion not proceed, until comprehensive health surveys had been conducted to demonstrate that there were no ongoing health issues or they had been reduced as far as practical.

Having considered the advice of the Department of Health and Department Environment, the EPA considers that approval for expansion at Wagerup could be considered provided appropriate safeguards were adopted to protect and monitor the health of the community.

Importantly, all of the following essential requirements would need to be met:

- Demonstration that there would be no general increase in ambient ground level concentrations for key pollutants from the Refinery, consistent with the predicted ground level concentrations presented in the Environmental Review and Management Program.
- Best practice was applied in design, selection, installation and commissioning of pollution control equipment integral to the expansion to minimise emissions from the Refinery. This should be subject to review by an expert Independent Design Review Team, established in consultation with Alcoa, during the design phases leading to Works Approval application.

- A technically sound, independently monitored program was agreed for commissioning performance verification to demonstrate emissions met those proposed.
- Key recommendations from previous reviews and investigations, particularly those of the CSIRO 2004 Air Quality Review, were completed in parallel with the design phases of the expansion.
- A comprehensive ambient air quality monitoring and reporting program was established for the area.
- A baseline health survey, independently managed by the Department of Health, was undertaken in the area within twelve months of approval being granted.
- A Government land use strategy be developed and implemented for the area prior to construction commencing, in association with Alcoa's land use strategy, to ensure compatible land uses in the vicinity of the Refinery.
- Periodic follow-up, independent health surveys following implementation of the expansion to monitor community health issues.
- Establishment of an independent process for assessment and diagnosis of any persons reporting health symptoms attributable to operation of the refinery.
- Establishment of a process to enable persons who have been professionally/independently assessed to be experiencing chemical sensitivity symptoms to relocate from the area without personal disadvantage.

These requirements have been considered at length by the EPA and reported on in this assessment report. It is stressed that if Government approval is granted for the expansion to proceed, all of these requirements are essential and must be implemented as a complete package.

The EPA also considers that the Cogeneration plant could be implemented.

With respect to Alcoa's Regulation 17 application to exceed noise standards prescribed in the *Environmental Protection (Noise) Regulations 1997*, the EPA has recommended that this be granted subject to conditions requiring noise reduction measures to be implemented to the existing Refinery. The EPA has also recommended that Alcoa be required to implement all reasonable and practicable measures to reduce noise as a condition of approval for expansion of the Refinery.

Recommendations

The EPA submits the following recommendations to the Minister for the Environment:

1. That the Minister considers the EPA' assessment report on Alcoa's proposals to expand the Wagerup Refinery to increase production to approximately 4.7 million tonnes per annum and establish a Cogeneration Plant.
2. That the Minister notes that a Health Risk Assessment carried out for the expansion indicates that emissions from the refinery should not pose an increased public health risk for the general community. However, periodic occurrences of short-term ground level concentrations under certain meteorological conditions may lead to health symptoms in certain individuals susceptible to chemical sensitivities. This presents both policy and ethical questions as to whether

expansion of the Refinery should be considered while there continues to be unresolved health issues related to chemical sensitivities.

3. That the Minister notes that, having considered the advice of the Department of Health and Department of Environment, the EPA considers that approval for expansion at Wagerup could be considered provided the safeguards listed in this report are introduced as a complete package to protect and monitor the health of the community. Implementation of portions of the package will not provide the protection considered necessary by the EPA.
4. That if approval is granted for expansion of the Refinery, the Minister imposes conditions on Alcoa as recommended in Appendix 4 of this report.
5. That in addition to the conditions placed on Alcoa, the Government implements the following actions in association with Alcoa and the community:
   - a comprehensive ambient air quality monitoring and reporting program be established for the area;
   - a baseline health survey, independently managed by the Department of Health, be undertaken in the area within twelve months of approval being granted;
   - a Government land use strategy be developed and implemented for the area prior to construction commencing, in association with Alcoa's land use strategy, to ensure compatible land uses in the vicinity of the Refinery.
   - periodic follow-up, independent health surveys be undertaken following implementation of the expansion to monitor community health issues;
   - establishment of an independent process for assessment and diagnosis of any persons reporting health related symptoms attributable to operation of the refinery, and
   - establishment of a program to enable persons who have been professionally/independently assessed as experiencing chemical sensitivity symptoms to relocate from the area without personal disadvantage;
6. That the Minister notes that the EPA has also concluded that the Cogeneration plant could be implemented.
7. That if approval is granted for the Cogeneration plant, the Minister imposes the conditions recommended in Appendix 5 of this report.
8. That the Minister grants the Noise Regulation 17 approval to Alcoa subject to conditions requiring further noise reduction measures to be implemented to the existing refinery.
9. That the Minister notes the EPA's advice under "Other Advice" in regard to establishment of an interagency working group on cumulative rail noise impacts for the sections of railway to the Bunbury Port used by the alumina industry.

Conditions

Having considered the proponent's commitments and information provided in this report, the EPA has developed a set of conditions that the EPA recommends be imposed if the proposal by Alcoa to expand the Wagerup Refinery to increase production to 4.7 million tonnes per annum is approved for implementation. These conditions are presented in Appendix 4. Matters addressed in the conditions include the following:

(a) The proponent shall fulfill the commitments in the Consolidated Commitments statement set out as an attachment to the recommended conditions in Appendix 4.

(b) Prior to submitting a Works Approval application the proponent shall submit a Detailed Design Report demonstrating that the proposed works adopt best practice pollution control measures to minimize emissions from the Refinery.

(c) Prior to submitting a Works Approval application the proponent shall carry out data acquisition and investigations to further validate the air dispersion model used for predictions of ground level concentrations in the ERMP (May 2005) and, if necessary, make revisions to the detailed engineering design to reasonably achieve similar ground level concentrations to those predicted in the ERMP.

(d) Prior to submitting a Works Approval application the proponent shall prepare a revised Air Quality Management Plan that includes an operational performance verification monitoring program and management procedures to enable agreed emission rates to be achieved.

The EPA has also developed a set of conditions that the EPA recommends be imposed if the proposal by Alcoa to establish a Cogeneration plant at Wagerup Refinery is approved for implementation. These conditions are presented in Appendix 5. Matters addressed in the conditions include the following:

(a) Prior to construction of the co-generation facility, the proponent shall prepare a Stack Emissions Management Plan to ensure that best practice technologies are used to minimise emissions from the co-generation facility, such that the Plan includes specific measures to minimise emissions and ground level concentrations of oxides of nitrogen (NO_X).

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Appendices

1. Introduction and background

This report provides the advice and recommendations of the Environmental Protection Authority (EPA) to the Minister for the Environment on the environmental factors and principles relevant to the proposals by Alcoa World Alumina Australia (Alcoa) to expand the Wagerup Refinery through construction of a third production unit and to establish a Cogeneration plant.

The proposed production increase to approximately 4.7 million tonnes per annum (Mtpa) of alumina is to be achieved by a combination of new equipment and upgrade of existing equipment (referred to as Unit 3), in order to achieve an increase in both capacity and efficiency.

The Cogeneration plant is to provide electricity and steam for the Refinery, and for electricity supply into the South West Interconnected System (SWIS). The Cogeneration plant is a separate proposal and not dependent on the Refinery expansion. The proposals have been assessed together however, to consider predicted cumulative impacts. The Cogeneration plant may be constructed and operated by a third party.

The Wagerup Refinery is located 120 kilometres (km) south of Perth, 2km north of Yarloop and 7 km south of Waroona. Bauxite is supplied to the refinery by an overland conveyor from Alcoa's Willowdale bauxite mine located 15 km to the east. Alumina produced at the Wagerup refinery is transported by rail to Alcoa's shipping terminal at the Bunbury Port for export.

Alcoa was granted approval under Part IV of the *Environmental Protection Act, 1986* (EP Act) in 1990 to expand production from the Refinery from 840,000 tpa to 1.5 Mtpa after assessment by means of a Consultative Environmental Review (CER) (Implementation Statement No 95). In 1995, following another CER, Alcoa was granted approval to increase capacity to 3.3 Mtpa (Implementation Statement No. 390 as amended by Statement No. 564 in 2001), however, the refinery's current EP Act Part V prescribed premises operating licence limits production to 2.5 Mtpa. As the Wagerup Refinery has previously been assessed, the proposal to expand production to 4.7 Mtpa is a revised proposal pursuant to s45B of the EP Act.

The proposed production increase to 4.7 Mtpa represents a major upgrade to the refinery with potential for significant environmental impacts. The expansion proposal has therefore been assessed at the level of Environmental Review and Management Program (ERMP). The Cogeneration plant proposal has also been assessed as part of the ERMP.

Alcoa has also applied for approval under Regulation 17 of the *Environmental Protection (Noise) Regulations 1997* to allow the emission of noise from the Refinery to exceed the standards in the Regulations. This report also provides the EPA's advice and recommendations to the Minister for the Environment on Alcoa's application pursuant to Regulation 17.

Further details of the proposals are presented in Section 2 of this report. Section 3 sets out the EPA's context for this assessment. Section 4 discusses the environmental factors and principles relevant to the proposal. The Conditions and Commitments to which the proposals should be subject, if the Minister determines that it may be implemented, are set out in Section 5. Section 6 provides Other Advice by the EPA, Section 7 presents the EPA's conclusions and Section 8, the EPA's Recommendations.

Appendix 9 contains a summary of submissions and the proponent's response to submissions and is included as a matter of information only and does not form part of the EPA's report and recommendations. Issues arising from this process, and which have been taken into account by the EPA, appear in the report itself.

2. The proposals

Expansion proposal

Alcoa proposes to expand the Wagerup Refinery through construction of a third production unit. The proposed production increase to approximately 4.7 Mtpa alumina is to be achieved by a combination of new equipment and upgrade of existing equipment in order to achieve an increase in both capacity and efficiency. As the Wagerup Refinery has been subject to previous assessments, this represents a revised proposal pursuant to s 45B of the EP Act. The current maximum production permitted under the Refinery's current EP Act Part V licence is 2.5 Mtpa.

Although the expansion proposal will result in an increase in the rate of bauxite mining, the proponent has not proposed increasing the approved mining area.

The main characteristics of the expansion proposal are summarised in Table 1 below. A detailed description of the proposal is provided in Section 5 of the ERMP (Alcoa, 2005).

Table 1: Summary of key characteristics for the 4.7 Mtpa expansion proposal

Element	Units	Current Refinery	4.7 Mtpa Expansion Proposal
Alumina production	Mtpa	2.4 (maximum)	approximately 4.7
Bauxite mining rate	Mtpa	9	16
Bauxite residue	Mtpa	4.8	9.6
Refinery footprint	hectares	183	183
Raw Materials			
Caustic Soda (dry)	tpa	141,000	282,000
Lime	tpa	110,000	200,000
Water	MLpa	4,800	9,600
Main Equipment Components			
Milling		• 3 SAG mills	• Increased milling capacity
Ore stockpiles		• Stockpile reclaimer and conveyor • 2 stockpiles plus one emergency	• New reclaimer and conveyors • New dust suppression and cleaning system for conveyor
Slurry storage		• 4 slurry tanks	• New slurry tanks
Digestion		• Digester banks and flash vessels • Vapour condenser	• Increased digestion capacity • New and upgraded pumps
Evaporation		• Evaporation units • Heat interchange units	• New evaporation units • New heat interchanger
Lime		• 1 lime silo	• Upgrade lime storage and associated equipment
Clarification		• Sand removal units • Washers, thickeners • Filter tanks and presses	• New filter presses • New and upgraded washer facilities • New cyclone system
Residue Area		• Approx. 180 hectares required for drying and storing residue	• New sand separation • Additional 80 to 100 hectare drying area • Upgrade RDA sprinkler system
Precipitation		• Precipitators and seed filters	• New precipitators and seed filters

Element	Units	Current Refinery	4.7 Mtpa Expansion Proposal
		• Thickeners and liquor tanks • Cooling towers and cyclone clusters	• New thickeners and liquor tanks • Additional cooling capacity • New cyclone clusters
Oxalate removal		• Decommissioned oxalate kiln	• Oxalate kilns with RTO (regenerative thermal oxidizer)
Liquor Burning		• liquor burner	• Install a RTO
Calciners		• 4 calciner units • 100 metre multiflue for calciners 1, 2, 3.	• Upgrade calciner 3 • 2 new calciners with multiflue • No.4 calciner to new multiflue
Alumina Storage		• 2 alumina storage bins and alumina conveyors	• Additional alumina storage • Upgrade or additional conveyor
Powerhouse		• Turbo-alternators and boilers • Gas turbine with steam generator	• 2 new 270 tonnes per hour boilers with 2 x 35 MW steam turbines
Port Facilities		• Alumina storage and handling facilities • Caustic storage	• Upgraded alumina handling facilities
Water Supply		• Licenced surface water sources	• Increased surface water supply

Abbreviations: **Mtpa = million tonnes per annum**
KgCO2/t = kg of carbon dioxide equivalent per tonne of alumina produced
tpa = tonnes per annum
MLpa = million litres per annum
MW = megawatts

The Wagerup Refinery comprises of two primary operation areas; the processing facilities and the residue disposal area. In this report, 'Refinery' is used to refer to the total operations, 'refinery' to the processing facilities and RDA to the residue disposal operations.

An alternative to provide energy requirements by means of a cogeneration plant was also assessed as part of this proposal, and if implemented the cogeneration plant would replace the boiler option above (i.e. the 2 x 270 tonnes per hour boilers and 2 x 35 MW steam turbines option).

Cogeneration plant proposal

The main characteristics of the Cogeneration plant are summarised in Table 2 below.

Table 2: Summary of key characteristics for the Cogeneration Plant proposal

Element	Units	Cogeneration Plant Proposal
Gas turbines	MW	2 x 140MW-capacity gas turbine generators
Steam generators	tph	2 x 430 tph Heat Recovery Steam Generators (HRSG)

Abbreviations: **MW = megawatts**
tph = tones per hour

The potential impacts of the proposal initially predicted by the proponent in the ERMP document (Alcoa, 2005) and their proposed management are summarised in Table 1 (Appendix 3).

3. Context for the Assessment

There have been numerous studies relating to emissions from the Wagerup refinery and health issues reported in the area, undertaken since the installation of a liquor burner in 1996.

Of particular note, in 2001 the Government established a Medical Practitioner's Forum to investigate concerns that emissions from the Wagerup refinery were impacting on community health. The Forum included eminent health professionals and representatives from relevant government agencies, and made a series of recommendations to Government. In 2004, the CSIRO undertook a comprehensive Air Quality Review associated with the Refinery, for Alcoa (CSIRO, 2004e). More recently, in October 2004, the WA Legislative Council Standing Committee on Environment and Public Affairs reported on a three year inquiry into the operations and impacts of the refinery (Government of Western Australia, 2004).

The studies and investigations carried out to date, have consistently shown that predicted and measured ground level concentrations of compounds emitted from the refinery meet established national and international air quality health standards. The studies and investigations have not demonstrated any specific causal link between

- individual compounds, or mixture of compounds emitted from the refinery; or
- particular refinery sources,

and health related issues in the area.

Notwithstanding this, the Medical Practitioner's Forum concluded that there appears to be an association between health issues in the area and operation of the refinery, and some people living in the area continue to experience health issues.

Nature of the health issues

As part of the ERMP process for assessment of the proposed expansion, Alcoa commissioned a Health Risk Assessment (HRA) of emissions from the refinery. Consistent with previous studies, the HRA indicated that predicted ground level concentrations from both current emissions and predicted expansion emissions should not result in chronic health impacts or increased cancer risk to the surrounding community. Even with conservative assumptions and uncertainty estimates applied, the HRA did not indicate ground level emission concentrations which should cause adverse health impacts. The findings of the HRA were generally consistent with those for other alumina refineries, with established national and international air quality standards being met within close proximity to refineries.

The Department of Health has advised that on the basis of the HRA, emissions from the refinery should not present an abnormal public health risk for the general community.

The Department of Health also noted however, that HRA is generally based on air quality standards for chemical exposures averaged over periods of 1 hour, 1 day or 1 year, and does not specifically account for shorter term events such as a few minutes, and that certain individuals may be susceptible to health symptoms due to short-term concentrations.

Previous investigations including analysis of complaint information, have indicated that periodic short-term ground level concentrations, above those occurring in the area for the majority of

time, may occur under certain meteorological conditions. This appears to be particularly the case during winter months to the south and south-west of the Refinery. Whilst not considered to present a health risk to the general community, based on medical views presented to the EPA, such periodic short-term ground level concentrations may contribute to health symptoms in some individuals with sensitivities to chemicals.

Parameters such as odour and irritation thresholds provide an indication of the potential for health symptoms in individuals from short-term exposures to chemicals. Ambient air quality monitoring which has been undertaken in the area to date by Alcoa and government agencies has consistently found levels to be below recognized odour and irritation threshold limits. Based on the monitoring, it would appear that where individuals are experiencing health symptoms, it is at very low chemical levels.

The Wagerup Medical Practitioners Forum concluded that health symptoms being experienced by some people in the area include those that are consistent with a clinical syndrome, referred to as Multiple Chemical Sensitivities (MCS) syndrome.

While there are varying views regarding the syndrome there is a general theme that the health problems may be triggered in one of two ways:

- acute or definitely characterisable event, either a single episode or multiple episodes over a short period of time after which triggering of symptoms and observed sensitivities occur at very low levels of chemical exposure; or
- repeated or continuous lower-level exposures over a period of time may lead to sensitisation.

Given the incidence of reported health issues in the period following the installation of the liquor burner in 1996 this may have been a fundamental trigger for health issues. If this is the case, then it may be that people in the area who have become sensitised will continue to experience health issues even from reduced emissions from the refinery.

Furthermore, there may be people who, if they moved into the area, could be susceptible to exposure to periodic short-term concentrations arising under certain meteorological conditions. While the percentage of the general population who may be susceptible to such chemical sensitisation has not been scientifically quantified, the EPA has been advised that it may be in the order of a few percent.

The previous investigations and reviews which have been carried out into operations and impacts of the Refinery, including the three year inquiry by the WA Legislative Council Standing Committee on Environment and Public Affairs, have made various recommendations to assist address the reported health issues in the area. The findings and recommendations of these previous reviews have been implemented to varying degrees, although some key aspects are still continuing. To date, a formal health survey of residents in the area has not been carried out to document current health or any perceived change in health status since emission reduction measures have been implemented at the Refinery. Also, while Alcoa has implemented a land management strategy for the area, there is currently no formal statutory land management policy or strategy for the area. Neither is there a formal independent process available to people who feel they are affected by operation of the refinery so as to provide reasonable opportunity to relocate from the area without personal disadvantage.

This presents both policy and ethical questions as to whether expansion of the Refinery should be considered while there continues to be unresolved health issues related to chemical sensitivities. Hence any decision needs to be made in the context of a number of considerations, including environmental, economic, social and health factors. Some of these come within the

legislative scope of the EPA's assessment, and the EPA has considered these to the extent it can within this assessment. Some considerations, particularly certain economic and other matters, are outside the EPA's assessment and are matters for Government to consider in its decision making process.

Management approach to addressing chemical sensitivities

The primary factor for the EPA is air quality and potential health impacts.

As part of the assessment, the EPA received a submission from a number of independent (i.e. non government and non industry) members of the Wagerup Medical Practitioner's Forum which advised that:

"*In summary, we do not support the proposal to expand the Wagerup refinery in the existing circumstance of an inadequate buffer zone. Our judgement is that, in the face of much uncertainty, the problematic history of the relationship between the refinery and the local community is the most reliable guide to what the risk of further compromising the health and social functioning of the local community to be high,: and the trade off of this risk against the broader benefits to be unjust.*"

The submission cited in particular the following matters:

- "*there has been no formal health assessment of residents to document current health or any perceived change in health status since the engineering modifications, despite the intention to do so.*
- *There is no proposal to increase the buffer zone, which will remain at a very small 1.2 km, compared with the buffers of 6-8km around the Pinjarra and Worsley refineries. These refineries do not appear to have caused the same intensity of health problems.*
- *There is no proposal to provide local residents with genuine choices, such that those residents affected adversely by the proposed expansion would be able to leave the area freely, without economic loss or hardship.*
- *We are concerned that Alcoa's existing land policy has resulted in an increasing number of nearby tenants for whom Alcoa is the landlord. The tenant of a landlord, who is also a neighbouring producer of noxious emissions, may have a reduced freedom to voice concerns about health problems for fear of eviction"*

A full copy of the submission from these members of the Medical Practitioners' Forum is included at Appendix 7)

The Department of Health has advised the EPA that it considers that it would be inappropriate to arbitrarily introduce a new "protection of MCS" guideline for emissions, some order of magnitude below current air quality health standards. (Setting new, arbitrarily low guidelines for emissions may not prevent continued occurrence of health issues for people affected.) It also advised that it would be inappropriate to declare a large "no residents" zone of influence around the refinery as while some people have been impacted the majority of residents are not experiencing health issues. The Department advised, with qualifications, that it was supportive of the expansion proposal if appropriate safeguards are introduced to protect and monitor the health of the community. The necessary safeguards include:

1. *"The establishment of an adequate buffer zone around the refinery.*
2. *That a set of principles are adopted to enable individuals who experience health concerns within the buffer to have adequate compensation to enable them to relocate from the area.*

3. *That the proposed community surveys are mandated to ensure that the impacts are readily identifiable."*

With respect to the proposed buffer zone, the Department stressed that the justification for the zone in this instance was to allow for those individuals who may be impacted to be sensitively managed. It was not proposing that all residents be removed from the zone as this would be unnecessary. While not prescribing a definite zone, it considered that it should be a minimum of 5 km.

The EPA has reviewed other jurisdictions, nationally and internationally, to determine whether there are specific approaches which have been adopted for addressing chemical sensitivity issues. The review could not determine any specific guidelines, regulations or policy approaches being adopted elsewhere to specifically account for chemical sensitivities from industrial emissions below established air quality health standards. Similar to the policy approach applied in WA, other jurisdictions have required industries to meet established air quality standards, and implement 'best-practice' pollution control measures to minimise emissions.

The EPA notes that Wagerup generally has a larger population in proximity to it than other alumina refineries in Australia with Yarloop located between 2 and 5 kilometres (km) from the refinery. The notable exception to this is the Gladstone alumina refinery which has several thousand people within 5 km. A number of the other refineries also have people located within similar distances to those at Wagerup within which health issues have been reported (ie approximately 2-8 km). The Pinjarra refinery has a number of residents between 3 and 5 km and the townships of Pinjarra and North Pinjarra are located between 6 and 8 km (SKM,2003). Hope Valley and Wattleup are located between about 3 and 5 km from the Kwinana refinery. There are a number of aboriginal communities within 6km of the Gove refinery (URS, 2003).

While the other refineries (apart from one) do not have a liquor burner, the pollution control equipment now installed on the Wagerup refinery liquor burner, is such that its emissions are very low. Other emissions from the refineries are of a similar nature and order (Pacific, Air and Environment. 2004). While there have been air quality issues associated with some of these other refineries, particularly with odour and dust, the EPA is not aware of any general chemical sensitivity health issues within nearby communities. The management approach for these refineries has been based on achieving recognised air quality health standards and minimising emissions.

The EPA therefore concurs with the Department of Health that it would not be appropriate, and nor would it be consistent with other jurisdictions, to set arbitrary lower criteria below established air quality health standards. The EPA also concurs with the Health Department that the most appropriate approach to addressing such issues is through sensitively managing via an independent process, people who currently feel they are effected, and minimising the potential for new people being affected. This is also consistent with the recommendations of the Medical Practitioner's Forum that there needs to be improved focus on the clinical management of affected people and a focus on getting affected people out of the exposure situation.

Reductions in emissions and extent of current health issues

Alcoa has implemented a number of changes to operations and equipment at the refinery since 1998 to reduce emissions. Most of these were implemented by June 2002, as part of the requirements under the company's *Environmental Protection Act, 1986* prescribed premises (Part V) licence. In particular, odour emission levels from the plant are estimated to have been reduced from around 3,300,000 Odour Units per second (OU/s) in 1996 when the liquor burner was operating without current pollution control equipment to 1,600,000 (OU/s) in 2002 (CSIRO, 2004). Further reductions have been made since that time, and Alcoa estimates current average

emissions to be around 1,350,000. As such, ground level concentrations, and potential for people to be affected, has been reduced over time.

Alcoa has also implemented a land use management strategy to purchase properties in proximity to refinery where it considers people may be affected by operation of the refinery, particularly noise, (referred to as Area A). Alcoa has also established zones (referred to as Area B) covering the townships of Yarloop and Hamel which are designated as economic management zones within which it purchases properties from people seeking to relocate. Areas A and B cover most properties within 5 km of the refinery. This has lead to some people relocating from the area over past years when they have felt affected.

As indicated above, there has not been any formal health survey since these actions to accurately define the extent of current health issues. Information which is available to the EPA includes the following:

Health Department Community Health Nurse

The Department of Health operated a community health clinic at Yarloop during the period November 2002 to October 2003 established in response the recommendations of the Medical Practitioners forum. The Community Nurse's report presents descriptive data during the period (Cook, 2003).

Seventy individuals presented to the nurse during the period with symptoms including dry itchy eyes, headaches, fatigue and sleep disturbances. Some individuals were able to clearly state the time of detecting odour preceding their symptoms, while others did not notice an odour prior to feeling unwell. The information did not conclude whether the health issues raised by individuals were likely to be attributable to the operation of the refinery.

Alcoa and Department of Environment complaints databases

Alcoa and the DoE both maintain databases of complaints in relation to the Wagerup Refinery. While it is accepted that these databases may not present a complete picture of all health incidences being experienced in the area, they do provide some context.

The Alcoa database records complaints by type, including where the person considers it to be health related. The data shows a general decline in both the number of health complaints and the number of properties lodging complaints over recent years (Table 3 below). In addition, the number of new properties experiencing more than one complaints has reduced.

Table 3: Alcoa complaint database

Year	2002	2003	2004	2005 (to 8 Nov)
Total no. health complaints	105	45	110	34
No. of properties lodging single complaint.	11	11	12	3
No. properties lodging more than one complaint.	12	10	8	7
No. new properties lodging more than one complaint		3	1	1

The DoE database includes complete complaint data for only 2004 and 2005. The database does not specifically record complaints as health complaints but does record the 'incident description'. A review of the database indicates, however, that many of the complaints under the category odour relate to health symptoms. The data generally reflects a similar pattern to the Alcoa database with 27 complaints regarding odour or air quality from 8 properties for 2004, and 17 complaints for 5 properties for 2005.

Alcoa occupational health monitoring

Alcoa also advised that it was not aware of any cases of MCS being diagnosed within the workforce at Wagerup, since the completion of engineering improvements for odour and emissions management in 2002.

Submissions to the EPA on this assessment

The EPA received 12 submissions relating to health issues as part of this assessment. Most of these were from people who had experienced problems over a considerable period of time. The submissions were received from properties located between 2.3 and 8.7 km from the Refinery. One person who had lived in Yarloop for a considerable period advised that they had first experienced problems following installation of the calciners and liquor burner high multi-flue in June 2002. Another person, from Cookernup about 8.5 km south of Wagerup, advised they had developed health problems after moving into the area in 2003. This was supported by a letter from their doctor advising that it was considered they had developed multiple chemical sensitivity related to emissions from the refinery. This is the only case that has been brought to the EPA's attention of people moving into the area after 2002, who have been diagnosed with multiple chemical sensitivity symptoms.

The EPA also received submissions from people living in proximity to the Refinery who were supportive of the expansion proceeding.

The EPA acknowledges that the above information does not represent a complete picture of the current extent of health issues at Wagerup. Some people who feel affected may have ceased complaining due to the length of time that issues have continued there. This was reflected in the survey of residences undertaken by Geo and Hydro Environmental Management Pty Ltd as part of the Pinjarra – Brunswick Junction Region Study.

Notwithstanding these points, it appears that the number of properties whose occupants are currently experiencing health issues in the Wagerup area is reducing (relating to either the reductions in emissions or people moving out of the area), and that there are currently few new residents raising complaints relating to health issues.

Requirements under which expansion of the refinery could be considered

The EPA considers that it would be preferable in situations where there have been health concerns in proximity to industry for expansion not to proceed, until comprehensive health surveys had been conducted to demonstrate that there were no ongoing health issues or they had been reduced as far as practical.

Having considered the advice of the Department of Health and Department of Environment, the EPA considers that approval for expansion at Wagerup could be considered provided appropriate safeguards were adopted to protect and monitor the health of the community.

Importantly, all of the following essential requirements would need to be met:

- Demonstration that there would be no general increase in ambient ground level concentrations for key pollutants from the Refinery, consistent with the predicted ground level concentrations presented in the Environmental Review and Management Program.
- Best practice was applied in design, selection, installation and commissioning of pollution control equipment integral to the expansion to minimise emissions from the Refinery. This should be subject to review by an expert Independent Design Review Team team, established in consultation with Alcoa, during the design phases leading to Works Approval application.
- A technically sound, independently monitored program was agreed for commissioning performance verification to demonstrate emissions met those proposed.
- Key recommendations from previous reviews and investigations, particularly those of the CSIRO 2004 Air Quality Review, were completed in parallel with the design phases of the expansion.
- A comprehensive ambient air quality monitoring and reporting program was established for the area.
- A baseline health survey, independently managed by the Department of Health, was undertaken in the area within twelve months of approval being granted.
- A Government land use strategy be developed and implemented for the area prior to construction commencing, in association with Alcoa's land use strategy, to ensure compatible land uses in the vicinity of the Refinery.
- Periodic follow-up, independent health surveys following implementation of the expansion to monitor community health issues.
- Establishment of an independent process for assessment and diagnosis of any persons reporting health symptoms attributable to operation of the refinery.
- Establishment of a process to enable persons who have been professionally/independently assessed to be experiencing chemical sensitivity symptoms to relocate from the area without personal disadvantage.

These requirements have been considered at length by the EPA and reported on in this assessment report. It is stressed that if Government approval is granted for the expansion to proceed, all of these requirements are essential and must be implemented as a complete package.

The following sections provide the EPA's assessment of the proposed Wagerup Unit 3 expansion in the context of these requirements.

4. Relevant environmental factors and principles

Section 44 of the *Environmental Protection Act 1986* requires the EPA to report to the Minister for the Environment on the environmental factors relevant to the proposal and the conditions and procedures, if any, to which the proposal should be subject. In addition, the EPA may make recommendations as it sees fit.

The identification process for the relevant factors selected for detailed evaluation in this report is summarised in Appendix 3. The reader is referred to Appendix 3 for the evaluation of factors not discussed below. A number of these factors, such as flora and fauna, radiation, light spill, groundwater quality, surface water quality, water supply, liquid and solid wastes, public safety risk, visual amenity, and heritage are very relevant to the proposal, but the EPA is of the view that the information set out in Appendix 3 provides sufficient evaluation.

It is the EPA's opinion that the following environmental factors relevant to the proposal require detailed evaluation in this report:

(a) Air pollutant emissions;

(b) Predicted ambient air quality and Health Risk Assessment;

(c) Potential for health and amenity impacts due to short-term ground level concentrations;

(d) Land use management in proximity to the refinery;

(e) Noise; and

(f) Greenhouse gases.

The above relevant factors were identified from the EPA's consideration and review of all environmental factors generated from the ERMP document and the submissions received, in conjunction with the proposal characteristics.

Details on the relevant environmental factors and their assessment are contained in Sections 4.1 - 4.6. The description of each factor shows why it is relevant to the proposal and how it will be affected by the proposal. The assessment of each factor is where the EPA decides whether or not a proposal meets the environmental objective set for that factor.

The following principles were considered by the EPA in relation to the proposal:

(a) The precautionary principle;
(b) Principles relating to improved valuation, pricing and incentive mechanisms; and
(c) The principle of intergenerational equity.

4.1 Air pollutant emissions

Description

Characterisation and quantification of emissions

Air emissions from Wagerup Refinery can be considered in two groups; point source emissions and diffuse source emissions.

The emissions associated with the refinery processing operations are considered point source emissions and occur where the refinery gases or particulates are emitted to the atmosphere through identified points such as stacks or vents.

Diffuse source emissions originate over a broader area where there is little or no redirection of vapours or particulates. Emissions from the various parts of the residue drying areas (RDA) and bauxite stockpiles are considered diffuse source emissions.

As point sources occur mostly at a discrete location, they are generally more conducive to monitoring/estimation of emission levels than diffuse sources where emissions occur over a broader area.

Point sources

Comprehensive assessment of point source emissions at the refinery generally commenced in 2000. During 2000 and 2001, Alcoa undertook a comprehensive emissions inventory to enable a more complete range of emissions to be characterised and quantified. This included a series of detailed monitoring programs, some of which were required as part of the Refinery's

Environmental Protection Act, 1986 prescribed premises (EP Act Part V) licence conditions, and some as performance testing associated with emissions reduction programs. The results of this work are presented in *Wagerup Refinery Air Emissions Inventory Final Report – September* 2002 (included as Appendix A to the Response to Public Submissions).

In March 2002, A.W.N. (Air Water Noise) Consultants (AWN) was appointed to conduct an independent audit of the Wagerup Refinery by the Department of Environment. The audit was conducted during the period April 2002 to May 2003 and included review of the emissions inventory, including parameters measured, sampling method, analysis and reporting. With respect to the emissions inventory the audit found "In general terms, the emissions inventory scope is considered comprehensive and appropriate". The audit report further identified a number of areas for improvement in subsequent monitoring (AWN, 2003)

In 2004, Alcoa commissioned CSIRO Atmospheric Research to carry out a review of air quality issues at Wagerup Refinery which included systematic examination of possible sources of emissions and a review of the rates of emissions as background to subsequent reviews on air quality (refer next section). The CSIRO review found "The emission measurement program which has been carried out by Alcoa has identified a large number of chemical compounds that to the best of our knowledge have not previously been measured in emissions from alumina refineries anywhere. It has also established, within the detection limits of measurement undertaken, that a number of other compounds are not emitted in amounts greater than or equal to these detection limits. This work represents a substantial advance in knowledge about emissions to the atmosphere from alumina refineries" (CSIRO, 2004e). The report made a number of recommendations concerning further air quality studies at Wagerup, including several relating to emissions monitoring and database recording.

Alcoa, in association with CSIRO, has subsequently prepared a programme of work to address the recommendations from the 2004 CSIRO review. The status of progress of implementation of these recommendations, and current work is set out in Alcoa's Interim Environmental Improvement Plan 2005/06 (Alcoa, 2005c), which is being implemented under the Refinery's EP Act Part V licence. A summary table of the status is provided at Appendix 6 to this report. A Technical Advisory Panel (TAP), including the DoE, Chemistry Centre WA (CCWA), CSIRO, Alcoa and community representative has been established to review and advise on progress of implementation of the Plan, and to report to the Wagerup Tripartite Group.

Alcoa is also continuing to monitor and update emission estimates for the refinery through routine and specific purpose monitoring programmes. A number of these programmes are required as part of the EP Act Part V licence and Alcoa is required to report regularly to the Department of Environment on these programmes. Alcoa also reports to the National Pollutant Inventory on emission estimates.

Diffuse sources

Limited measurement and estimation of gaseous emission levels from diffuse sources had been undertaken at Wagerup Refinery prior to 2004, due to the inherent difficulties in doing this. In line with recommendations of the 2003 AWN and 2004 CSIRO reviews, and the Wagerup Refinery EP Act Part V licence conditions, Alcoa instigated a detailed programme to assess particulates (dust) and gaseous emissions from the Residue Drying Areas. Details and results of this program are set out in *Emissions to Air from Residue Disposal Area – Assessment of Emissions from Diffuse Sources* (GHD, 2005). As recommended in the CSIRO and AWN reviews, the programme used emission isolation flux chambers to measure gaseous emission rates (mass/unit area/time) from all components of the RDA and also the lower dam. Due to the large surface area of the various component parts of the RDA and inherent variability in flux chamber measurements, the programme is considered at this stage to provide indicative data on

emission rates of gaseous emissions from these diffuse sources. Estimated particulate emission rates have been based on modelling and air monitoring. Alcoa is intending to continue this assessment of emission rates from the diffuse areas to continue to refine estimates and is required to report to the DoE on this work as part of the Refinery's EP Act Part V licence.

Estimated emissions for the base case and expansion

Results from the monitoring programmes and assessments discussed above have been used to estimate air emission levels for the Refinery pre and post expansion. The pre-expansion (base case) estimates are based on monitoring results between July 2002 to March 2004 (for a nominal annual throughput of 2.4 Mtpa). The post-expansion estimates are based on predicted emissions for 4.7 Mtpa taking into account the increased throughput and planned improved emission management measures associated with the expansion.

Estimates of emission rates have been derived for all main sources associated with the refinery and RDA. Emission rates were determined for 27 compounds, which were assessed through a screening process, to be the major potential contributors to potential health impacts for air emissions from the Wagerup refinery. Emission rates were also determined for odour. The emission rates were derived for use in air dispersion modelling to determine predicted ground level concentrations in the vicinity of the Refinery, and subsequent use in Health Risk Assessment (HRA) and determining odour impacts, as discussed in the following sections.

Estimates have been made of both average and peak emission rates for the Refinery. The average rates were used to determine average annual concentrations to assess the impact of potential chronic and carcinogenic exposures, and the peak emission rates to assess potential acute health impacts. The estimated average and peak emission rates for the refinery are set in Appendix F of the Response to Submissions. (Note, these were modified slightly from those presented in the ERMP based on the submissions and further work in this time). Estimated emission rates for the diffuse sources are set out in *Air Dispersion Modelling of Fugitive Emissions Wagerup Refinery* (Air Assessments, 2005)

Proposed air emissions management measures for Wagerup 3 expansion

Alcoa has implemented a number of emission reduction programmes over past years, particularly associated with the liquor burner and digestion processes. A new 100 metre multi-flue stack was also installed in 2002 with the aim of improving dispersion of emissions from calciners 1, 2 and 3 and the liquor burner, to reduce ground level concentrations.

Key emission management measures proposed as part of the Wagerup Unit 3 Refinery are summarised in below.

Table 4: Key emission management measures proposed as part of the Wagerup Unit 3 expansion

Process area	Emission management measures
Refinery point sources	
Calciners	1. Existing Calciner 3 to be upgraded to equivalent of Mark IV Standard to match emission characteristics of Calciner 4; 2. New Calciners 5 and 6 to be fitted with 3 zone Electrostatic Precipitators (ESPs); 3. Existing Caciner 4 to be routed to new 100 m multi-flue with new Caciners 5 and 6; 4. Low volume vent emissions from calciners to be the directed into calciner combustion air feed system.
Cooling towers	1. New cooling requirements in precipitation from fin-fan cooling, or technology that can meet similar emissions reductions; 2. Modification to operation of the cooling towers to achieve a 50% reduction in odorous emissions by reducing suspended particulate matter and water treatment chemical usage.
Organic removal • oxalate kiln • liquor burner	1. Installation of an RTO on the new oxalate kiln; 2. Existing Catalytic Thermal Oxidiser (CTO) on the liquor burner to be replaced with a Regenerative Thermal Oxidiser (RTO).
Slurry tanks (25A)	1. Existing tank contact heaters to be replaced with sealed units; 2. Vapour flows in the 25A slurry tank vents to be reduced to achieve 75% reduction in odorous emissions.
Causticisation/clarification (35J&35A)	1. 35J causticisation to be replaced with high efficiency units or a technology installed to reduce VOC and odour emissions to negligible levels; 2. New filters to modern day equivalent for 35A. Existing tank vents to be modified to reduce flows and emissions by 50%.
Boilers and gas turbines	1. Low NO_x burner for new gas turbines.
RDA diffuse sources	
Residue dry stack areas	1. Improved design and management of sprinkler system.
Residue wet stack area	1. Conversion of RDA2 from wet-stacking to dry-stacking.
Cooling ponds	1. Limiting the increase of VOC load to the cooling pond to 50% by use of fin-fan cooling or technology that can meet similar emissions reductions.

Predicted changes in emission levels for Wagerup expansion

For the purposes of considering potential health and amenity impacts emissions from the Wagerup Refinery can be broadly considered in five groups:

- volatile organic compounds (VOCs) (e.g. aldehydes, ketones, PAH's and aromatic compounds (BTEX));
- metals (e.g. mercury, arsenic, cadmium);
- particulate matter (e.g. total suspended particulates, PM_{10} and $PM_{2.5}$);
- combustion gases (e.g. nitrogen oxides (NOx)); and
- odour.

Table 5 below sets out the predicted changes in emission levels for particular compounds for point sources for the expanded Refinery as presented in the ERMP and Response to Submissions.

Table 5: Predicted changes in emissions for refinery point sources

Compound	average emissions (tpa)			peak emissions (g/sec)		
	base case	expansion	% chg	base case	expansion	% chg
Odour (OU/sec)	1,356,000	872,000	-36%	2,540,000	916,000	-64%
VOCs						
• 'total' (1)	90.8	80.3	-12%	5.6	2.72	-51%
• acetaldehyde	13.4	18.4(3)	+37%	0.806	0.632(3)	-21%
• formaldehyde	17.8	21.8(3)	+23%	1.15	0.750(3)	-35%
• acetone	45.0	24.5	-46%	2.65	0.815	-69%
• 2-butanone	3.1	4.3	+38%	0.314	0.142	-55%
• benzene	2.1	2.4	+11%	0.173	0.080	-54%
Metals						
• mercury (2)	0.164	.24	+46%	0.0069	0.0076	+10%
• arsenic	0.080	.078	-2%	0.0035	0.0027	-23%
Particulates	60	66	+10%	8.4	5.3	-37%
NOx	1,005	1,975	+94%	75.2	92.9	+24%

Notes: (1) – total for 14 organic compounds assessed in Health Risk Assessment
(2) – the average emission estimates for the expansion case in the ERMP were modified in response to submissions 3.4.7
(3) - Following the response to submission, Alcoa advised there should be negligible acetaldehyde or formaldehyde emissions from the cooling tower after the expansion.

The changes in emission levels are not directly proportional to the increase in production due to the emission management measures proposed as part of the expansion discussed above.

Table 6 below sets out the predicted change is emission levels for particular compounds for diffuse sources for the expanded Refinery as presented in the ERMP and Response to Submissions.

Table 6: Predicted changes in RDA diffuse sources (1)

Compound	average emissions (tpa)		
	base case	expansion	% chg
Odour (OU/sec)	1,356,000	1,384,000	+2%
VOCs (2)			
• acetaldehyde	9.6	10.1	+5
• formaldehyde	1.5	2.3	+53%
• acetone	13.1	13.8	+5%
• 2-butanone	1.7	1.8	+6%
• benzene	0.15	0.2	+28%
Metals			
• mercury (3)	0.054	0.02	-64%
• arsenic	0.02	0.02	0%
Particulates (4)	453	492	+9%

Notes: (1) – Changes in peak emission rates are not presented as some diffuse source emissions are dependent on wind speed and temperature.
(2) – includes lower dam.
(3) – predominantly from refinery discharge to cooling pond (see response to submissions 3.4.7).
(4) – based on PM_{10} . Includes bauxite stockpile.

The predicted changes in emission levels for diffuse sources are generally less than for the refinery point sources. The major predicted changes are for formaldehyde and benzene, although total diffuse emissions for these compounds represent only 10% and 8% respectively of the total Wagerup Refinery emissions for these compounds.

As with the point sources, changes in the diffuse source emission levels are not directly proportional to the increase in production due to improved emission management measures proposed as part of the expansion.

Emissions verification post-expansion

The Air Quality Management Plan included at section 10 of the ERMP sets out proposed monitoring and other measures to verify emission levels post-expansion.

For point sources, the Plan includes:

- Commissioning monitoring;
- Performance verification monitoring; and
- On-going compliance monitoring.

Due to their nature, performance verification monitoring is proposed to be extensive in terms of the number of parameter monitored and frequency of monitoring. Where appropriate, the commissioning and performance verification will include engineering certification of improvement measures, for example, where reductions in process flows are proposed.

Verification monitoring for the diffuse sources will rely on upwind and downwind ambient monitoring combined with back trajectory modelling.

Submissions

A number of the submissions on the ERMP raised issues about emission levels. These are covered in Sections 3.1 and 3.2 of the Response to Submissions. These included:

- the extent to which compounds have been identified for the Refinery;
- the extent to which the emissions from particular sources have been characterised;
- the certainty of emission estimates;
- the validity of the odour estimates based on VOC relationship;
- the predicted amount of increase in emissions relative to the increase in production, and how the process changes would achieve improvements;
- the verifiability of changes in emissions if the expansion proceeds, and the extent of validation/monitoring post-expansion;
- whether the process changes planned for the expansion represented best practice.

Assessment

The area considered for assessment of this factor is the refinery and RDA.

The EPA's environmental objective for this factor is to ensure:-

- emissions from the refinery and RDA are adequately characterised and quantified;
- best practice pollution control measures (consistent with EPA's Guidance Statement No. 55) are taken to minimise emissions from the Refinery; and
- changes in emissions can be reliably validated if the expansion proceeds.

Characterisation and quantification of emissions

It is not generally practical to monitor all emissions from an industrial facility. However, to ensure air quality is properly managed and facilities do not pose an unacceptable health risk, sufficient monitoring and testing must be carried out to adequately characterise key pollutants and estimate emission rates with reasonable confidence. When considering an expansion of a facility, it is also necessary to be able to predict the change in emissions with reasonable confidence. An assessment of the level of uncertainty associated with estimates and predictions also needs to be made, and appropriate sensitivity analysis undertaken to ensure that there is a sufficient margin of safety in the assessment of any likely impacts from the emissions.

The EPA considers that the extent of assessment of emissions from the Wagerup Refinery is generally comprehensive and has been subject to a number of reviews, particularly the 2003 AWN review and 2004 CSIRO review. The EPA notes that emissions inventory undertaken in 2002 included dedicated analysis of approximately 600 individual compounds at the refinery (Alcoa, 2002). The main pollutants identified in terms of mass emission rates are consistent with findings of assessments for other alumina refineries.

In line with recommendations from the 2004 CSIRO review (recommendations 1 and 3) Alcoa has established a systematic database of chemicals emitted from the Refinery and is establishing a process for maintaining a single verified series of Refinery emission rate data (Alcoa, 2005c). The EPA concurs that the systematic maintenance of such information is important in the on-going characterisation and quantification of emissions from the Refinery.

In line with the CSIRO review, Alcoa has also implemented detailed monitoring and assessment of gaseous emissions from the RDA. However, due to the inherent complexity in monitoring and assessing emissions from large areal sources the current estimates may still be considered as preliminary. Nevertheless, they provide a useful basis for evaluation of the contribution of these sources to the overall Refinery emissions, and for assessment of likely changes in emissions for the expansion.

The EPA notes that average and peak emission rates have been predicted for 27 significant compounds for use in the HRA. The ERMP recognises that there is a level of uncertainty with emission estimates due to a number of factors including refinery process variations and the effect of sampling and analytical variability. Alcoa has applied uncertainty levels to these estimates to evaluate the sensitivities in the HRA (refer following section). The EPA considers this to be a valid approach to dealing with the uncertainties.

Overall, the EPA considers the characterisation and quantification of emissions is sufficiently robust for assessment of the likely impacts of the expansion.

There is some question, however, regarding the validity of the 'odour-VOC' relationship (ERMP section 7.9.3) for estimating odour emission rates for refinery point sources. While the EPA understands the intent in developing the relationship, it may not sufficiently, reliably predict odour rates for particular sources that have high moisture content. This issue is addressed in more detail below in the section on process improvements and predicted changes in emissions for key substances.

The EPA also notes recommendations 13 and 4 of CSIRO's 2004 review that there is a need to better establish the extent of short-term variations in emission rates from the Refinery, and to continue to develop techniques for continuous monitoring of key pollutants. These are important to more fully assess the potential for short-term elevated ground level concentrations of compounds in the surrounding district. The EPA notes that these recommendations are being

addressed through the Refinery Environmental Improvement Plan (Alcoa, 2005c). The EPA considers the work should include variations due to both, process variations under normal operations, and also during equipment shut-down and start-up.

The EPA is aware that Worsley Alumina Pty Ltd is also intending to evaluate variability of emissions from its refinery as part of Phase 2 of its Air Emissions Impact Assessment project, which is currently being undertaken. This should provide a useful basis for comparison with Wagerup emissions.

Proposed process improvements and predicted changes in emissions

The EPA notes that Alcoa has implemented a number of emission reduction programmes over past years, particularly associated with the liquor burner and digestion processes, and that further emission management measures are proposed as part of the Wagerup Unit 3 expansion.

The EPA notes that emission management measures proposed as part of the expansion will generally limit the rise in emissions of most compounds, and reduce total emissions for some compounds. The extent of predicted improvements/reductions in emission rates for some of the key compounds (as a representation of the general extent of expected changes) is discussed below.

(i) VOCs

Table 8 below sets out the predicted changes in VOC emissions for the refinery and RDA.

The major sources of VOCs for the refinery are the cooling towers and calciners, accounting for about 80% of the current emissions.

Cooling load for the refinery can be satisfied by use of cooling towers (in the refinery), other types of cooling equipment such as fin-fan coolers (also in the refinery), and cooling lake heat loss. Alcoa has proposed that all new cooling requirements for the precipitation process for the expansion will be through use of fin-fan coolers or technology that can meet similar emissions reduction. In addition, modifications will be made to the operation of existing cooling towers through either elimination of particular towers and/or the substitution in the others of freshwater quality cooling water instead of condensate as the coolant. This is expected to reduce current emissions by at least 50%, particularly acetone emissions. Alcoa has also advised that it should eliminate or significantly reduce emissions of other priority VOCs including formaldehyde and acetaldehyde. This should also lead to smaller differences between the peak and average emissions of specific substances and odour than has historically been the case. This is due to the steady rate at which the cooling towers would be run, and the consistent quality of freshwater coolant supplied to the towers. Use of freshwater coolant filtered to remove suspended particulates greatly reduces the need for cooling tower dosing chemicals to control biological activity levels. These chemicals are currently believed to be important contributors to the characteristic odour of cooling towers. Given that production is increasing nearly 100%, the EPA considers this to be a reasonable level of reduction to be sought as part of the expansion. The EPA considers that it is important in the detailed design to endeavor to eliminate the priority VOCs formaldehyde and acetaldehyde as far as practicable. VOC emissions from the cooling towers are predicted to account for only about 15% of total emissions following the expansion.

While total VOC emissions from the calciners are predicted to increase, the emission rate per unit production is expected to improve by about 40% (from 20.5 g/t to 12.1 g/t). This is largely due to improvements in the performance of existing calciner 3. These improvements, which have been implemented earlier this year, have been subject to testing to verify the improved performance level. The proposed redirection of the calciner low volume vents to the combustion

air feed will also contribute to the reduction in VOC emissions per unit production. The use of RTOs on the new oxalate kiln and the liquor burner will limit VOC emissions from these sources and is considered to be best practice.

The predicted net change in VOC emissions from refinery point sources is a reduction of 12%. Table 7 below presents a comparison of predicted VOC emissions for the expanded Wagerup Refinery, with predicted emissions for expanded Pinjarra and Worsley Refineries.

Table 7: Comparison of predicted VOC emissions for Wagerup, Worsley and Pinjarra

	average emissions (tpa)			**average emissions (g/t)**		
	Wagerup	Worsley(1)	Pinjarra(2)	Wagerup	Worsley(1)	Pinjarra(2)
Calciners	56.7	55.5	69	12.1	12.6	16
Refinery total	80.3	85.5	193	17.1	19.4	46

Notes: (1) – Worsley Project Expansion ERMP (strategen,2005). (Excluding existing coal fired boilers and power cooling emissions).
(2) – Pinjarra Efficiency Upgrade EPS (Environ, 2003).

While there are some differences in the approach to estimating emissions between the refineries, the comparison indicates the predicted calciner emissions for Wagerup (which is a major VOC source) are similar to Worsley and lower than for Pinjarra. The difference in comparison to the Pinjarra emissions is largely due to the proposed redirection of the low volume vents to air combustion at Wagerup. Total VOC emissions for Wagerup are also predicted to be similar to Worsley. In addition to the higher emissions from calciners, the other major increase in emissions at Pinjarra compared to Wagerup is from the cooling towers.

The major source of VOCs from the RDA is from the cooling pond which accounts for nearly 50% of estimated emissions for the current operations. The EPA notes that Alcoa is intending to use fin-fan cooling or technology that can meet similar emissions reduction for all new cooling requirements for precipitation and that this will limit the increase in emissions. The other major current source of VOC emissions is the RDA2 wet stacking area which accounts for about 22% of current emissions. The proposed modification of RDA2 to dry stacking will effectively eliminate these emissions.

No estimates are currently available for Worsley or Pinjarra to compare against the Wagerup diffuse emissions, although the EPA understands that programmes have been implemented to investigate diffuse source at these Refineries.

Overall, the emission management measures proposed by Alcoa are predicted to result in a reduction of about 7% in average VOC emissions for the expanded Refinery.

Table 8: Predicted changes in VOC emissions (1), (2)

Process area	Average emissions (tpa)			peak emissions (g/sec)			process improvements
	base	exp'n	% chg	base	exp'n	%chg	
Refinery point sources							
milling/slurry tanks	4.0	1.8	-55%	0.132	0.0599	-55%	Improvements to reduce vapour flows from 25A tank vents.
digestion	0	0	0%	0	0	0%	
causticisation/clarification	5.5	3.6	-34%	0.254	0.115	-54%	Negligible emissions from 35J vents and reduction from 35A vents.
organic removal							
• oxalate kiln	0	0.06	new	0	0.002	new	RTO fitted to new oxalate kiln.
• liquor burner	4.2	0.84	-80%	0.277	0.029	-90%	CTO replaced by RTO.
cooling towers	22.0	11.6	-50%	1.955	0.366	-81%	Use of fin-fans for new cooling, and modifications to operation of towers.
calciners	49.2	56.7	+15%	2.753	1.956	-29%	Improved performance calciner 3 and low volume vents to combustion.
boilers and gas turbines	5.7	5.7	0%	0.229	0.190	-17%	
total	90.8	80.3	-12%	5.6	2.7	-52%	
RDA diffuse sources							
residue dry stack areas	1.0	1.5	+50%				Dry stacking area increased by 50%.
residue wet stack areas	5.8	0	-100%				RDA2 modified from wet stacking to dry stacking.
cooling pond	12.8	19.2	+50%				Use of fin-fans for all new cooling in precipitation.
lower dam	0.5	0.5	0%				
runoff water pond	0.9	1.8	+100%				
oxalate pond	0.05	0.08	+60%				
super thickener	2.2	2.3	+5%				
sand cannon and lake	2.8	2.9	+4%				
total	26.4	28.6	+8%				
Refinery total	117	109	-7%				

Notes: (1) – includes major VOC compounds

(2) - changes in peak emission rates are not presented for diffuse sources as some emissions are dependent on wind speed and temperature.

(ii) Formaldehyde

Formaldehyde is one of five priority VOCs which is currently monitored as part of the Wagerup Refinery's EP Act Part V licence. It has one of the lowest irritation thresholds of the VOCs emitted from the refinery. Table 10 below sets out the predicted changes in formaldehyde emissions for the refinery and RDA.

The main source of formaldehyde emissions for the refinery is the calciners, accounting for about 95% of the current emissions. Average formaldehyde emissions from the calciners are predicted to increase by about 17% with the expansion. Improvements to the performance of calciner 3 and redirection of calciner low volume vents to combustion will, however, improve the average emission rate per unit production by about 40% (from 7.1 g/t to 4.3 g/t). The calciner 3 improvements, which have been implemented earlier this year, have been subject to testing to verify the improved performance level

The increased formaldehyde emissions will largely be from new calciners 5 and 6. The emissions will be vented through a new 100m multi-flue stack which is expected to minimise impacts on ground level concentrations. Emissions from existing calciner 4 will be also be redirected to the new multi-flue rather than its existing 49m stack, which should reduce ground level concentrations from this source. Predicted ground level concentrations are discussed in the following section on predicted ambient air quality[1].

The peak formaldehyde emissions are predicted to decrease by about 30% due mainly to the improvements implemented to calciner 3, improved operation of the other calciners and the redirection of calciner low volume vents to combustion. The EPA notes that the OPSIS Ultra-Violet absorption method implemented by Alcoa in recent years for continuous stack monitoring for the calciners has measured formaldehyde concentrations and provided useful information about the short term temporal variation in formaldehyde emissions and the influence of calciner operating variables on these emissions. This provides some capacity for verifying that, if the expansion proceeds, peak emission rates will comply with those predicted rates.

The only other main source of formaldehyde emissions for the expanded refinery, is from the gas turbines proposed as part of the Cogeneration plant. These emissions will however, contribute less than 10% of total emissions for the expanded refinery. Other sources of formaldehyde emissions for the refinery are generally low and predicted to reduce with proposed process improvements. The use of RTOs on the new oxalate kiln and the liquor burner is considered to be best practice.

The predicted net change in average formaldehyde emissions from refinery point sources is an overall increase of 23%. Table 9 below presents a comparison of predicted formaldehyde emissions for the expanded Wagerup Refinery, with predicted emissions for expanded Pinjarra and Worsley Refineries.

Table 9: Comparison of predicted formaldehyde emissions for Wagerup, Worsley and Pinjarra refineries

	average emissions (tpa)			**average emissions (g/t)**		
	Wagerup	Worsley(1)	Pinjarra(2)	Wagerup	Worsley(1)	Pinjarra(2)
Calciners	20.0	13.4	16.0	4.3	3.1	3.8
Refinery total	21.8	19.3	25.6	4.6	4.4	6.1

Notes: (1) – Worsley Project Expansion ERMP (strategen,2005). Based on cogeneration option.
(2) – Pinjarra Efficiency Upgrade EPS (Environ, 2003). Includes cogeneration plant.

[1] It is important to understand that an increase in emission rate does not automatically result in an increase in ground level concentrations as the increased emission rate may be offset by improved dispersion measures. Predicted ground level concentrations are discussed in the following section.

The comparison indicates that calciners are the dominant source of formaldehyde emissions for each refinery. It is apparent that the predicted calciner emissions for Wagerup are higher than for Pinjarra and Worsley, although this may be due in part to differences in the approach to estimating emissions at the different refineries. On a total refinery basis, predicted emissions for Wagerup are similar to Worsley (with the emissions for the existing coal fired power station cooling towers at that refinery providing a significant contribution) and lower than predicted for Pinjarra refinery.

Based on current monitoring and estimates, the RDA provides only a small contribution to overall formaldehyde emissions from the total Refinery. The main sources are the run-off water collection areas (ROCP1 and ROWS). Formaldehyde emissions are not expected to increase substantially from the RDA with the proposed expansion.

As noted above, no estimates are currently available to compare the Wagerup diffuse emissions with Worsley or Pinjarra, although the EPA understands that programmes have been implemented to investigate diffuse source at these Refineries.

Table 10: Predicted changes in formaldehyde emissions (1)

Process area	average emissions (tpa)			peak emissions (g/sec)			process improvements
	base	exp'n	% chg	base	exp'n	%chg	
Refinery point sources							
milling/slurry tanks	0.02	0.01	-50%	0.0006	0.0003	-50%	Improvements to reduce vapour flows from 25A tank vents.
digestion	0	0	0%	0	0	0%	
causticisation/clarification	0.006	0.003	-50%	0.0003	0.0001	-67%	Elimination of emissions from 35J vents and reduction from 35A vents.
organic removal							
• oxalate kiln		0.003	new	0	0.00004	new	RTO fitted to new oxalate kiln.
• liquor burner	0.09	0.015	-80%	0.0028	0.0006	-90%	CTO replaced by RTO.
cooling towers	0	0(2)	0%	0.1546	0(2)	100%	Use of fin fans for new cooling, and modifications to operation of towers.
calciners	17.1	20.0	+17%	0.977	0.688	-30%	Improved performance calciner 3 and low volume vents to combustion.
boilers and gas turbines	0.6	1.8	+300%	0.018	0.060	+300%	
total	17.8	21.8	+23%	1.15	0.75	-34%	
RDA diffuse sources							
residue dry stack areas	0.24	0.39	+50%				Dry stacking area increased by 50%.
residue wet stack areas	0.05	0	-100%				RDA2 modified from wet stacking to dry stacking.
cooling pond	0.04	0.06	+50%				Use of fin-fans for all new cooling in precipitation.
lower dam	0.31	0.31	0%				
runoff water ponds	0.8	1.4	+75%				
oxalate pond	0.03	0.05	+60%				
super thickener	0.01	0.07	+700%				
sand cannon and lake	0.03	0.03	+4%				
total	1.52	2.3	+50%				
Refinery total	19.3	24.1	+25%				

Notes: (1) - changes in peak emission rates are not presented for diffuse sources as some emissions are dependent on wind speed and temperature.
(2) – following the response to submissions, Alcoa advised there should be negligible formaldehyde emissions from the cooling tower after the expansion.

(iii) Acetaldehyde

Acetaldehyde is also one of the five priority VOCs which is currently monitored as part of the Wagerup Refinery's EP Act Part V licence. It has one of the lowest odour thresholds of the VOCs emitted from the refinery. Table 12 below sets out the predicted changes in acetaldehyde emissions for the refinery and RDA.

The main source of acetaldehyde emissions for the refinery is the calciners, accounting for nearly 80% of the current emissions. Average acetaldehyde emissions from the calciners are predicted to increase by about 55% with the expansion. Improvements to the performance of calciner 3 and redirection of calciner low volume vents to combustion will, however, improve the average emission rate per unit production by about 20% (from 4.4 g/t to 3.5 g/t). The calciner 3 improvements, which have been implemented earlier this year, have been subject to testing to verify the improved performance level.

The peak acetaldehyde emissions are predicted to increase by only 15% due improved operation of the calciners and the redirection calciner low volume vents to combustion. The EPA notes that while Alcoa has been developing the use of OPSIS Ultra-Violet absorption method for continuous monitoring of priority VOCs including acetaldehyde in the calciner stack emissions, at this time, the method has proven valid only for measuring formaldehyde. There remains some uncertainty therefore regarding the variability and peak emissions of acetaldehyde. The EPA notes that further work is continuing on this as part Alcoa's Interim Environmental Improvement Plan 2005/06 (Alcoa, 2005c) in line with CSIRO's recommendation 4.

The increased acetaldehyde emissions will largely be from new calciners 5 and 6. The emissions will be vented through a new 100m multi-flue stack which is expected to minimise impacts on ground level concentrations. Emissions from existing calciner 4 will be also be redirected to the new multi-flue rather than its existing 49m stack, which should reduce ground level concentrations from this source. Predicted ground level concentrations are discussed in the following section on predicted ambient air quality.

Other sources of acetaldehyde emissions for the refinery are generally predicted to reduce with proposed process improvements The use of RTOs on the new oxalate kiln and the liquor burner is considered to be best practice.

The predicted net change in average acetaldehyde emissions from refinery point sources is an overall increase of 37%. Table 11 below presents a comparison of predicted acetaldehyde emissions for the expanded Wagerup Refinery, with predicted emissions for expanded Pinjarra and Worsley Refineries.

Table 11: Comparison of predicted Acetaldehyde emissions for Wagerup, Worsley and Pinjarra refineries

	average emissions (tpa)			**average emissions (g/t)**		
	Wagerup	Worsley(1)	Pinjarra(2)	Wagerup	Worsley(1)	Pinjarra(2)
Calciners	16.4	17.1	14.1	3.5	3.9	3.4
Refinery total	18.4	21.8	22.5	3.9	5.1	5.4

Notes: (1) – Worsley Project Expansion ERMP (strategen,2005). Based on cogeneration option.
(2) – Pinjarra Efficiency Upgrade EPS (Environ, 2003). Includes cogeneration plant.

The comparison indicates that calciners are the dominant source of acetaldehyde emissions for each refinery and that the Wagerup calciner emissions are similar to Worsley and Pinjarra. Notwithstanding that there are some differences in the approach to estimating emissions at the

different refineries, the comparison also indicates that predicted total acetaldehyde emissions per unit production for Wagerup is lower than for the other refineries.

The major current sources of acetaldehyde from the RDA are from the cooling pond and RDA2 wet stacking area which account for nearly 75% of the estimated current emissions. The use of fin-fan cooling, or technology that can meet similar emissions reduction for all new cooling requirements for precipitation will limit the increase in emissions from the cooling pond and the proposed modification of RDA2 to dry stacking will effectively eliminate emissions from this source.

Table 12: Predicted changes in Acetaldehyde emissions (1)

Process area	average emissions (tpa)			peak emissions (g/sec)			process improvements
	base	exp'n	% chg	base	exp'n	%chg	
Refinery point sources							
milling/slurry tanks	0.9	0.5	-45%	0.028	0.016	-44%	Improvements to reduce vapour flows from 25A tank vents.
digestion	0	0	0%	0	0	0%	
causticisation/clarification	0.8	0.4	-50%	0.03	0.013	-57%	Elimination of emissions from 35J vents and reduction from 35A vents.
organic removal							
• oxalate kiln	0	0.006	new	0	0.0002	new	RTO fitted to new oxalate kiln.
• liquor burner	0.5	0.10	-80%	0.0643	0.0033	-90%	CTO replaced by RTO.
cooling towers	0	0(2)	0%	0.166	0(2)	100%	Use of fin-fans for new cooling, and modifications to operation of towers.
calciners	10.6	16.4	+55%	0.496	0.566	+15%	Improved performance calciner 3 and low volume vents to combustion.
boilers and gas turbines	0.7	1.0	+45%	0.024	0.033	+37%	
total	13.4	18.4	+37%	0.81	0.63	-22%	
RDA diffuse sources							
residue dry stack areas	0.4	0.6	+50%				Dry stacking area increased by 50%.
residue wet stack areas	2.3	0	-100%				RDA2 modified from wet stacking to dry stacking.
cooling pond	4.9	7.4	+50%				Use of fin-fans for all new cooling in precipitation.
lower dam	0.04	0.04	0%				
runoff water ponds	0.10	0.17	+75%				
oxalate pond	0.004	0.006	+60%				
super thickener	0.8	0.84	+5%				
sand cannon and lake	1.1	1.1	+4%				
total	9.6	10.1	+5%				
Refinery total	23.0	28.5	+24%				

Notes: (1) - changes in peak emission rates are not presented for diffuse sources as some emissions are dependent on wind speed and temperature.
(2) – Following the response to submissions, Alcoa advised there should be negligible acetaldehyde emissions from the cooling tower after the expansion.

As noted above, no estimates are currently available to compare the Wagerup diffuse emissions with Worsley or Pinjarra, although the EPA understands that programmes have been implemented to investigate diffuse source at these Refineries.

Overall, acetaldehyde emissions are predicted to increase by about 24%, although process improvements will significantly reduce emissions per unit production.

(vi) Metals

Seven metals were included in the 27 compounds considered in the HRA. Average emission levels for metals were generally predicted to decrease. Table 13 below sets out the predicted changes in two key metals, mercury and arsenic, for the refinery and RDA.

Table 13: Predicted changes in Mercury and Arsenic emissions

Process area	**mercury**			**arsenic**		
	ave emissions (kg/yr)			ave emissions (kg/yr)		
	base	exp(1)	% chg	base	exp	%chg
Refinery point sources						
slurry tanks	9	17	+90%	1	0	-100%
organic removal						
• oxalate kiln		74	new		0.3	new
• liquor burner	12	10	-17%	5	5	0%
calciners	9	19	+111%			
boilers (incl non condensables)(2)	132	100	-25%	75	72	-4%
other		20	-			
total	164	240	+48%	80	77	-4%
RDA diffuse sources						
residue dry stack areas	0.03(3)	0.03(3)	0%	19	19	0%
cooling pond and lower dam (incl condensate to RDA)	54	20	-64%			
total	54	20	-69%	19	19	
Refinery total	218	260	+19%	99	96	-4%

Notes: (1) - the average emission estimates for the expansion case in the ERMP were modified in response to submissions 3.4.7;
(2) – based on expansion with cogeneration facilities.
(3) – based on metal speciation in PM_{10}

The main source of mercury emissions from the refinery is the boiler stacks, which occurs as a result of exhaust from the evaporation and digestion areas being routed to the powerhouse for non-condensables gas destruction. The main source from the RDA is the cooling pond which occurs as a result of mercury losses to process water used in the refinery.

The ERMP estimated that average mercury emissions for the expanded refinery would be reduced to 103 kg/yr. In its response to submissions (3.4.7), Alcoa advised that this assumed successful implementation of new mercury reduction technology being trialed at Alcoa Point Comfort Refinery (USA). Alcoa is continuing with the developmental work in the Point Comfort trials and will implement this at Wagerup if proven successful. Based on current conventional (proven) technology, Alcoa has estimated the average mercury emissions would be 260 kg/yr. While this represents an increase of about 40 kg/yr, average emissions per unit production would still be improved by about 40% (from 0.091 g/t to 0.055 g/t). The EPA supports this approach of investigating new technologies to reduce emissions and adoption of

new best practice technology where this can be practicably applied. The EPA recommends that, if the expansion is approved, this be reviewed further prior to EP Act Part V Work Approval, and the new technology be adopted if proven practical.

The major source of arsenic emissions is also from the powerhouse. Arsenic emissions are not expected to increase if cogeneration facilities are adopted for the extra steam and power generation required for the expansion. Arsenic emissions are expected to increase if cogeneration is not adopted and additional boilers are installed. Alcoa is currently investigating the source of arsenic associated with the boiler facilities.

Table 14 below provides a comparison of emissions predicted for the expanded Wagerup refinery, with predicted emissions for expanded Pinjarra and Worsley refineries.

Table 14: Comparison of predicted metal emissions for Wagerup, Worsley and Pinjarra refineries

refinery	**mercury**		**arsenic**	
	kg/yr	g/t	kg/yr	g/t
Wagerup(1)	260	0.05	77	0.016
Worsley(2)	332	0.075	26	0.006
Pinjarra (3)	148	0.035	31	0.007

Notes: (1) – Based on cogeneration option;
(2) – Worsley Project Expansion ERMP (strategen,2005). Based on cogeneration option;
(3) – Pinjarra Efficiency Upgrade EPS (Environ, 2003).

Given variations in processes between the refineries and approaches to estimating emissions, the comparison indicates similar orders of metals emissions for the refineries.

(v) Particulates

Table 15 below sets out the predicted changes in emission of particulates for the refinery and RDA.

Table 15: Predicted changes in particulates emissions

Process area	**ave emissions (tpa)**			**peak emissions (g/s)**		
	base	exp	% chg	base	exp	% chg
Refinery point sources						
organic removal						
• oxalate kiln		3.2	new		0.1	new
• liquor burner	3.2	3.2	0%	0.5	0.5	0%
calciners	56.8	60.0	%6	7.8	4.7	-40%
Total	60	66	+10%	8.3	5.3	-36%
RDA diffuse sources (1) (2)						
dry stacked areas and 'sand' stockpiles	302	287	-5%			
bauxite stockpiles	63	102	+62%			
Total	365	389	+7%			
Refinery total	425	455	+7%			

Notes: (1) Based on PM_{10} estimates for 'observed' winds (Table 5.9 Air Assessments, 2005);
(2) Changes in peak emission rates are not presented for diffuse sources as some emissions are dependent on wind speed and temperature.

The main source of particulate emissions from the refinery is the calciners, which account for about 95% of refinery point source emissions. The existing calciners are fitted with 2 zone Electrostatic Precipitators (ESPs) for dust control. ESPs are efficient in controlling dust but require periodic shakedown ('rapping') to dislodge dust into a collection system. This can result in increased peak emissions from the stacks during this time. The potential for peaks is minimized by only rapping one zone at a time (so for a two-zone ESP one zone is still collecting while the other zone is rapping), and managing the time of rapping. For the expansion Alcoa is proposing to use 3 zone ESPs on new calciners 5 and 6. This will mean that two zones will remain collecting while the third is rapping so the peaks during rapping should be reduced for these calciners. Dust emissions are also impacted by the calciner design itself as well as by the protection capabilities of ESPs. Alcoa has advised that the existing infrastructure associated with the present calciners make retrofitting of a third zone to the current ESPs impractical without huge disruption, delay and cost. With the new calciners they can be designed into the project, so they are far more practical to include.

The EPA notes that ESPs have been used for dust control in industry for a considerable period and are used on other alumina refineries. The EPA has been advised however, that dust spikes can occur for systems fitted with ESPs during shut-down and purging operations. AS:384 requires purging of gas furnace and ducting systems that usually takes about ½ hour. Purging has to occur with the system (including ESPs) shut down (i.e. no electrical system that may ignite any unburnt gases). The EPA is aware that baghouses are used for dust control on calciners at some refineries. Worsley has proposed to include both an ESP and baghouse dust contol system on the new calciner proposed as part of its expansion. The ESP will clean then feed to the baghouse. This system is expected to result in better performance and overcome the issue of purging because the baghouse would continue to function during the purging operation. A baghouse was originally proposed on calciner 7 for the recent Pinjarra refinery expansion, however, the EPA notes this was changed to an ESP following a review by Alcoa of the comparative efficiency and operability.

Notwithstanding this, given the continuing reported health issues at Wagerup, the EPA recommends that if approval is granted for the Wagerup refinery expansion, Alcoa further review the comparative efficiency and operability of baghouses versus ESPs (particularly in relation to peak emissions), to provide additional justification on best practice for dust control for the facility prior to EP Act Part V Works Approval.

The main source of particulate emissions from the RDA is the dry stacked areas which accounts for about 70% of the emissions from the RDA. The Wagerup 3 expansion will require an increase of about 90 ha (50%) in the dry stacked area. The other major source is the bauxite stockpile. The bauxite stockpile will increase by about 5 ha (30%).

The principal measure for management of particulates from the RDA is the sprinkler system. As part of the Wagerup 3 expansion, Alcoa proposes to install an improved irrigation system in the new the dry stacked areas (using poly-pipes in the 60m X 60m triangular arrangement) to optimise water cannon arrangements. The old steel pipes in the existing areas will also be replaced with this new system. This will improve coverage and reduce current failure rates. Based on the improved design, it is predicted that particulate emissions from the dry stacked areas for the expanded operations will be reduced by about 12% from current levels.

The EPA notes that there has been incidences of excessive dust emissions from the RDA in the past, and therefore, with the expansion of the area by 50%, there will need to be best practice management of the improved irrigation system if such incidences are to be avoided in the future.

(vi) NO_X

Table 16 below sets out the predicted changes in emission of nitrogen oxides (NO_X) for the refinery.

Table 16: Predicted changes in NOx emissions

Process area	ave emissions (g/s)		
	base	exp	% chg
Refinery point sources			
organic removal			
• oxalate kiln		0.5	new
• liquor burner	1.2	1.2	0%
calciners	9.4	17.4	+85%
boilers	18.2	9.7	-47%
gas turbines (1)	3.0	33.8	new
Total	32	63	+97%

Notes: (1) Based on cogeneration option with 2 gas turbines.

NO_x emissions will increase from the calciners with the increased throughput. These emissions will be vented from the new 100m multi-flue stack. NO_x emissions will also increase from gas use for steam and power generation. Based on the proposed cogeneration facilities, NOx emissions would increase by about 30 g/s. The EPA notes that Alcoa has proposed to use low NO_x burner gas turbines which the EPA considers to be required best practice.

The impacts of the increased NO_x emissions on ground level concentrations are discussed in the following section on predicted ambient air quality.

Table 17 below presents a comparison of predicted NO_x emissions for the expanded Wagerup Refinery, with predicted emissions for expanded Pinjarra and Worsley Refineries.

Table 17: Comparison of predicted NO_x emissions for Wagerup, Worsley and Pinjarra refineries

	average emissions (g/s)		
	Wagerup(1)	Worsley(2)	Pinjarra(3)
Refinery total	63	250	64

Notes: (1) - Based on cogeneration option.
(2) – Worsley Project Expansion ERMP (strategen,2005). Cogeneration option.
(3) – Pinjarra Efficiency Upgrade EPS (Environ, 2003). (Includes cogeneration plant).

The Wagerup and Pinjarra emissions are similar. The large difference with Worsley is predominantly due to the existing coal fired boilers at Worsley. The Worsley expansion also includes greater cogeneration facilities.

(vii) Odour

Odour emissions have been a prime source of complaints from residences in proximity of the refinery. Odour emissions from the refinery are considered to have peaked in 1996 at the time of commissioning of the liquor burner and have been reduced since that time through a number of odour reduction programmes.

Table 18 shows odour emissions from the Wagerup refinery for various sampling periods from 1995 until 2002 (CSIRO, 2004e).

Table 18: Changes in odour emissions from Wagerup refinery (1)

Sampling period	Total odour emissions (1) (OU/sec)
1995	1,536,747
1996	3,368,568
1999	2,660,000
Jan 2000-Sep 2000	2,026,060
Oct 2001- Feb 2002	1,639,629

Note (1): - Estimates are for refinery point sources only.

A critical review of the sampling techniques and results of odour measurements made on the refinery's stacks between 1999 and 2002, was undertaken by AWN Consultants (AWN, 2003). AWN drew attention to the inadequate measurement techniques used in determining some stack flow rates in the 1999-2000 period that reduced the validity of some of the derived odour concentration and emission data. Alcoa has subsequently implemented changes to measurement techniques to address the limitations identified.

Table 19 below sets out the predicted changes in odour emissions for the refinery and RDA as presented in the ERMP and response to submissions.

Table 19: Predicted changes in odour emissions in the ERMP and response to submissions (1)

Process area	average emissions (OU/s)			peak emissions (OU/s)			process improvements
	base	exp'n	% chg	base	exp'n	%chg	
Refinery point sources							
milling/slurry tanks	334,271	89,626	-73%	349,287	90,110	-74%	Improvements to reduce vapour flows from 25A tank vents.
digestion	0	0		0	0	0	
causticisation/clarification	109,517	13,200	-88%	164,643	7,423	-95%	Elimination of emissions from 35J vents and reduction from 35A vents.
thickners/washers	54,465	80,327	+47%	54,465	80,336	+47%	
organic removal							
• oxalate kiln		352	new		376	new	RTO fitted to new oxalate kiln.
• liquor burner	27,022	5,383	-80%	55,814	5,757	-90%	CTO replaced by RTO.
cooling towers	448,044	190,000	-58%	1,269,931	310,000	-76%	Use of fin-fans for new cooling, and modifications to operation of towers.
calciners	355,907	472,544	+33%	608,245	514,413	-15%	Improved performance calciner 3 and low volume vents to combustion.
boilers and gas turbines	27,080	26,390	-3%	33,462	27,855	-17%	
total	1,356,000	878,000	-36%	2,536,000	1,042,000	-59%	
RDA diffuse sources							
residue dry stack areas	37,830	63,430	+67%				Dry stacking area increased by 50%.
residue wet stack areas	398,770	0	-				RDA2 modified from wet stacking to dry stacking.
cooling pond	666,500	999,800	100%				Use of fin-fans for all new cooling in precipitation.
lower dam	58,840	58,840	+50%				
runoff water pond	12,100	24,200	0				
runoff collection pond	23,880	23,880	+50%				
oxalate pond	703	1,080	0				
super thickener	40,400	52,170	+54%				
sand cannon and lake	156,810	161,110	+29%				
			+3%				
total	1,356,000	1,384,000	+3%				

Notes: (1) - changes in peak emission rates are not presented for diffuse sources as some emissions are dependent on wind speed and temperature.

Average odour emissions from the refinery point sources are predicted to decrease by about 36% and peak emissions by about 60%. The main area of improvement is from the cooling towers where modifications to operations, including reducing suspended particulate matter and water treatment chemical usage, are predicted to achieve significant reductions in odorous emissions. Other areas where significant improvements are expected include the slurry tanks (25A tanks) and causticisation/clarification areas (35A and 35J tanks).

Average emissions from the RDA are expected to stay similar. An increase in the predicted emissions from the cooling pond will be largely offset by the emissions reduction from converting the RDA2 wet stacking area to dry stacking.

Due to the inherent complexities in measuring and estimating odour emissions, Alcoa has developed an odour/VOC regression relationship for predicting odour emission rates for sources in the refinery based on measured VOC concentrations for sources (ERMP appendix G, section 8). Alcoa considers the regression relationship improves the statistical validity of odour emission rates due to a number of reasons, including the greater uncertainty associated with individual and collective odour concentration measurements than for individual and total VOC measurements, and the fact that there has generally been more VOC monitoring runs.

The estimated odour emission rates for the refinery point sources for the base and expansion cases, as indicated above, are based on use of the odour/VOC relationship (the estimated emission rates for the RDA diffuse sources were based on the fluxhood monitoring programme).

While the EPA understands the intent in using the odour/VOC relationship, it notes the DoE has questioned the validity of the relationship for estimating emissions for some sources, particularly with very moist vapours. Table 20 below illustrates the comparison between predicted base and expansion emissions in the ERMP with previous odour estimates (ERMP appendix G, section 8).

Table 20: Changes in odour emissions for key source groups (1)

Source Group	Jan-Sep 2000 baseline	Oct'01-Feb'02	Oct'01-Feb'02 AWN Audited	ERMP base case ave	ERMP exp case ave
25A tank vents	286,425	202,296	206,500	328,704	82,204
35A Vents	240,870	230,547		81,250	7,422
35J vents	6,135	12,888		28,267	0
Calciners	829,540	752,059	722,231	302,533	472,544
Cooling towers	200,112	229,313		448,044	190,000
Refinery total	2,026,060	1,693,629		1,356,306	872,044

Note(1): - some odour improvements have been implemented by Alcoa post the 2002 estimates.

The table indicates that while the ERMP base case odour estimates are of a similar order to earlier monitored levels (given some improvements have occurred since 2002), the odour/VOC relationship potentially over-estimates emissions from some sources and under estimates others. As impacts on ground level concentrations will

vary between high-level and low-level sources, it is important to have reasonable understanding not just on overall emission levels, but also variations between sources.

To assess the sensitivity of the predicted ground level odour concentrations to variations in odour emissions from the different refinery sources, during the assessment period, Alcoa undertook further computer modelling and analysis of this issue (Environ, 2005). This work looked at particularly, predicted changes in ground level concentrations for refinery 'low-level' sources (stacks/vents generally less than 50m, including 25A tank vents and cooling towers) and 'high-level' sources (100m multi-flue stacks including calciners and liquor burner).

In this work, Alcoa utilised revised estimates for the 'high-level' sources based on post July 2003 odour emissions monitoring. This monitoring included improvements in procedures recommended by AWN in its 2002 audit. Table 21 below presents the revised odour emission estimates adopted in the work. The average emissions represent the average monitored from July 2003 to March 2005. The peak emissions were taken as the highest combination of emissions in any one quarter during that time (quarter 1, 2005).

Table 21: Odour emission estimates based on monitoring post July

	Existing refinery		**Expanded refinery**	
Source	Average	Peak	Average	Peak
Calciners 1-3	482,838	1,849,019	482,838	1,849,019
Calciner 4 existing case	188,695	253,351		
Calciners 4-6 exp'n case			566,085	760,053
Liquor burner	200,715	1,221,708	10,036	244,342

The EPA considers that the emission rates used in the further analysis adopt a reasonable level of conservativeness to assess likely changes in ground level concentrations between the current refinery and proposed expansion and address the uncertainties raised by use of the odour/VOC relationship in the ERMP.

Based on this, the EPA is satisfied that overall odour emissions from the refinery should be reduced with the expansion, notwithstanding that emissions from the 'high-level' sources will increase. The overall impact on ground level concentrations is discussed in section 4.3 on potential health and amenity impacts from short-term ground level concentrations.

Commissioning, Performance Verification, and On-going Monitoring

The EPA notes that Alcoa has prepared an Air Quality Management Plan included at section 10 of the ERMP which sets out proposed monitoring and other measures to verify emission levels post-expansion. The EPA considers such a Plan to be a critical part of any implementation.

The EPA considers that the current Plan provides sufficient detail for the purposes of this assessment to demonstrate how verification of emissions can be undertaken. If the proposal is approved, however, the EPA recommends that a condition be applied

requiring that, prior to Work Approval being granted under the EP Act, the Plan be reviewed, taking into account detailed design, to provide further prescription on the planned emission management measures and emissions verification monitoring.

This should include documentation of the base emission levels agreed for the current plant and performance improvements stated as part of the expansion (eg 75% reduction in flows/VOC and odour emissions from slurry storage 25A tanks, 50% reduction in VOC and odour emissions from cooling towers, etc), and detailed processes to verify achievement. This may include engineering certification as well as emissions monitoring.

Until such time as the odour/VOC regression relationship has been subject to further peer review to justify its validity for different emission sources at wagerup, the EPA considers that standard monitoring techniques and procedures should continue to be used to assess and verify odour emission levels and improvements.

The Plan should also set out verification monitoring for RDA diffuse sources, including upwind and downwind ambient monitoring combined with back trajectory modelling.

The Plan should give particular consideration to emission variability associated with normal process variability and shut-down and startup events, and how this should be dealt with in on-going monitoring for the refinery.

Summary

The EPA considers the emissions from the Wagerup Refinery have been reasonably characterised and quantified to assess the likely changes in emissions for the proposed expansion.

With the pollution control and management measures proposed by Alcoa, emissions of a number of compounds are predicted to reduce. Emissions of some compounds are expected to increase, but not directly in proportion to the increase in production, with emission rates per tonne of production reducing with the improved pollution control. The predicted impacts on ground level concentrations from changes in emissions are discussed in the following sections.

The predicted emission rates for the proposed expansion are based on preliminary design, and estimated flow rates and concentrations. These will need to be more fully substantiated during the Front End Engineering Design (FEED) leading to the EP Act Part V Works Approval application. This should include further demonstration based on the FEED that, at a minimum, the emissions improvement performance levels committed to in the ERMP, are achievable, and that the pollution control and management measures proposed are current best practice.

The EPA considers that it is important that Alcoa works interactively with the DoE during the engineering design leading to the Works Approval application to ensure these matters are adequately addressed prior to consideration of the expansion. Due to the specialised nature of this work, the EPA recommends that an Independent Design Review Team (IDRT) comprising specialists in design, construction,

commissioning and monitoring of large industrial plants, be established to advise and assist the DoE in this process. The IDRT team may also assist the Technical Advisory Panel in advising the Tripartite Working Group during this process.

The Air Quality Management Plan presented in the ERMP sets out proposed monitoring and other measures to verify emission levels post-expansion. The EPA considers that this Plan also be reviewed during design, to provide further prescription on the planned emission management measures and emissions verification monitoring.

This should include documentation of the base emission levels agreed for the current plant and performance improvements and emission levels to be achieved for the expanded plant utilising the performance levels set in the ERMP as a minimum requirement (eg 75% reduction in flows and emissions from slurry storage 25A tanks, 50% reduction in emissions from cooling towers, etc). It should also provide further detail on methods and procedures for validation of emission performance levels, including engineering certification as well as emissions monitoring.

Having particular regard to the:
a) emissions inventory programs and monitoring carried out at the Refinery;
b) emissions management and control measures proposed as part of the expansion;
c) proposed emissions verification procedures set out in the draft Air Quality Management Plan; and
d) the proposed role of the IDRT,

it is the EPA's opinion that the proposal can be managed to meet the EPA's environmental objective for this factor, provided that:
1. Condition 8 to demonstrate that the engineering design meets best practice and achieves the ERMP predicted reductions in emissions;
2. Condition 10 to require a detailed emissions verification program post commissioning; and
3. Procedure 1 to establish the IDRT to review the design details during the FEED and engineering design leading to Works Approval application under Part V of the EP Act, and advise and assist the DoE prior to the Works Approval being granted;

are implemented.

4.2 Predicted ambient air quality and Health Risk Assessment

Air dispersion modelling to predict ambient ground level concentrations with the expansion

In order to predict the change in ambient air quality associated with the proposal, Alcoa commissioned CSIRO to undertake air dispersion modelling. Further modelling was also undertaken by Environ utilizing updated emissions estimates. The chosen base case represented refinery conditions during 2004 when the project was referred to the EPA. The average daily production used was 6600 tonnes per day (tpd) and the peak daily production was 7100 tpd.

CSIRO's TAPM model was used to model point source emissions but was unsuitable for modelling diffuse source emissions from the Residue Disposal Area (RDA). Diffuse source emissions were modelled by specialist consultants using the California Puff Model (Calpuff).

In order to consider the combined effects of emissions from diffuse and point sources, the ground level concentrations (GLCs) from TAPM and Calpuff modelling were added on an hour by hour basis for the modelled year.

Comparison with established air quality guidelines

The predicted GLCs from the air dispersion modelling were compared with the National Environment Protection (Ambient Air Quality) Measure (NEPM) criteria pollutants-SO_2, NO_2, CO and particulates (as PM_{10}) and with the draft investigation levels for the air toxics (benzene, formaldehyde, toluene and xylenes). As shown in Table 22 below, all were found to be well within the NEPM guidelines and draft investigation levels (NEPC, 1998) at all receptors for both the base case and for the expansion case. A comparison of predicted ground level concentrations for Yarloop and Hamel with the NEPM guidelines and investigation levels are also shown in the Table.

Table 22: Comparison of predicted ground level concentrations with NEPM guidelines and investigation levels (ERMP response to submissions Tables 21, 22, 23 and 24)

Pollutant	Guideline/ Inv level	Maximum at any receptor		Yarloop (receptor 4)		Hamel (receptor 10)	
	ug/m^3	ug/m^3	%	ug/m^3	%	ug/m^3	%
Nitrogen dioxide	**246 – 1 hour**	64.6	26.0%	61	24.8%	42	17.2%
	62 – annual	0.6	1.0%	0.28	0.4%	0.33	0.5%
Carbon monoxide	**11,250 – 8 hr**	46.9	0.4%	22	0.2%	22	0.2%
Sulphur dioxide	**571 – 1 hour**	21.5	3.5%	13.0	2.3%	7.3	1.3%
	229 – 1 day	4.5	1.8%	1.7	0.8%	1.6	0.7%
	57 – annual	0.07	0.1%	0.03	0.1%	0.03	0.1%
Particulates as PM_{10}	**50 – 24 hour**	44.6	89%	6.4	13%	4.9	10%
	5 days/yr	0(1)	0	0(1)	0	0(1)	0
Formaldehyde	**54 – 24 hr**	0.17	0.3%	0.08	0.1%	0.088	0.2%
Benzene	**10.4 – annual**	0.0035	<0.1%	0.0011	<0.1%	0.0010	<0.1%
Toluene	**4,113 – 24 hr**	0.05	<0.1%	0.021	<0.1%	0.013	<0.1%
Xylenes	**1,183 – 24 hr**	0.009	<0.1%	0.002	<0.1%	0.002	<0.1%

Note(1): -predicted number of days exceeding guideline.

Health Risk Assessment

The combined air dispersion modelling results for the refinery and RDA were also used as input for a HRA. The HRA (Environ, 2005) concluded that :

- the potential for emissions from the existing and expanded refinery to cause acute health effects is low and is primarily driven by the particulate emissions from the RDA and oxides of nitrogen emissions from the refinery;

- the potential for emissions from the existing or expanded refinery to cause chronic non-carcinogenic health effects is very low; and
- the potential for emissions from the existing or expanded Wagerup refinery to contribute to the incidence of cancer based on inhalation exposure is below the United States Environmental Protection Agency *de minimus* threshold of one in a million at all residential receptors considered[2].

Submissions

Submissions related mainly to uncertainty in the dispersion modelling and whether or not all chemicals present in refinery emissions were adequately considered in the HRA.

Assessment

The area considered for assessment of this factor is the Wagerup Refinery and surrounding areas, especially the townships of Yarloop and Hamel.

The EPA's environmental objective for this factor is to ensure that:

- ambient ground level concentrations meet established air quality standards; and

- given the current unresolved health issues in the area, there is no significant increase in ground level concentrations of key pollutants.

Air dispersion modelling to predict ambient ground level concentrations

In considering this factor the EPA gave close consideration to the uncertainties associated with the TAPM air dispersion modelling as well as those associated with estimated emissions input into the model.

The peer reviewer (Katestone, 2005a,b) made the following observations in regard to uncertainties in the modelling:

- The model's performance at Bancell Road monitoring station is poor for wind speed. The model significantly under-predicts the frequency of light to moderate winds and the frequency of predicted winds from the northerly sector is less than half the observed frequency. The consequence of this is that the frequency of short term events would be under-predicted and there would be a lower annual average predicted.

- Radiosonde measurements conducted during July 2003 showed very light winds well above stack height and elevated temperature inversions at heights that would impact on the dispersion of plumes from the refinery. TAPM does not resolve many of these characteristics.

- The TAPM modelling was based on a single year of meteorological data and the modelling needs to account for inter-annual variability.

[2] The term *de minimus* means the risk is so low it has no impact.

- The modelling was based on average and peak emissions as if they remained constant, whereas in reality they may vary daily or even hourly.

In order to deal with the issue of under-prediction of northerly and light to moderate winds near Yarloop (which could have been due to local influences such as terrain effects) CSIRO investigated the use of data-assimilation. This is a technique in which the computer modelling is "nudged" by incorporation of locally measured winds. It is important when using data-assimilation to carry out sensitivity checks to optimise the radius of influence allowed for the nudged data, as there is a trade off with overall integrity of the model on a larger scale.

The CSIRO found that data-assimilation led to reductions in ground level concentrations at some locations and increases in others. At receptor 4 (Yarloop) the peak and annual averages were higher by a factor of 2 and 1.5 respectively.

CSIRO did not use the data-assimilated results in its final report which was used for input into the HRA, however, it did state clearly that overall the modelled concentrations had an uncertainty of a factor of approximately 2 (i.e. the actual values lie in the range of +100% to -50% of the listed concentrations) at the 95% confidence limit.

The EPA notes the following advice from the peer reviewer of CSIRO's TAPM dispersion modelling (Katestone, 2005b) which states that the modelling undertaken for the ERMP adequately assesses the potential impacts:

"…*the modelling undertaken for the Wagerup 3 Refinery expansion adequately assesses the potential impacts on the local atmosphere so long as a degree of conservatism is taken into account when applying the uncertainty factors from the modelling results presented by CSIRO in the HRA*"

CSIRO's data-assimilated modelling was carried out with limited local meteorological data and so Katestone (2005b) recommended that the modelling be redone when more meteorological data became available from the Bancell Road meteorological station. This would allow consideration of data-assimilation over a longer period of time.

The EPA notes that, in order to focus on the uncertainties referred to above, Alcoa engaged Environ to carry out further air dispersion modelling for Alcoa's response to submissions. In particular, wind data measured at Bancell Road (including additional wind data to that used by CSIRO in its wind data assimilation analysis) and from the RDA were assimilated into the modelling. Evaluation was carried out to optimise the radius of influence of the assimilated wind data so as to provide the best fit with observed NO_X concentrations (Environ, 2005).

Comparison of assimilated and non-data-assimilated modelling predictions by Environ at Receptor 4 at the north end of Yarloop is of particular interest. Here the 1 hour maximum NO_X GLC using data-assimilation was the same as CSIRO's prediction without data-assimilation, although the annual average NO_X GLC was higher by a factor of 1.4. This compares with CSIRO's data-assimilation to non-data-assimilation ratio for the annual average of 1.5.

Alcoa has argued that the few changes that Environ made to the CSIRO data-assimilation set up were improvements and provide a better simulation of reality than the original CSIRO data assimilation set up. The results from the Environ set up essentially make very little change from the original CSIRO non-data-assimilated predictions when carried through the HRA or when compared with the NEPM guidelines for criteria pollutants.

In regard to the validity of the Environ data-assimilation testing, the DoE has reviewed the work carried out and is satisfied with the methodology used and the interpretation of the results.

To consider the worst case, however, the DoE requested Alcoa have the HRA recalculated by carrying CSIRO's original uncertainty factor (x2) forward into the HRA. These results are discussed below.

Whilst the EPA considers that dealing with uncertainty in the air dispersion modelling by applying the factor of 2 is adequate for this assessment, the EPA on advice from the DoE, considers that further work is required so that the modelling can be improved in the future, to enable post commissioning performance verification, if the proposal is approved.

In particular, upper level meteorological data needs to be acquired and TAPM's performance reassessed. The EPA notes that Alcoa has already made some progress in this regard and a meteorological station has been installed on the escarpment. Vertical profile temperature and wind speed data also needs to be acquired for a period of at least a year. This could be achieved by means such as remote sensing methods and/or weather balloons.

Further work incorporating recent findings reported in literature on plume rise behaviour from multiflue stacks also needs to be undertaken. The performance of TAPM's building wake dispersion scheme, which plays an important role in the modelling dispersion from low elevation sources, needs to be checked. Additional meteorological stations on the coastal plain in the Wagerup area would be useful for further work on data assimilation.

Comparison of predicted ambient ground level concentrations against established air quality guidelines

The EPA notes that the ground level concentrations for priority pollutants and air toxics are predicted to meet the established air quality guidelines at all receptors at all times (Table 22 above)

At Yarloop (as represented by receptor 4):

- the maximum 1 hour concentration of NO_2 was 24.8% of the NEPM guideline and 0.4% of the annual average was guideline;
- the maximum 1 hour SO_2 GLC was 2.3% of the NEPM guideline and 0.1% of the annual average guideline;
- the maximum 8 hour carbon monoxide GLC was 0.2% of the NEPM guideline;

- the sixth highest 24 hour PM_{10} GLC was 4% of the guideline (for particulates the NEPM goal is to have no more than 5 exceedances per year of the 24 hour standard of 50 micrograms per cubic metre); and
- the air toxics (benzene, formaldehyde, toluene and xylenes) were 0.1% or less than the relevant NEPM draft Investigation Level.

At Hamel for the expansion case, the modelled ground level concentrations for the criteria pollutants and air toxics were even lower.

NO_2 is the pollutant identified as representing the highest proportion of its NEPM guideline (24.8% of the 1 hour guideline). Even with an uncertainty factor of 2 applied to the modelling results (in accordance with the uncertainty range considered by CSIRO), the predicted maximum 1 hour NO_2 concentration is 49.6% of the NEPM guideline and in reality the NO_2 concentration is likely to be limited by ozone concentrations. The annual average NO_2 would increase from 0.4% to 0.8% of the NEPM guideline.

As discussed above, the further work on data-assimilation using additional meteorological data indicated that the factor of 2 actually provides a considerable safety factor.

The EPA notes that other conservatism are also built into the modelling. For example, the predicted peak emissions have been assumed to occur continuously throughout the year in calculating peak ground level concentrations, whereas in reality, peak emissions may not coincide with the most adverse meteorological conditions.

Predicted changes in ambient ground level concentrations for key pollutants

Given the reported health issues in the area, the EPA considers that if the expansion is approved to proceed, it should not only be expected to meet established air quality guidelines, but also that there be no significant increase in ground level concentrations for key pollutants.

As indicated in section 4.1 above, the main increases in emission rates for the expansion are associated with the refinery itself rather than the RDA. Table 23 below shows the predicted change in ground level concentrations for key pollutants from the expanded refinery.

Table 23: Predicted change in ambient ground level concentrations for the expanded refinery (CSIRO, 2005c Table 8, 2005d Table 7)

Pollutant	**Max'm Predicted 1-hr GLC at Receptor**		**% change**	**Max'm annual ave GLC at Receptor**		**% change**
	base	**expansion**		**base**	**expansion**	
VOCs						
• **formaldehyde**	1.2	0.61	-49%	0.0083	0.0080	-4%
• **acetaldehyde**	4.3	1.9	-55%	0.037	0.022	-40%
• **acrolein**	0.062	0.067	+8%	0.00063	0.00072	+14%
Metals						
• **mercury**	0.030	0.02	-33%	0.00022	0.00018	-18%
Dust	7.7	4.2	-45%	0.029.	0.029	0%
NO_2	54	54	0%	0.54	0.68	+26%

The modelling predicts that maximum ambient ground level concentrations should generally reduce for the expansion. There is an increase in ground level concentrations for some pollutants but these are slight. The HRA, as discussed below, did not indicate that these increases would present a health risk.

The maximum 1-hour ground level concentrations have been determined using predicted peak emission rates for the refinery. As indicated in section 4.1 above, peak emission rates are mostly predicted to reduce for the expanded refinery. As also indicated in section 4.1 however, there remains some uncertainties associated with predicted emission rates and if the expansion proceeds, independent verification monitoring should be undertaken during commissioning and early operation to verify peak emission rates were reasonably meeting those predicted.

The average annual ground level concentrations were determined using predicted average emission rates. These are generally considered to have less uncertainty associated with them As indicated in section 4.1 above, the average emission rate for a number of key pollutants has been predicted to increase for the expansion (eg formaldehyde and acetaldehyde). Despite this, annual average ground level concentrations are generally predicted to reduce.

This is due largely to differences in changes for predicted emissions between different refinery sources. In particular, emissions from the 'low-level' sources (such as the 25A slurry tank and 35A and 35J causticisation/clarification tanks) are generally expected to reduce, while total emissions from the 'tall-stacks' increase (average emissions from the calciners are generally predicted to increase, although they should be offset in part by a reduction in emissions from the liquor burner due to the installation of the RTO).

Some members of the public have complained that ambient air quality has got worse since the establishment of the tall stacks in 2002, particularly south of Yarloop. It is critical therefore that if emissions are to be increased from the tall-stacks, that there is sufficient confidence in modelling the dispersion from these sources and the predicted ground level concentrations. The EPA notes that the CSIRO (2004) has recommended that further monitoring should be undertaken in the area to obtain additional meteorological data to improve the certainty of modelling. The EPA considers that 12 months of monitoring as recommended by CSIRO should be undertaken, and the modelling reviewed, in light of this before any EP Act Part V Works Approval is granted for further tall-stack emissions from the refinery.

Health Risk Assessment

The EPA notes from public submissions that issues have been raised concerning whether or not all chemicals present in refinery emissions were adequately considered in the HRA.

In this regard there are two questions that are important.

1. Are there chemicals in the refinery emissions which have not been identified that would be of significance to the HRA?
2. Have all chemicals identified been adequately considered in the HRA?

The proponent has responded to the first question by pointing out that the 2002 Wagerup Refinery Emission Inventory was independently reviewed by Air Water, Noise Ltd (AWN) in 2002/3 and also by CSIRO in 2003/4. Both reviewers indicated that the emissions inventory scope was comprehensive and appropriate. CSIRO noted the following in respect to the Air Emissions Inventory:

> *The emissions measurement program that has been carried out by Alcoa at the Wagerup Refinery has identified a large number of chemical compounds (mainly organic compounds) that probably have not previously been measured in emissions monitoring of alumina refineries. It has also established, within the detection limits of the measurements undertaken, that a number of compounds are not emitted in amounts greater or equal to these detection limits. This work represents a substantial advance in knowledge about emissions in the atmosphere from alumina refineries.*

Both AWN and CSIRO made a number of recommendations aimed at improving certainty and filling information gaps in the inventory. Each of these recommendations has been acted upon or is currently in the process of being implemented.

With regard to whether or not all chemicals that were identified have been adequately considered in the HRA it is useful to compare the Wagerup Unit 3 expansion HRA with the recent Worsley refinery expansion HRA, as both relate to alumina refineries in Western Australia. A comparison reveals that slightly different selection criteria were used for compounds to be included in each HRA. As a result 64 substances were selected for the Worsley HRA and 27 substances were selected for the Wagerup HRA.

In spite of these differences the results of the two HRAs were similar. The main contributors to risk for the Worsley HRA were nitrogen dioxide, sulphur dioxide and particulate matter. For the Wagerup HRA, nitrogen dioxide and particulate matter were also the main contributors to health risk, but not sulphur dioxide. This difference arises because Wagerup refinery does not burn coal as a fuel, which is a major source of sulphur dioxide. Other substances were minor contributors.

As indicated above, to consider the worst case, the DoE requested Alcoa have the HRA recalculated by carrying CSIRO's original uncertainty factor (x2) forward into the HRA. Even with this conservative approach the Acute Hazard Index remained below 1 at all receptors (0.71 at receptor 4 at Yarloop). A Hazard Index of less than one is generally considered to represent no cause for concern with respect to adverse health effects. Similarly, the HRA indicated the Chronic Hazard Index was well below one at all receptors. The Total Carcinogenic Risk at all receptors was also below one in a million, which is the USEPA's *de minimis* (negligible) threshold.

Two other types of sensitivity analysis were also done. These considered uncertainty in estimated emissions data and inter-annual variability in meteorological conditions.

A discussion of the consequences of emissions uncertainty on the HRA is contained in section 3.1.5 of the proponent's Response to Submissions. It is shown that the impact of allowing for this uncertainty by applying appropriate multiplying factors is an

increase in the Acute Hazard Index from 0.47 to 0.56. As stated above a Hazard Index of less than one is generally considered to represent no cause for concern with respect to adverse health effects.

With regards to inter-annual variability of meteorological conditions, CSIRO estimated that annual averages could be expected to be either 30% higher or 30% lower at a particular location, depending on the year. These did not significantly alter the findings of the HRA.

The EPA notes that the proposed expansion at Wagerup will result in a 50% increase in drying area at the bauxite Residue Disposal Area (RDA) so that the drying area will increase from 180 to 270 hectares. The increase in drying area has the potential to increase fugitive dust emissions and fugitive VOC emissions. These increased emissions have been modelled and included in the HRA. Also particulate emissions from the RDA will meet the NEPM PM_{10} guidelines.

The EPA notes that the HRA peer reviewer (Bisby, 2005) concluded that a prudent, conservative and highly health protective approach was taken in the HRA and that the inputs used to calculate the measures of risk and the choice of methods were conservative and appropriate. The EPA also notes the comment that, considering the inherent uncertainty and safety margins built into each section of the HRA, the risk of acute health effects, chronic health effects and incremental cancer risk could all rightly be referred to as *de minimus*.

The Department of Health raised a number of technical issues regarding the HRA which it recommended be reviewed. Alcoa responded to these in its response to submissions (Appendix 9).

Notwithstanding these issues, the Department of Health advised that on the basis of the HRA, emissions from the refinery should not present an abnormal public health risk for the general community.

Summary

Having particular regard to:

(a) the predicted ground level concentrations for the expansion being well within the NEPM guidelines;

(b) there is not expected to be any significant increase in ground level concentrations for key pollutants from the Refinery;

(c) the conclusion reached by the HRA which indicated acute health effects, chronic health effects and incremental cancer risk could all be referred to as *de minimus;*

(d) the fact that sensitivity analysis has demonstrated that conservative allowance for uncertainties in the dispersion modelling such as for emissions uncertainty, inter-annual variability in meteorological conditions, localized variations in wind speed does not change the conclusions indicated by the HRA;

(e) the peer reviewer of the HRA concluded that a prudent, conservative and highly health protective approach was taken in the HRA; and

(f) the advice of the Department of Health,

it is the EPA's opinion that the proposal can be managed to meet the EPA's environmental objective for this factor provided that Condition 9 to further validate the air dispersion modelling after additional investigations and data acquisition has been completed and, if necessary, make revisions to the engineering design to achieve similar ground level concentrations to those predicted in the ERMP (May 2005).

4.3 Potential for health and amenity impacts due to short-term ground level concentrations

Description

There has been a history of reported health issues in the Wagerup area, since the installation of a liquor burner at the Refinery in 1996.

Studies and investigations which have been conducted in the Wagerup area to date however, have consistently shown that predicted and measured ground level concentrations of compounds emitted from the refinery meet established national and international air quality health standards. The studies and investigations have not been able to determine any specific causal link between:

- any individual compound, or mixture of compounds emitted from the refinery; or
- particular refinery source,

and health related issues in the area.

The HRA discussed above has also indicated that emissions from the refinery should not present an abnormal public health risk for the general community. Despite this, there has been ongoing health complaints in the area.

HRA is generally based on air quality standards for chemical exposures averaged over periods of 1 hour, 1 day, or a year, and does not specifically account for shorter term events such as a few minutes. Irritation and other health symptoms may occur from exposure to elevated ground level concentrations over shorter periods (e.g. less than 10 minutes) particularly for members of the community who suffer from hypersensitivity to chemicals. HRA may also not account for health symptoms due to a combination of compounds present over a short period. Exposure to individual compounds or a combination of compounds at even very low concentrations may affect some individual's quality of life but not the potential to reduce life span or result in objective impairment of organs.

The Medical Practitioners' Forum identified that health symptoms being experienced in the Wagerup area include those that are consistent with a clinical syndrome which is referred to as Multiple Chemical Sensitivity (MCS) syndrome. Symptoms can vary between individuals, but complaints in the Wagerup area have included eye and respiratory irritation, nausea, headaches and fatigue.

While no specific causal link has been identified between health issues reported in the Wagerup area and operation of the Refinery, previous investigations and complaint information indicate that periodic occurrences of short-term ground level

concentrations, above those occurring normally in the area for the majority of time, may occur under certain meteorological conditions leading to health symptoms in some individuals with sensitivities to chemicals. This appears to be particularly the case during winter months to the south and south-west of the refinery.

The potential for the expansion proposal to cause short-term health and amenity effects are considered together in this section as each can manifest at low ground level concentrations of pollutants or odour. Complaints received by the DoE from people in the Wagerup area experiencing health symptoms have often reported that these occurred during odour events. Both short-term health and amenity effects may occur even when air quality would not be considered harmful to the general population. Also, atmospheric conditions may be such that that exposure may be very short, perhaps lasting only a few minutes.

Historical background and previous reviews

There has been a history of public complaint about short-term health effects and odour associated with the Wagerup refinery. This situation was the subject of the *Legislative Council Standing Committee Inquiry Report on the Alcoa Refinery at Wagerup* (Government of Western Australia, 2004). The Committee made a site visit, met with representatives of Alcoa, and conducted public hearings at Waroona and Perth between November 2001 and September 2003.

A key testimony was provided by the Wagerup Medical Practitioners' Forum which, in 2001, convened key medical experts, local practitioners, practitioners and specialists from Perth, epidemiologists and industry representatives together with officers from the DoH, DoE and DoIR.

The Inquiry Report (paragraph 4.243) cited the Wagerup Medical Practitioners' Forum as concluding that there was a "sense of concern within the forum", expressing its belief that "lives were affected" and stating that it was "taking the concerns of the community and the workers at Alcoa seriously." It also commented that the Wagerup Medical Practitioner's Forum noted that there is considerable weight of medical opinion that there is a medical problem, but noted that it did not have a specific chemical as a causal target for which a solution could be developed or regulated (paragraph 4.245).

Recommendations from the Wagerup Medical Practitioner's Forum, contained in the Inquiry Report, which are relevant to the environmental assessment of the Wagerup Unit 3 expansion proposal are as follows:

- *Further research into identifying causality is unlikely to be rewarding and hence should not be a priority. However, an open dialogue should be maintained on this issue and it is recommended that a workshop on Multiple Chemical Sensitivity be convened by the Department of Health.*
- *There needs to be improved focus on the clinical management of affected people. There needs to be a focus on getting affected people out of the exposure situation.*
- *The Forum supported exposure reduction via a planned buffer zone.*
- *The Forum supported exposure reduction via reduction of emissions.*

- *There [should] be an ongoing commitment to surveillance and monitoring and review process involving the Medical Forum.*

A Ministerial Council on Environment, Health and Industry Sustainability was established in February 2002 to formally respond to the Wagerup Medical Practitioners' Forum. The Ministerial Council is comprised of the Minister for Environment as Chair and the Ministers for Health, State Development, Consumer and Employment Protection, Planning and Infrastructure and Tourism, Small Business, Peel and the South West.

The formal response to the recommendations of the Wagerup Medical Practitioners Forum was released in September 2002. The Ministerial Council supported all of the recommendations made by the Wagerup Medical Practitioners' Forum (paragraph 4.255).

It further noted that: "Considering the significant emission reductions already achieved or scheduled, any further emissions reductions are unlikely to resolve this issue. Other programs such as worker and community support and the buffer strategy must be developed and continued." (paragraph 4.269).

In an update (December, 2004) the Ministerial Council noted that: "through the DoE, the Minister for the Environment required emissions reductions from the refinery which had been achieved through the expenditure by Alcoa of approximately $36million." The Ministerial Council also advised that its strategy for resolving the Wagerup issue was consistent with the recommendations of the Wagerup Medical Practitioners' Forum (paragraphs 4.302 and 4.303). The key elements of the Ministerial Council's strategy are to:

- *continue to require Alcoa to reduce emissions from the refinery wherever it is reasonable and practical to do so*;
- *encourage Alcoa to assist those members of the community who wish to leave the area to do so*;
- *ensure that all relevant health and environmental guidelines are achieved and preferably bettered*;
- *monitor emissions, the ambient environment, community health (and complaints) to ensure actual improvements are achieved and maintained*;
- *address collateral social issues and concerns where these can be alleviated by government agencies*;
- *improve regulatory controls over refinery operations and ensure compliance*;
- *identify and as appropriate coordinate programs which facilitate the establishment of sustainable communities in the region from Pinjarra to Brunswick*;
- *engage the community and facilitate its meaningful input into the resolution of the issue and in guiding the future development of the area*; *and*
- *regularly reviewing progress and success of the strategy and modify it as required.*

The findings and recommendations of the Standing Committee, after interviewing all parties, are contained in the Inquiry Report paragraphs 4.410 – 4.439. Key findings which are relevant to the Wagerup Unit 3 expansion proposal are:

4.410 The Committee has found that some Alcoa employees at the Wagerup refinery and some members and former members of local communities of Yarloop, Hamel and Cookernup have experienced a wide range of adverse health effects that are associated with emissions from the refinery.

4.413 The Committee is of the view that some people are more susceptible to experiencing adverse health effects from emission events than others. Some of these people have experienced severe symptoms known as multiple chemical sensitivity.

4.414 The Committee notes that the onset of multiple chemical sensitivity may be triggered by a single, significant initiating event, such as inhalation of noxious gases or other toxic exposure. This may lead to broadening sensitivity to a diverse range of chemicals at very low doses. This sensitivity impacts on the ability of the sufferer to both work and socialize normally.

4.415 The Committee believes that the emissions from Alcoa's Wagerup refinery are likely to have been trigger events which have caused some people to suffer from multiple chemical sensitivity.

4.416 The Committee finds that the operations of the liquor burner facility during 1996 to 1999 could have been responsible for such trigger events.

4.420 The Committee believes it is important that a standard, systematic process be established for assessing people who have developed adverse health symptoms.

4.421 The Committee is of the view that this process should be limited in its geographic scope to the adjacent communities, because surveys of larger areas are unlikely to disclose statistically significant findings.

4.422 The Committee considers that the health surveillance program should include an audit of the entire Yarloop community as suggested by Professor Holman in his evidence to the Committee. The Committee is of the view that such an audit would demonstrate the extent of health problems currently experienced in the local community and could be used as a baseline to assess the incidence of new reports of adverse health impacts in the future.

Previous investigations of health and amenity complaints

In 2000 the Department of Environment and Chemistry Centre (WA) carried out monitoring at two properties 2 kilometres south of the refinery at Boundary Road and Kaus Road, Yarloop. One property was several hundred metres west of the other. At each property continuous monitoring for oxides of nitrogen and sulphur dioxide were set up and the householders were asked to register a complaint during an "event". They were also asked to activate a sampling device provided by Chemistry Centre (WA) to analyse for selected VOCs .

The study found that the levels of sulphur dioxide and oxides of nitrogen were well below the levels of concern. However, there was a good correlation between low level peaks of oxides of nitrogen, complaints and wind direction from the refinery. Comparison between the results at the two residences indicated that complaints of each resident related to different "events", but there was a common description of the odour as "wet cement" and symptoms were related to the upper respiratory tract. A sample taken at one of the properties showed a higher acetaldehyde concentration than the atmospheric acetaldehyde levels detected at the refinery[3]. The coincident peaking of oxides of nitrogen with odour suggests that the odour events coincided with ground level contribution from a tall stack plume from a combustion process. It would be consistent with emissions from the calciners.

By July 2002 important modifications had been completed at the Wagerup refinery in order to address the emissions issues. The liquor burner had been improved by fitting a dehumidifier to further reduce VOC emissions and the height of the liquor burner stack and stacks for calciners 1, 2 and 3 had been increased from 60 metres and 49 metres respectively to 100 metres (calciner 4 stack was left at 49 metres). Alcoa was also required to reduce its annual production from 2.35 to 2.2 million tonnes.

CSIRO reported in the Wagerup Air Quality Review (CSIRO, 2004e) results of odour modelling using post July 2002 emissions data (post tall stack modifications). CSIRO reported that the highest number of modelled odour 'events' occurred at 11.00 am followed by a secondary peak at 8.00 to 9.00 pm. These two peaks agreed approximately with the record of complaints although the complaints spanned different years. The model results suggested that the main morning peak was dominated by the multi-flue stack and the secondary evening peak was dominated by the calciner 4 and calciner 4 vacuum stacks.

Based on arbitrary odour event criteria, CSIRO found that the modelling suggested 5 to 8 odour 'events' per month and noted that the intermittent occurrence of modelled 'events' was consistent with complaints.

As part of the ERMP, Alcoa commissioned Emphron Infomatics Pty Ltd to carry out a statistical analysis of its complaints data (Emphron, 2005). Complaints records were available from 24th April 2000 to 18th September 2004. For comparison, air quality measurements at Boundary Road Yarloop were available for the period March 2002 to January 2004.

For the purposes of the study complainants were divided into two groups:

- high frequency complainants (those who made more than 50 complaints); and
- low frequency complainants (those who made less than 50 complaints).

The resulting breakdown of complaints is summarised in Table 24.

[3] Acetaldehyde can also be generated from natural vegetation and fires. The measured acetaldehyde concentration was 0.273mg/m^3 which is very small in comparison to relevant health guidelines.

Table 24: Complaints Apr 2000 - Sep 2004 (Emphron, 2005)

	Complainant Type		
Issue	All (250 complainants)	High Frequency (16 complainants)	Low Frequency (234 complainants)
Total	3124	1665	1459
Odour	2687	1482	1205
Health	376	169	207

A number of factors are notable from these figures:

- The dominant cause for complaint was odour;
- About half of the recorded complaints were made by just 16 of the 250 complainants; and
- The proportion of health to odour complaints was not significantly different for the two groups of complainants.

After comparing the complaints data with air quality monitoring at Boundary Road in Yarloop, Emphron (2005) concluded:

Complaints do seem to be more common when the wind is blowing from the North, and they may be increased when there are elevated Oxides of Nitrogen concentrations. These elevated Oxides of Nitrogen concentrations are far too small to be of physiological significance, but may serve as a marker for the stack plumes. In other words, days experiencing a higher proportion of time with peak NO_X [Oxides of Nitrogen] levels are likely to be days in which the stack plumes ground in Yarloop. Plume odour is the most probable cause of complaints (and indeed odour is the most common issue for complaints).

From the findings of these studies it is apparent that the calciners have contributed to complaint events at Yarloop, however, it is not possible to determine from these studies to what degree. Other refinery sources may also have contributed.

Predicted changes in pollutant and odour ground level concentrations with the expansion

As noted in section 4.2 above, air dispersion modelling carried out as part of the ERMP, has indicated that there is not expected to be any significant increase in ground level concentrations of key pollutants with the expanded refinery. Alcoa has also predicted the change in odour ground level concentrations in the vicinity of the Refinery using the dispersion modelling (ERMP sections 7.9.3 and 8.3.8) The modelling has predicted a reduction in odours at Yarloop and Hamel due to additional proposed odour emission control measures. Consistent with this, Alcoa has undertaken to ensure that if the expansion proceeds there will be no increase in odour impacts or short-term health effects.

Submissions

The ERMP did not adequately address chemical illness and amenity impacts currently being experienced in the Wagerup area. There is a concern that an increase in production will result in an increase in these impacts.

Assessment

The area considered for assessment of this factor is the Wagerup refinery and surrounding areas, especially the townships of Yarloop and Hamel and nearby areas.

The EPA's environmental objective for this factor is to ensure that emissions do not adversely affect the well-being and amenity of people, and in particular, that incidents giving rise to public complaint do not increase.

The EPA notes that there has been a history of health issues reported in the Wagerup area since installation of the liquor burner in 1996, and despite reductions in emissions over time, there continues to be some complaints. A number of public submissions to the EPA for this assessment expressed concerns about chemical illness and that an increase in production will result in an increase in these impacts.

The studies and investigations which have been carried out to date have consistently shown that predicted and measured ground level concentrations of compounds emitted from the refinery meet established air quality health standards. The studies and investigations have not been able to determine any specific causal link between operation of the refinery and the reported health issues, although some studies have shown correlations of health and odour complaints with wind directions from the Refinery.

The EPA notes, in particular, the conclusions of the Wagerup Medical Practitioners Forum that there appears to be an association between health issues in the area and operation of the refinery, and that the health symptoms being experienced include those that are consistent with a clinical syndrome which is referred to as MCS syndrome.

As discussed in section 3 above, this presents a policy and ethical question as to whether expansion of the Refinery should be considered while there continues to be unresolved health issues related to chemical sensitivities. The EPA considers that if the expansion is allowed to proceed, at a minimum, there should be no increase in risk of health and amenity impacts to the nearby communities. All practicable measures should be taken to reduce the likelihood of these impacts.

The EPA notes Alcoa's undertaking in the ERMP to ensure that odour impacts and short term health effects will not increase due to the proposal. To achieve this Alcoa has proposed engineering measures to reduce odour and VOC emissions for the expansion. Point source odour emissions from the refinery are estimated to reduce by 36% and total VOC emissions are estimated to reduce by 12%. However, acetaldehyde and formaldehyde emissions from the refinery, in particular, will increase by about 37% and 23% respectively.

The EPA also notes that, while odour and total VOC emissions will reduce for the total Refinery, those from the calciners in particular, will increase. The proposed 33% increase in average odour emissions from the calciners is offset by significant reductions of odour emissions from low elevation sources such as the 25A slurry storage tank vents and the cooling towers. Similarly, total VOCs (and acetaldehyde and formaldehyde in particular) will increase from the calciners and decrease at the low elevation sources. Alcoa has put a case that reduction in emissions from low

elevation sources will have greater influence on ground level odour concentrations in Yarloop and other receptors than increases in emissions from the calciners.

The EPA is aware that some people consider that odour events and incidents of short-term health effects are associated with the 'grounding' of the high-level calciner/liquor burner multi-flue stack plume under certain meteorological conditions. This is consistent with the general findings of a number of previous reviews of health and amenity complaints discussed above. If this were true then increasing odour and VOC emissions from the calciners might make the problem worse, in spite of the overall reduction in emissions.

Therefore, in assessing the potential for the expansion to lead to increased short-term health and amenity effects, the EPA:

- requested Alcoa to carry out further computer modelling to assess the likely impact of the individual major emission sources on ground level concentrations;
- assessed whether odour emissions and ground level concentrations are likely to be reduced; and
- assessed the potential for short-term concentrations of other pollutants to cause health symptoms.

Additional analysis to assess the impact of individual refinery sources and predicted changes in odour ground level concentrations

The original CSIRO modelling (CSIRO, 2004c,d) and further modelling by Environ that was carried out for the ERMP was carried out in such a manner that each emission source was modelled separately. The ground level concentrations associated with each source, for each hour in the modelled year, were determined for each grid point. However, the reported modelling results showed only the sum of ground level concentrations at each grid point.

In order to better understand the contribution of high and low elevation emissions sources to air quality at ground level in Yarloop, as part of the assessment the EPA requested Alcoa to further analyse the CSIRO results in order to study changes in impacts from individual sources.

Objectives for the analysis were:

- to establish which sources were dominant at ground level in and near Yarloop (receptors 3, 4 and 5) for the base and expansion cases;
- to establish which sources were dominant at ground level in and near Yarloop (receptors 3, 4 and 5) at certain times of day for both the base case and the expansion;
- to demonstrate that conclusions reached by simple comparison of peak ground level concentrations were also valid under other meteorological conditions;
- to establish that a shift in emissions profile from low elevation to high elevation sources would not simply shift the maximum odour ground level concentrations further away, thus increasing the ground level impact zone; and
- to demonstrate which changes in emission sources due to the expansion were responsible for any improvement in ground level odour concentrations at Yarloop and were therefore critical for ongoing management.

The resulting report (Environ, 2005) was included in Alcoa's Response to Submissions[4]. Key findings were:

The additional modelling showed that 3 minute ground level concentrations of odour at northern Yarloop (receptor 4) for average emissions, in both the base case and the expansion case, are dominated by low elevation sources (especially the tank 25A tank vents). Under average emissions conditions there is a significant reduction of ground level concentrations for the expansion case and this pattern is consistent for the 50 highest hours. The reduction in odour associated with the expansion is due to reduction in emissions from the low elevation sources.

A similar odour reduction is evident under peak emissions, except that ground level concentrations are marginally higher than for the average emissions case and more of the top 50 hours are dominated by the higher elevation sources (calciners and liquor burner).

Table 25 compares predicted odour ground level concentrations resulting from all sources for the existing refinery and proposed expansion. The 99.9th percentile is based on estimated peak odour emission rates and the 99.5th percentile is presented for average estimated average emission rates. The results show a predicted reduction in odour ground level concentrations for both the peak and average conditions.

Table 25: Odour - peak emissions, total from sources

	99.9th Percentile Odour Units (3 min average)			**99.5th Percentile Odour Units[5] (3 minute average)**		
Receptor	Existing	Expansion	Change	Existing	Expansion	Change
3 (southern Yarloop)	9.5	3.0	-6.5	3.2	1.0	-2.2
4 (northern Yarloop)	10.7	3.7	-7.0	5.1	1.7	-3.4
5 (west of Yarloop)	8.6	2.8	-5.8	2.6	0.9	-1.7

A comparison of day time ground level concentrations with night time levels indicated that the main contributors at night are the low elevation sources (25A, 35A and 35J) and in the day the calciners become more significant, and especially so for the expansion case, due to the increase in odour emissions from the calciners. However, it is important to note that both day and night ground level odour concentrations at receptor 4 Yarloop are predicted to reduce for the proposal.

[4] Odour emissions from the calciners and liquor burner were increased for this study to reflect higher odour units measured at source since the ERMP was prepared (post Q3 2003).

[5] Environ (2005) initially reported slightly different results for the 99.5th percentile. The results reported here are based on a corrected version of Envron 2005 which, for consistency of method uses average instead of peak odour for the 99.5th percentile and peak emissions for the 99.9th percentile.

Direct comparison of the influence of the calciners, in isolation, indicated minimal difference in the day time peak in ground level odour concentrations at Yarloop receptor 4 for both the base case and the expansion. This is a significant finding because in the expansion case the calciner odour emissions increase by 33% and make up more than half of the refinery odour emissions inventory. A review by the Department of Environment indicated that ground level concentrations may increase slightly but the conclusion reached was essentially the same.

Table 26 compares predicted odour ground level concentrations resulting from the calciners only for the existing refinery and proposed expansion. The 99.9th percentile is based on estimated peak odour emission rates and the 99.5th percentile is presented for average estimated average emission rates. The results show the predicted odour ground level concentrations for both the peak and average conditions are similar for the existing and expanded refinery when considering only the contribution from the calciners.

Table 26: Odour - peak emissions, calciners in isolation

	99.9th Percentile Odour Units (3 minute average)			**99.5th Percentile Odour Units[5] (3 min average)**		
Receptor	Existing	Expansion	Change	Existing	Expansion	Change
3 (southern Yarloop)	2.3	2.5	0.2	0.53	0.45	-0.8
4 (northern Yarloop)	2.9	2.8	-0.1	0.76	0.68	-0.8
5 (west of Yarloop)	2.2	2.0	-0.2	0.56	0.43	-0.13

Comparison of receptor 4 (northern Yarloop) and receptors 3 and 5 (which are further from the refinery) indicated that ground level concentrations reduced with increasing distance. This was due to the decreasing influence of the low elevation sources which more than offset the increasing influence of the calciners.

The additional modelling was carried out using odour emissions data determined using dynamic olfactometry for the high elevation sources, whilst the tank 25A emissions were calculated using an odour/VOC regression relationship. As discussed in section 4.1, there are uncertainties regarding the use of this regression relationship. Taking into account that a significant part of the odour reductions demonstrated by the modelling were due to reductions from the tank 25A vent, any over estimation of the odour contribution from this source in the base case might lead to an exaggeration in the benefits of the odour reduction expected for the expansion proposal.

To provide further validation therefore, Alcoa was asked to carry out the odour modelling using acetaldehyde as a surrogate at all sources. Acetaldehyde is one of the most odorous of the VOCs and it was considered that this would provide a worst case analysis. The results indicted there should be essentially no change in ground level concentrations of acetaldehyde with the expansion proposal, providing support to

Alcoa's undertaking to ensure that there is no increase in odour impacts due to the proposal.

In the Wagerup Air Quality Review, CSIRO(2004e) pointed out that a limitation of the modelling was that odour events may take place over a much smaller area than the area of one model grid cell which is 250 metres x 250 metres for pollution and 1 kilometre x 1 kilometre for meteorology.

There is also increased uncertainty when calculating very short term averages. The CSIRO TAPM model calculates hourly averages and a power law relationship is then used to estimate 3 minute averages when assessing odour impacts. In reality, odour events may be noticed by residents in very short time frames, perhaps less than 3 minutes. In these time frames meteorological processes are not adequately simulated in the modelling approach used.

The EPA notes that Alcoa has built conservatism into the modelling which would tend to offset some of the considerations given above. For instance, peak emissions have been assumed to occur continuously throughout the year, whereas in reality, peak emissions may not coincide with the most adverse meteorological conditions.

Notwithstanding the limitations, the EPA considers that the modelling was of the highest standard practical within the term of the ERMP assessment process. The EPA notes that whilst the prediction of absolute odour levels over very short time periods (3 minutes or less) is subject to uncertainty, the modelling, including the individual source modelling undertaken during the EPA's review (Environ, 2005) provides a reasonable basis for assessment of the likely change in odour ground level concentrations with the expansion proposal.

The EPA considers that there is sufficient conservatism in the modelling for the purposes of the odour assessment, and that it has been reasonably demonstrated that Alcoa's undertaking to implement the proposal without increasing odour impacts is achievable. Therefore, implementation of the proposal should not result in any increased amenity impacts on the surrounding community due to odour, and should reduce impacts.

Potential for short term health effects

The EPA notes that while the HRA indicates that emissions from the Refinery should not present an abnormal public health risk for the general community, irritation and other health symptoms may occur from exposure to ground level concentrations over shorter periods such as 3 – 10 minutes, particularly for members of the community who are sensitive to chemicals. This is consistent with the conclusions of the Medical Practitioners Forum that health symptoms being experienced in the Wagerup area include those that are consistent with the clinical syndrome referred to as MCS.

To assess the potential for Refinery emissions to cause short-term ground level concentrations which may lead to health symptoms, as part of the EMRP Alcoa used the air dispersion modelling to predict short-term ground level concentrations (i.e. modelled 3 minute GLCs) of key pollutants. The pollutants considered included oxides of nitrogen, carbon monoxide, sulphur dioxide, particulates (PM_{10}), benzene,

formaldehyde, toluene and xylenes. These were compared with the established longer term guidelines, such as hourly or even 24 hourly guidelines for health impacts. As health guideline values are normally higher for shorter averaging periods due to shorter exposure times, using an hourly or 24 hourly guideline for comparison with predicted 3 minute GLCs is a conservative approach. In each case the modelled 3 minute ground level concentrations were small in comparison to the longer term guideline and did not indicate any likelihood of causing health symptoms. This was the case for both the existing refinery and expansion.

The EPA notes also that of the substances included in the HRA, 18 are listed in the group used to assess the Acute Hazard Index. Data assimilated modelling of these substances, indicated that, except for particulates (PM_{10}) and acrolein, the ground level concentrations of all of these substances will decrease due to the proposal.

Alcoa has also carried out considerable ambient air quality monitoring in the area, particularly at northern Yarloop, to measure short-term ground level concentrations of key pollutants. This work has found that ground level concentrations of key pollutants have always been low and below levels generally reported as causing short-term health symptoms such as eye and respiratory irritation. In line with recommendations from the CSIRO's 2004 Air Quality Review, Alcoa has installed an OPSIS Long Path air monitoring system at northern Yarloop to assist short-term events detection and characterisation. This work is continuing with results being reported to the Technical Advisory Panel reporting to the Wagerup Tripartite Group.

The DoE is also continuing specific programs to monitor short-term ambient air quality in the area. Recently this has include use of SiloCan sampling canisters which enable assessment of VOCs and carbonyls. A sampling program where the canisters were provided to a number of members of the community, was commenced in September, 2005. Two samples have subsequently been taken by community members in reponse to health or odour concerns.

The preliminary results of the chemical analysis of these samples is summarized in Table 27 below. The results are considered preliminary at this stage and still require validation. The sampling detected a number of compounds which are emitted from the Wagerup Refinery, however, it is not possible to conclude whether the reported levels are associated with operation of the Refinery. The compounds can also occur as a result of other sources.

Table 27: Preliminary results of canister sampling at Yarloop

Compound	Previous sampling highest ambient reading (ug/m^3)	Recent canister sampling highest reading (10 mins ug/m^3)	Acute health affects guideline (1) (ug/m^3)	Irritation guideline (1) (ug/m^3)	Odour threshold guideline (ug/m^3)
formaldehyde	10	32	107 (30 mins-1hr)	120	60-1250
acetaldehyde	13	58	2,000 (24 hour)	90,000	65-285
Acetone	17	41	62,000 (1-14days)	464,670	100,000-350,000

Note (1): - Toxicos, 2005

The results indicate the ambient levels measured are below both acute health effects and irritation guideline levels for the general population, particularly for acetaldehyde and acetone. The EPA notes however, that irritation effects have been reported for some individuals at lower levels for formaldehyde, and for formaldehyde in combination with other compounds.

The Department of Health has advised that the levels are not of a health concern, and generally remained well below levels likely to cause irritation in humans, although the reported formaldehyde concentration approached this level.

In particular, the irritation thresholds available in literature for acetaldehyde and acetone are at least two orders of magnitude above the concentrations recorded in the canister sampling.

The Department of Health noted however, that irritation thresholds for formaldehyde are much closer to the concentrations recorded in the canister results. IARC (International Agency for Research on Cancer) in 1995 considered the irritaion threshold for eyes, nose and throat lie between 600 to 1200 ug/m^3. A review by a panel of experts in 1977 (Paustenbach) suggested that 360 ug/m^3 was a level below which there was no significant increase in irritation above the general background incidence level observed with exposure to clean air. However, WHO in 2000 recognising the variability in irritation response have placed the irritation threshold between 100 and 3,100 ug/m^3 and has "concluded that in order to prevent sensory irritation in the general population, an air quality guideline value of 100 ug/m^3 is recommended" Health Canada in 2000 concurred that only a very small proportion of the population experienced a symptom of irritation following exposure to 0.1 ppm (120 ug/m^3)

The results are also below generally reported odour thresholds, although the reading for acetaldehyde is approaching threshold levels. Acetaldehyde is one of the most odorous compounds of the Refinery emissions.

The Department of Environment has advised the EPA that the results are considered preliminary and have not been verified at this stage. The department is continuing to examine the laboratories' quality assurance to verify the analysis and ensure the process was scientifically robust. The department has noted that with only two samples, these data are very limited and the Wagerup air quality sampling program needs to be expanded to gather more information using this and other techniques.

The EPA concurs with this and recommends that if approval is granted for the expansion to proceed, the Department of Environment should coordinate a comprehensive ambient air quality monitoring and reporting program for the area, complementing that operated by Alcoa.

The EPA notes that, consistent with previous Alcoa and Department of Environment ambient monitoring, the results are very low (parts per billion), and do not appear to present any health issue for the general population. Based on the ambient monitoring to date, it would appear that where individuals are experiencing symptoms, it is at very low chemical levels. This is consistent with MCS diagnosis.

As discussed above the additional computer modelling undertaken by Alcoa of the impacts of individual refinery sources has provided some confidence that there should be an improvement in odour (and VOC) concentrations with the expansion proposal. In particular, it was demonstrated that increased emissions from the calciners would not result in a significant change in short term (3 minute average) levels at Yarloop. This is considered important as a number of people have indicated that they believe health related issues have been associated with grounding of the plume from the high level calciners multi-flue stack, under certain meteorological conditions.

Whilst it is not possible to conclude that there would be no on-going issues of chemical sensitivity in the area if the expansion proceeded, from the analysis and monitoring undertaken to date, the EPA considers that the potential for short-term ground level concentrations to result in public complaints is not likely to increase due to the expansion proposal, and may actually decrease.

Given the unresolved health issues, it is possible that some individuals may continue to experience MCS type symptoms, at low ground level concentrations of pollutants. If a decision is made to grant approval for the expansion therefore, processes would need to be put in place to enable assessment and diagnosis of any people who feel they have health symptoms attributable to operation of the refinery, and to enable people who have been assessed as experiencing chemical sensitivity symptoms to relocate from the area without disadvantage. This is discussed further in the following section on appropriate land use management in the area.

Summary

Having particular regard to:

(a) the fact that total refinery odour emissions are estimated to reduce by 36% and total VOCs by 12%;

(b) the proposed 33% increase in odours from the calciners is predicted to be offset by significant reductions from the low elevation sources, and that the increased odour emissions from the calciners is unlikely to lead to a significant change in ground level contribution from that source;

(c) the additional modelling data provides reasonable confidence that odour levels at Yarloop and Hamel should decrease with the proposal; and

(d) the results of ambient air quality monitoring in the area indicating that the ground level concentrations of pollutants are very low; and

(e) the levels are below relevant national and international health guidelines.

it is the EPA's opinion that the proposal could be managed to meet the EPA's environmental objective for this environmental factor, to ensure that the potential for health and amenity impacts are not increased. However, it is not possible to conclude that there would be no on-going issues of chemical sensitivity in the area, and if the proposal was granted approval to be implemented, processes would need to be put in place to deal sensitively with any people experiencing chemical sensitivities.

4.4 Land use management in proximity to the refinery

Description

Given the unresolved health issues in the area, special management measures are required in the vicinity of the refinery to assist those people who are experiencing health symptoms consistent with chemical sensitivities, and to implement compatible land uses.

Emission reductions from the Wagerup Refinery and current extent of health issues

The findings and recommendations of previous reviews and investigations of emissions and health complaints have been implemented to varying degrees, although some key aspects are still continuing.

In particular, since 1998 Alcoa has implemented a number of changes to operations and equipment at the refinery to reduce emissions. Most of these were implemented by June 2002, as part of the requirements under the company's *Environmental Protection Act, 1986* prescribed premises (Part V) licence. In particular, odour emission levels from the plant are estimated to have been reduced from around 3,300,000 Odour Units per second (OU/s) in 1996 when the liquor burner was operating without current pollution control equipment to 1,600,000 OU/s in 2002 (CSIRO, 2004). Further reductions have been made since that time, and Alcoa estimates current average emissions to be around 1,350,000 OU/s. As such, ground level concentrations, and potential for people to be affected, has been reduced over time.

At this time, however, there has not been any specific health surveys undertaken in the area since the emission reductions were implemented to determine the current level of health issues in the area, and extent of those related to chemical sensitivities. As discussed in section 3, based largely on complaint data, it appears that the number of properties in the area whose occupants are currently experiencing health issues is reducing (relating to either the reductions in emissions or people moving out of the area) and that there are only a few new residents recording issues, although the information on which this is based cannot be considered complete.

As part of the ERMP, Alcoa has committed that if approval is granted for the extension proposal, it will commission a local community health survey (ERMP, section 8.3.1.3). The aim of the survey would be to measure the current health status of local community members to compare this with Western Australia wide health results.

Alcoa's land management program

In October, 2001 Alcoa released its "Wagerup Land Management Draft Proposal" for community comment. Alcoa's stated aims were to:

- give people a choice about whether they continue to live where they do;
- protect property values; and
- invest in the future of Yarloop and Hamel.

The draft proposal identified two areas, designated Area A and Area B, around the Wagerup refinery (Appendix 8, Figure 1). It was proposed to establish a Special Control Area to restrict further residential development in Area A. Area B was an area surrounding Area A where Alcoa proposed to protect property values.

The basis for the areal extent of Area A was not the limit of reported short term health effects, or odour complaints, but was the area where Alcoa was sometimes out of compliance with the *Environmental Protection (Noise) Regulations 1997*. The boundary was defined by comparison of modelled refinery noise with the night time noise limit under the noise regulations, which is 35 dBA. Alcoa reasoned that this area also corresponded with the area where over 95% of community odour complaints were being reported. It also allowed for future expansion of the Bauxite Residue Area to the west of its current site for the life of the refinery.

Between 2002 and 2004 Alcoa's Land Management Proposal was revised and improved to take into account community concerns. As it now stands, in Area A Alcoa has offered to buy homes at 135% of the unaffected market value plus provide $7000 to cover relocation costs. In Area B, for property owners in Yarloop and Hamel on or before 1st January 2002, Alcoa has offered to purchase properties at the unaffected market value until 31st December 2011 and even beyond that under certain conditions.

An unfortunate aspect of the Area A/Area B delineation has been that it divided the town of Yarloop as 118 properties in northern Yarloop were included in Area A and the others in Area B. This has resulted in a great deal of controversy due to the consequential difference in property values, especially in view of the fact that the Area A/Area B delineation was based on noise only and did not definitively take into account short term health impacts and loss of amenity due to odours.

Submissions

A health survey should have been carried out for inclusion in the ERMP prior to the expansion. The future health survey referred to in the ERMP should be undertaken by an independent body and include people who have moved out of the area.

An adequate buffer zone should be established around the refinery.

The buffer zone should be at least as large as for the Pinjarra alumina refinery where few health complaints are received.

There are residents outside of the current land management area who suffer the same impacts.

Assessment

The EPA's objectives for this factor are:

- to ensure that appropriate surveys are undertaken to assess the extent of health issues occurring in the area and that programs are in place to sensitively assist people experiencing health issues consistent with sensitivity to chemicals; and
- to ensure appropriate land use management processes are in place for compatible land uses close to the refinery and limit the intensity of development in that area.

Health surveys and management to assist people experiencing health symptoms

The EPA notes that public submissions have expressed concern that a survey into the health status of the local community was not carried out for the ERMP and that the health survey proposed by Alcoa in the ERMP would not be undertaken until just prior to commissioning of the expansion, and may not be undertaken by an independent body.

While it is apparent that the number of properties in the Wagerup area with residents currently experiencing health issues is reducing, the EPA concurs that it would have been preferable that a formal health survey was undertaken prior to, or as part of the assessment. The EPA notes that one of the recommendations of the WA Legislative Council Standing Committee on Environment and Public Affairs' inquiry into the operations and impacts of the refinery (Government of Western Australia, 2004) was that a health survey should be undertaken to demonstrate the extent of health problems currently experienced in the local community and to provide a baseline to assess the incidence of new reports of adverse health impacts in the future

In this regard, the EPA notes that the Wagerup Unit 3 expansion proposal is still at an early stage of design and, if the proposal were to be approved, considerable time should be available to complete the health survey before construction. This would allow time to carryout a thorough health survey in order to establish a baseline against which to monitor any future environmental performance. The EPA considers that the health survey should be designed by the Department of Health and carried out prior to commencement of construction. The EPA has recommended a Procedure be applied to the Implementation Statement (Appendix 4) to require this if the proposal is approved for implementation. The survey should be carried out independently of Alcoa, although it may be funded by Alcoa.

The EPA also recommends that, if the proposal is implemented, periodic follow-up, independent health surveys should be undertaken to continue to monitor health issues in the area. An independent process, managed by the Department of Health, should also be established to assess and diagnose any people who feel they have health symptoms attributable to operation of the refinery. The EPA has recommended Procedures be included in the Implementation Statement to require these if approval is granted.

The Government would also need to establish a program, to complement Alcoa's land management strategy, to enable people who have been assessed to be experiencing chemical sensitivity symptoms to relocate from the area without disadvantage. This is consistent with the recommendations of the Medical Practitioner's Forum that there needs to be improved focus on the clinical management of affected people and a focus on getting affected people out of the exposure situation. While Alcoa's land management program provides for purchases of properties within Areas A and B, the EPA notes that there are residents located outside these areas who are currently reporting health symptoms consistent with chemical sensitivities (Figure 1 Appendix 8). The EPA recommends that these residents, living further to the south, who are currently outside of Areas A and B, and who have an established history of health

complaints relating to chemical sensitivities should also have access to a program to assist them to relocate from the area without disadvantage.

Land use management

The EPA notes that public submissions have expressed concerns that an adequate buffer zone should be established around the refinery. Submissions have also pointed out that there are residents outside Alcoa's current land management area (Areas A and B) who suffer health impacts and that the buffer zone should be at least as large as for the Pinjarra alumina refinery, where few health complaints are received.

As part of the ERMP Alcoa has put the case that Area A (which was originally established on the basis of noise contours) is a suitable buffer for both health and noise. The HRA indicates that in the outer parts of Area A (residential parts) the Acute and Chronic Hazard Indexes and the Incremental Cancer Risk are low to very low. Alcoa has acknowledged that, although computer modelling indicates that odours may reduce due to the proposal, odours will still be noticeable to some people outside of Area A from time to time. In regard to short term health effects Alcoa has expressed a view, that the HRA already incorporates large safety factors designed to protect susceptible sub-groups in the community and that it is therefore a valid basis for making Area A the buffer zone .

Alcoa has also expressed a view that Area A should not become a "no residents" zone but the zone could be reflected in formal land use planning, perhaps as a special control area, which would encourage compatible land uses but restrict intensification of sensitive land-uses.

In regard to the comparative buffer size, Alcoa has also pointed out that the Area A boundary is located at a minimum 3.5 kilometres from the Wagerup refinery (and up to 8 km), compared with the Pinjarra refinery where its 'management zone' (ie property boundary is a minimum of 2.7 kilometres). Area A provides a zone around the Wagerup refinery of 8442 hectares which would exceed Alcoa's land holdings around the Pinjarra operations (6071 hectares). Other points of comparison are discussed in section 3.5.1.1 of Alcoa's response to submissions.

In considering Alcoa's view that Area A provides a suitable buffer, based on the HRA results and the air quality in comparison to established standards, the EPA notes the advice of the Department of Health that a health impact has occurred, despite emissions from the plant not overtly breaching any health guideline and that the health impact is not attributable to any identifiable compound or group of compounds.

The EPA notes that Wagerup generally has a larger population in proximity to it than other alumina refineries in Australia with Yarloop located between 2 and 5 km from the refinery. The notable exception to this is the Gladstone alumina refinery which has several thousand people within 5 km. A number of the other refineries also have people located within similar distances to those at Wagerup within which health issues have been reported (ie approximately 2-8km). The Pinjarra refinery has a number of residents between 3 and 5 km and the townships of Pinjarra and North Pinjarra are located between 6 and 8 km (SKM, 2003). Hope Valley and Wattleup are

located between about 3 and 5 km from the Kwinana refinery. There are a number of Aboriginal communities within 6 km of the Gove refinery (URS, 2003).

While the other refineries (apart from one) do not have a liquor burner, the pollution control equipment now installed on the Wagerup refinery liquor burner, is such that its emissions are very low. Other emissions from the refineries are of a similar nature and order (Pacific, Air and Environment, 2004). While there have been air quality issues associated with some of these other refineries, particularly with odour and dust, the EPA is not aware of any general chemical sensitivity health issues within nearby communities. The management approach for these refineries has been based on achieving recognised air quality health standards and minimising emissions.

The Department of Health has advised that it would be inappropriate to declare a large "no residents" zone of influence around the refinery, as while some people have been impacted the majority of residents are not experiencing health issues. It does consider, however, that there should be a management zone within which people who feel they are affected can be dealt with sensitively.

In this regard, the EPA notes that the Department of Environment, Department of Industry and Resources, and the Department of Health jointly developed a series of principles to be applied in consideration of Wagerup Unit Three. These principles were endorsed by the Ministerial Council on Health, Environment and Industry Sustainability.

In particular, the following three principles were noted by the EPA in regard to the buffer issue:

- Residents should not be exposed to concentrations of compounds emitted from the refinery and associated operations at levels which exceed relevant health guidelines.
- The health and amenity of the community should not be compromised by emissions from the refinery and associated operations. All reasonable efforts should be made to minimise adverse health effects in the community.
- If the refinery emissions impact on the health and amenity of any residents, there should be genuine choices, freely and equitably available, for them and their families to either leave the area or to stay, without economic loss, hardship or unreasonable time constraint. Residents with demonstrated adverse health impacts associated with emissions should be encouraged to relocate.

In regard to the areal extent of a management zone, the Department of Health has recommended that a <u>minimum</u> of 5 kilometres be adopted

In adopting an appropriate management zone some consideration needs to be given to how this distance should be measured. The EPA has noted from submissions that there is some confusion about the distances involved with Alcoa's current land management zone. This situation arises because of varying reference points being adopted as the source reference point (i.e. the refinery boundary or calciners multi-flue stack or other point source). The EPA considers that the multi-flue stack provides an appropriate reference point at Wagerup for determination of a management zone. This is because the multi-flue sources (calciners and liquor

burner) are the major emissions sources at Wagerup. Although the cooling tower and 25A slurry tanks are also important emissions points, they are proposed to be reduced by 50% and 75% respectively for VOCs as part of the proposal.

As no causative agent has been identified for short-term health effects, the EPA is unable to provide a recommendation on the maximum distance for a management zone based on scientific grounds, such as air quality monitoring or computer modelling. The EPA notes however, that one person who has complained of health impacts, has been diagnosed with MCS and lives 8.7 kilometres to the south of the refinery. Alcoa has also reported that there are five other households that frequently complain of health impacts that are outside of the 5 kilometre minimum radius. These are located 5.1, 6.4, 7.2 and 8.5 kilometres to the south and south west.

Figure 1 (Appendix 8) shows Alcoa's land management Areas A and B with circles overlaid, centred on the multiflue stack and with radii of 5 and 8 kilomtres. It can be noted from Figure 1 that the 5 kilometres management zone, recommended by the Department of Health as the minimum, corresponds well with Alcoa's land management zone (Area A and Area B).

However, as also shown in the figure there are properties to the south of Yarloop located outside of the 5 kilometre zone, where health complaints are still being experienced.

In the absence of a scientific basis for setting a maximum radius for the management zone, the EPA recommends that the outer boundary of the management zone initially be formally set at 5 kilometres from the multiflue stack. This area corresponds with Alcoa's land management area (Area A + Area B). It is important to note that the management zone is not a no residents zone, it is a zone where residents who are concerned about short-term health impacts should be given the opportunity to relocate without disadvantage.

The EPA recommends that the Government establish a formal land management scheme for this area, with the principle that there be no intensification of residential development within the recommended 5 kilometre management zone, and objective of ensuring land uses compatible with operation of the Refinery in this area.

The EPA recommends that the boundary be reviewed once a formal health survey has been undertaken, as recommended above. The boundary should also be reviewed should further ambient air quality monitoring in the area indicate more elevated ground level concentrations than currently monitored.

Summary

Having particular regard to:

(a) the fact that reductions in emissions which have been introduced since health issues were initially reported at Wagerup and ambient air quality monitoring in the area has shown air quality meets established guidelines for the general population;

(b) there is an unresolved health issue in the area and this appears to be related to periodic events affecting people susceptible to chemical sensitivities at low concentrations;

(c) Alcoa's current land use management strategy for Areas A and B, which provides opportunities for people within these areas to relocate where they consider they are being impacted by the Refinery's operations;

(d) the number of properties with residences currently experiencing health impacts appears to be reducing, due to Alcoa's land management strategy and improvements in the environmental performance of the Refinery, although this need to be further investigated through a formal health survey for the area;

(e) the Department of Health's recommendation that a management zone with a minimum distance of 5 kilometres be established around the Refinery and that this largely coincides with Alcoa's Area A and B;

(f) the Department of Health's recommendation that it is not necessary to exclude residences in the management zone, but that there should be no intensification of residential development in this area;

(g) the DoE, Department of Industry and Resources and Department of Health jointly developed set of principles, which have been endorsed by the Ministerial Council on Health, Environment and Industry Sustainability, including the principle of providing persons experiencing health issues with a choice to relocate without economic loss, hardship or unreasonable time constraint; are

(h) the existence of a number of properties to the west and south of Yarloop, outside of Areas A and B with residences with continuing on-going health complaints,

it is the EPA's opinion that the proposal can be managed to meet the EPA's environmental objective for this factor provided that:

1. Recommended Procedures 2 and 3 are applied to the Implementation Statement (Appendix 4) to require formal health surveys for the area and the establishment of a process for assessment and diagnosis of people who feel they are affected by operation of the Refinery.
2. The Government establish a program, to complement Alcoa's land management strategy, to enable people who have been assessed to be experiencing chemical sensitivity symptoms to relocate from the area without disadvantage. This should included those residents living to the east and south of Yarloop who have an established history of health complaints relating to chemical sensitivities.
3. The Government establish a formal land management scheme for the area, with the principle that there be no intensification of residential development with the recommended 5km health management zone, and objective of ensuring land uses compatible with operation of the Refinery within this area.

4.5 Noise

4.5.1 Refinery Noise

Description

Alcoa World Alumina Australia ("Alcoa") constructed the Wagerup Refinery some time ago, before the promulgation of the current *Environmental Protection (Noise) Regulations 1997*, ("the noise regulations"), and their predecessor, the *Noise Abatement (Neighbourhood Annoyance) Regulations 1979*.

Alcoa has been working towards reducing noise from the Refinery for some years, since the issue was highlighted in the EPA's 1995 assessment for the upgrade to 3.3mtpa. Over $6m was spent on noise management projects at the Refinery between 1996 and 2001, resulting in the acquisition of some affected properties and completion of a number of noise reduction projects. Overall noise emission levels were reduced by some 14dB(A), including tonal adjustments, when measured at a nearby residential area in Boundary Road to the south of the Refinery.

The residual noise level of about 40dB(A) at the Boundary Road location exceeds the night time L_{A10} assigned level of 35dB(A) in the noise regulations by 5dB(A). This noise is masked by noise from wind in trees and traffic for a significant percentage of the time. Alcoa's analysis of prevailing weather conditions indicates that the Refinery noise emission may only be heard to exceed the assigned level for about 14% of the worst-case month at this location.

The noise-affected area around the Wagerup Refinery corresponds with Area A, of Alcoa's Land Management Area, which roughly follows the 35dB(A) contour at about 3km from the Refinery (see Wagerup Unit 3 ERMP Fig 59, Page 304). The approximate numbers of residences in each noise level range within Area A (as at 8 December 2005) are shown in Table 28.

Table 28: No. of residences at various noise levels in Area A

Ownership	**Noise level range – dB(A)**				**TOTAL**
	>43	**40-43**	**35-40**	**<35**	
Alcoa	5	8	36	25	74
Private	8	2	24	17	51
TOTAL	13	10	60	42	**125**

The residual noise levels at the nearest residences not owned by Alcoa are 46 - 47dB(A), exceedances of up to 11dB(A) over the night time L_{A10} assigned levels. Alcoa considers that achieving full compliance through engineering controls alone is not technically possible with current technology.

Noise regulation 17 application

Alcoa applied for noise regulation 17 approval to vary the assigned noise levels for its Wagerup Refinery in February 2002. Noise regulation 17 provides that *"where a person is of the opinion that he or she cannot reasonably or practicably comply with a standard prescribed under these regulations, or that a proposal of that person will not be reasonably or practicably capable of complying with that standard, that person may apply to the Minister for approval to allow the emission of noise in that case to exceed or vary from the standard."*

The application was referred to the EPA as required under regulation 17(2), and subsequently underwent extensive technical review and community consultation. In October 2004 the EPA decided to conduct the noise regulation 17 assessment in parallel with the Part IV assessment of the Wagerup Unit 3 proposal for expansion of the Refinery.

The supporting documentation to the 2002 noise regulation 17 application indicated that further Refinery noise reduction measures to a large number of existing plant items could hypothetically achieve up to a further 6dB(A) reduction, at a cost of some $15m. Further, the ERMP for the Wagerup 3 upgrade indicated that the upgrade could be implemented without increasing existing noise levels, but with some difficulty and at a cost of some $50m. Achieving full compliance without a noise regulation 17 approval could not therefore be achieved by noise reduction alone, but would also require the purchase of a number of affected properties, with the associated further social disruption.

In applying for a noise regulation 17 approval, Alcoa committed that there would be no further noise increases over the 2001 noise emission levels. Alcoa maintained this commitment on referral of the proposed Wagerup Unit 3 upgrade. Alcoa also committed to continue to take measures to reduce noise where reasonable and practicable and to ensure the Refinery noise emissions would continue to be free of tonal noise characteristics.

Alcoa committed to maintaining their Land Management Plan (LMP), which had been developed to provide a procedure for valuation and purchase of affected properties, and including some removal expenses. They also committed to continuing to provide a noise insulation program to improve the noise attenuation properties of dwellings for those residents who wished to remain in the area.

This section of this Bulletin represents the EPA's initial advice to the Minister on the application, as required under regulation 17 (3). It also represents the EPA's advice on the Part IV assessment of the Refinery noise aspect of the proposed Wagerup 3 upgrade. The EPA expects to provide final advice to the Minister on the regulation 17 application on receipt of further information from the proponent as discussed below.

Existing Refinery noise emissions

In order to assess the technical basis of the noise regulation 17 application for the existing Refinery, an independent review was commissioned by the DoE (SVT, 2003). The reviewer was asked to provide:

- a review of Alcoa's assessment of noise emissions up to 2002;
- recommendations for any additional noise monitoring that may be necessary;
- a technical review of the noise reduction programs at the Refinery;
- an assessment of whether all technically feasible noise reduction measures had been implemented; and
- an assessment of whether the increased assigned levels requested by Alcoa were representative of the current noise emission levels.

In summary, the SVT review found that Alcoa's noise monitoring systems were appropriate and reliable, and the analysis of results provided a good indication of Refinery noise emission levels. The reviewer agreed with Alcoa that it is difficult to measure Refinery noise at surrounding residences because of the influence of ambient noise. However, the reviewer considered that Alcoa's assessment that noise may only be in exceedance for 14% of the worst month would underestimate the extent of exceedance, because this only related to noise emitted in one direction.

The reviewer also noted that Alcoa had not accounted for tonality when assessing its compliance, and, noting that the noise emissions can sometimes exhibit tonality, indicated that further investigation of tonality was warranted.

SVT reviewed Alcoa's acoustic model, from which the spatial distribution of noise around the Refinery has been presented in the form of noise contours. SVT found some deficiencies in the way the model was developed and then calibrated from field measurements. They considered that, while the model was not suitable for ranking of noise sources at receiving locations, it was capable of providing a reasonable indication of the extent of noise control work required to achieve certain levels of noise reduction.

Alcoa's request for new noise limits as part of a noise regulation 17 approval was based on noise contours developed from this acoustic model. The reviewer commented that the requested variation is adequate to cover the current level of noise emissions (provided the emissions do not exhibit tonality) and any local variations due to inaccuracies in the model could be dealt with on a case-by-case basis.

The reviewer inspected the noise reduction measures in place at the Refinery and concluded that these measures were appropriate and effective. They considered that there are some areas at the Refinery where further noise reductions may be possible, but agreed with Alcoa that achieving compliance through noise reduction is not technically feasible.

SVT also commented on the two noise reduction scenarios presented in Alcoa's application, that is, 6 dB(A) and 3dB(A) reductions. On the 6dB(A) scenario, SVT commented that "at this stage insufficient work has been undertaken to establish if all of the noise control items listed are achievable." On the 3dB(A) scenario, SVT

"believes that the noise control scenarios are achievable." Alcoa has committed to a detailed investigation of these scenarios.

The EPA accepts the findings of the SVT review, and notes that Alcoa addressed these findings in its subsequent Noise Management Plan.

Further to the SVT review, a request was made to Alcoa to provide information on the likely scenarios and costs for achieving noise reductions of 3, 4, 5 and 6dB(A) on all sides of the Refinery. Alcoa provided estimates based on the likely costs of reducing the sound power levels of the major sources in their acoustic model, assuming a typical practical noise reduction measure was carried out on each source (Alcoa, 1 Jun 2004). To achieve greater noise reductions, more sources would need to be treated. The noise reduction scenarios were selected so as to be effective in reducing noise emitted in several directions from the Refinery.

The overall cost estimates were as follows:

Table 29: Noise reduction options versus cost

Overall reduction, dB(A)	No. Sources Treated	Cost, $m
3	24	9.8
4	36	11.7
5	58	13.6
5.9	121	20.8

Alcoa has subsequently advised that costs to achieve these reductions will have increased significantly due to increasing construction costs. Also, there would be significant operation and cost issues if these reductions needed to be implemented outside scheduled maintenance shut-down times.

The EPA notes that this analysis is hypothetical, and does not take into account resolving practical problems such as providing space around plant items to accommodate acoustical treatments, access for maintenance, and so on. The EPA also notes the difficulty inherent in attempting to achieve these reductions in several directions from the Refinery.

In the light of the above, the EPA concludes that Alcoa cannot reasonably or practicably comply with the prescribed standard in relation to noise emissions from the existing Wagerup Refinery.

However, the EPA is of the view that the practical benefit of achieving even small reductions in noise emissions is that the Refinery noise emission will be masked by ambient noise for a significantly greater portion of the time, rendering it less noticeable. Thus the community would be likely to notice the decrease in the number and duration of audible occurrences more than the change in level per se.

In the case of the nearest residence to the north-west of the Refinery, the EPA notes that the external noise level of 47dB(A) would correspond to an internal noise level of some 37dB(A), with windows open. This level is slightly above the internal noise criterion of 35dB(A) previously used by the EPA for bedrooms in new dwellings adjacent to roads or railways, and well above the WHO criterion of 30dB(A) for bedrooms. Given that two specific homes to the north-west and south-west of the Refinery receive the highest Refinery noise levels, greater reductions in these directions will result in the highest possible amenity improvements.

The EPA therefore considers that practicable noise reductions, even if small, should be pursued in this case. The EPA considers that a practicable outcome for the existing plant, in the absence of the Wagerup 3 proposal, would be a reduction of 2 to 4dB(A) over 4 years. This would be considered a significant reduction in noise emissions.

Alcoa has indicated that it requires up to 6 months to update the cost estimates and to assess the time required to implement practicable measures, allowing for normal shut-downs. The EPA considers this advice should be provided and considered prior to the regulation 17 Approval being granted. This information needs to be provided by the proponent in a timely manner.

Submissions
Is no increase in noise impacts the best practicable outcome for noise?

There should be a sign-off process for detailed construction noise management plans for various construction phases.

Besides the submissions received in relation to the ERMP, issues were raised via the regulation 17 consultation process. References to these are integrated with the assessment discussion below.

Assessment
The area considered for assessment of this factor is Wagerup Refinery and its surrounds.

The EPA's environmental objective for this factor is to protect the amenity of nearby residents from noise impacts resulting from activities associated with the proposal, by ensuring noise levels meet statutory requirements and acceptable standards.

The proponent's commitment is for the Wagerup 3 upgrade to produce no increase in existing noise levels.

The noise predictions presented in the technical appendices to the Wagerup 3 ERMP document are accepted as reasonable estimates of the noise emissions. These predictions take into account some noise reductions from existing plant that will remain, upgrades to some items of existing plant and noise reduction from new plant. The studies indicate that the commitment to "no increase" will be difficult to achieve, and estimate the total cost for noise control to be in the order of $50m, or some 3% of the total project cost.

The EPA notes that plant designs are in the early stage and there should be potential for further reductions in noise emissions as the design progresses. Achieving these potential reductions will require establishing a comprehensive design review process.

The EPA concludes that Alcoa's proposed Wagerup 3 upgrade to the Wagerup Refinery will not be reasonably or practicably capable of complying with the prescribed standard for noise emissions. The EPA also recognises that it may not be technically feasible for the Wagerup 3 upgrade to meet the maximum 4dB(A) reduction target identified above for the existing Refinery. The EPA recommends that the noise reduction target be reviewed in the light of the outcomes of the detailed plant design and commissioning process. In order to ensure that practicable noise reductions are achieved through this process, the EPA recommends that high level scrutiny of the design and commissioning process be carried out at all stages of the process. This should be required through an appropriate Part IV Ministerial Condition, rather than through the noise regulation 17 process.

Community consultation

The noise regulation 17 assessment involved extensive community consultation, conducted prior to that carried out for the Wagerup 3 upgrade. While taking part in the ongoing community consultation carried out by Alcoa, the EPA has also conducted its own process.

In summary, as part of its involvement in the consultation processes, the EPA has:

- sought community input to the scope of work for the independent review;
- met with the community and the reviewer before and after the review;
- attended an open day on the noise regulation 17 process organised by Alcoa;
- attended meetings with Alcoa and interested community members to assess the noise insulation program;
- conducted several meetings with a community representative group, and separately met with Alcoa, to explore possible conditions for a noise regulation 17 approval;
- together with Alcoa, met with four concerned resident couples to understand their issues;
- participated in the Tripartite process for placing noise conditions in the Part V Licence for the Wagerup Refinery;
- sent out Explanatory Notes on possible approval conditions for comment by the community and Alcoa; and
- remained available for contact with individual concerned residents.

The EPA notes that there are also residents outside Area A who consider themselves to be affected by noise at certain times, and some of these people have been involved in the community representative group.

The community has raised a number of noise-related issues over the consultation period. Many of these issues relate to noise monitoring and complaint response, and these have been addressed in the conditions in Alcoa's Licence and Environmental Improvement Plan (EIP). One issue that does not appear to have been addressed in detail to date has been the desire of the community to have access to sufficiently

recent noise data that can be related to their immediate day-to-day experience of noise. The provision of this information would assist in dispelling distrust of the proponent's environmental reporting. The EPA considers that the means for providing this data should be pursued through the EIP process as a matter of priority.

The EPA has addressed the following issues through the regulation 17 process:

- noise reduction;
- land management;
- noise insulation; and
- compensatory measures.

Noise reduction

From its consultations, the EPA notes that the community would like to see Alcoa's noise emissions reduced. While community members accept that compliance cannot be practicably achieved at all locations, they would like to see Alcoa pursuing noise reduction scenarios up to a 10dB(A) reduction. They believe that costs of up to $20m are not impracticable for a large organisation like Alcoa, and would like to see reductions implemented over a time frame of not more than five years, or less if possible. They would like to be assured that any noise reductions required through a noise regulation 17 approval would be strongly enforced.

The EPA considers that the community's views on noise reduction could be incorporated into a noise regulation 17 approval that required small but significant noise reductions over time.

Land management

The EPA notes that, while a number of residents have taken up the purchase offer under the Land Management Plan, there is a significant number of remaining residents who have expressed dissatisfaction with the LMP, claiming that the valuations do not provide sufficient funds to enable relocation to a property with equivalent facilities and amenity. One resident in Area A has expressed concern that the granting of a noise regulation 17 approval may make it very difficult for him to obtain planning approval to add further developments to his property. Others from outside Area A have expressed concern that, should the Refinery noise emission be shown to exceed the prescribed standard, they should be eligible for the same treatment under the LMP as applies inside Area A. Residents would be concerned about a noise regulation 17 approval that enshrined "Area A" within a regulatory instrument.

The EPA notes the above concerns, and has taken the approach that the noise regulation 17 process should not attempt to directly influence the LMP process or outcome. While the EPA supports the concept that an LMP remain in place to provide an equitable means of relocation for any affected residents who wish to move, it does not see that this needs to be a requirement of a noise regulation 17 approval.

Noise insulation

The EPA notes that Alcoa's offer of noise insulation for affected dwellings has been on the table for some time. The EPA has evaluated the process and found it to be

technically well-founded and has observed that it is presented to the community in a sensitive way. However, the EPA notes that take-up of the program by the community has been slow, with only about seven participants so far. To some extent this seems to be due to concern that take-up of the program may jeopardise future negotiations with Alcoa under the LMP, and to some extent to a notion that the program is of limited noise benefit or that acoustic treatment will cause residents to feel "shut in".

The EPA considers that an effective noise insulation program is an essential adjunct to any noise regulation 17 approval. However, noting that the program is well-developed and that Alcoa has remained committed to it for some time, the EPA does not consider that this needs to be a requirement of a noise regulation 17 approval.

Compensatory measures

The EPA explored with the community a range of possible compensatory measures, in the context that any such measures must provide for actual noise amelioration rather than a trading of amenity. These measures only ever received lukewarm support from the community, and the EPA does not support their further development as part of a possible noise regulation 17 approval.

The above consultation process was based on consideration of noise emissions from the existing Refinery, and drew to a close in September 2004. On several occasions, members of the community representative group expressed their view that this was the most positive consultation process they had been involved in concerning the Wagerup Refinery.

Summary
Having regard to:

- the fact that Alcoa has implemented a significant program of noise reduction, noise modelling, noise monitoring and complaint response in relation to the noise emissions from the Wagerup Refinery over the last 10 years;

- despite the above program, noise emissions from the existing Refinery cannot reasonably or practicably be ameliorated and/or managed so as to comply with the prescribed standard in the noise regulations;

- Alcoa's proposed Wagerup 3 upgrade to the Wagerup Refinery is capable of being managed so as to achieve no increase in noise from the baseline noise emissions from 2001, but will not be reasonably or practicably capable of complying with the prescribed standard for noise emissions;

- in the case of both the existing and upgraded refinery, there is benefit in pursuing further noise reductions in noise emissions where practicable, in order to address excessive noise levels at the nearest residences and to minimise audible occurrences of the noise at other residences;

- issues raised by the community relating to noise monitoring, provision of noise information and complaint response would be better addressed through the Part V industry licensing process than through a noise regulation 17 approval;

- Alcoa has in place an effective noise insulation program for affected dwellings, that is being implemented in a sensitive manner, albeit that take-up of the program by the community has been limited; and

- there are ongoing land management issues for the community, that need to be addressed through careful implementation of Alcoa's Land Management Plan.

It is the EPA's opinion that the proposal can be managed to meet the EPA's objective for this factor provided that:

a) a noise regulation 17 approval, to provide for variation to the prescribed standard for noise emissions under the *Environmental Protection (Noise) Regulations 1997* is granted;
b) the proponent's commitment to continue support of its Wagerup Land Management Strategy is implemented; and
c) condition 11 to revise, make publicly available and implement the Noise Management Plan submitted with the ERMP, to reasonably demonstrate that the design of the expansion works will include all reasonable and practical measures to control noise emissions, is implemented

The EPA considers that the regulation 17 approval should contain the features outlined below.

Outline of Noise Regulation 17 approval

Duration of approval

The EPA considers that the approval should have a life of some 20 years, with the possibility for extension if required.

Noise emission limits

Considerable work has gone into defining assessment positions where noise limits could be established. Advances in measurement techniques make remote measurements within the community more feasible than previously thought possible. As a result, about 10 positions have been selected as being representative of nearby residences. These reference positions are selected so as to be:

- within the 35dB(A) contour;
- clear of local noise sources as far as practicable; and
- readily accessible.

The recommended noise limit for each of these positions is determined from the noise model, and the locations and reference noise levels would be specified in the Approval. Recommended locations for these assessment positions are set out inTable 30. These positions are based on current locations of dwellings and on the spatial distribution of predicted Refinery noise reductions. Current noise reference levels are based on 2001 noise modelling and may vary slightly from point predictions expected to be incorporated in the update from Alcoa.

Table 30: Noise Reference Position Locations

Reference Position No.	Reference Position	Estimated Reference level
1.	Truck Bay: South-Western Hwy near Willowdale Rd. N-E corner of Lot 16	47
2.	Bancell Rd, north-east corner of Lot 1	47
3.	Bancell Rd west of South-Western Hwy, north-east corner of Lot 13	46
4.	West end of Lot 1 on South-Western Hwy	45
5.	Boundary Rd near water treatment plant, south-west corner of Lot 500	41
6.	Boundary Rd, south-east corner of Lot 2606	41
7.	North-west of corner where Millar and Aitken Rds join. Near N-W corner of Lot 281	37
8.	Intersection Aitken and Chapter Rds, north-west corner of Lot 98	37
9.	Waterous Rd, north-west corner of Lot 883	36

It has been the EPA's practice to provide a suggested draft regulation 17 Approval Notice reflecting its recommendations. A draft has not been provided with this Report because the extent of the reductions which can be practicably achieved will be determined in due course based on new information foreshadowed by the proponent and expected to be a submitted to the EPA by May 2006.

It is recommended that the relevant noise monitoring and reporting requirements would be set out in the License for the premises. This is preferred to their inclusion in the noise regulation 17 Approval, as these requirements may change with improvements in measurement methods and the accumulation of data at the various positions. Inclusion in the License is also preferred over incorporation in the Environmental Improvement Plan (EIP).

Reference noise limits for existing refinery

The EPA notes that the original noise regulation 17 application was made in relation to the existing Refinery noise emissions, and considers that the approval should address the situation where the Wagerup 3 proposal may not be implemented. In the light of the numbers of noise sources to be treated and the cost estimates for providing the treatment, as given above for the existing Refinery, the EPA considers that a reduction of 2 to 4dB(A) below the existing noise levels should be the target for the approval.

The main noise parameter to be affected by the above would be the L_{A10} level (a level that is not to be exceeded for more than 10% of a representative assessment period – an L_{A10} limit would control the essentially constant noise emission from the Refinery). Where the Refinery noise emission level is less than the L_{A10} assigned noise levels under the noise regulations (for example during day time), the approval would leave the existing assigned level in force.

Because the Refinery noise emission is essentially constant, the L_{A1} assigned levels in the noise regulations would not be needed in the approval. However, the L_{Amax} assigned levels in the noise regulations would not be affected by the approval, and would remain in force to limit any short term noise events.

The EPA considers that it is practicable to remove any tonality and other annoying characteristics from the noise emission. Therefore the Approval need not give special treatment to these characteristics. It is recommended that Alcoa not be subject to the "significantly contributing" noise constraints set out in Regulation 7(2). Regulation 7(2) specifies that where assigned levels are exceeded, the noise emissions from a premises are 'significantly contributing' to that exceedance if they exceed a level that is 5dB below the assigned level.

The Approval should control Refinery noise emissions to the specified levels and therefore should exempt Alcoa from the "significant contribution" obligation under regulation 7(2). Thus there would be no obligation on Alcoa to reduce Refinery noise emissions by a further 5dB in the presence of non-refinery noise emissions, as normally required under regulation 7(2).

The EPA is of the view that noise emissions from other proposals should remain subject to regulation 7(2).

The proposed initial noise limits (before any required noise reduction apply) are shown in Table 30.

Noise limits for Wagerup 3 upgrade

The EPA accepts that, if the Wagerup 3 upgrade is to be implemented within the next four years, it will be technically difficult and costly to meet the target maximum 4dB(A) reduction in noise emissions. The EPA therefore expects that the approval would contain provision for review of the noise limits to take into account the outcomes of the detailed design and commissioning process for the new plant.

Enforcement of noise limits in approval

The EPA is of the view that the approval should be structured such that, if an exceedance of the reference noise levels occurs, the force of the Act and noise regulations should come into play, without the approval itself lapsing. It is considered that the regulatory concept outlined above (based on reference noise levels at about 10 specified locations), would be compatible with this objective. The EPA envisages that the enforcement procedure would involve:

1) determining that the Refinery noise emission exceeded the reference level when measured at a reference location specified in the approval; and
2) determining that the Refinery noise emission exceeded an assigned level in Table 8 of the noise regulations when received at a nearby residence.

The EPA notes that noise regulation 7(3) allows the determination in Step 2 above to be done either by direct measurement at the point of reception or by calculation from the measured level at the reference position.

4.5.2 Overland conveyor noise

Potential increase in noise emissions from the ore transport system could arise as a result of

- an increase in the speed and belt width of the existing conveyor #371
- noise emissions from the proposed extension of the conveying system to Larego

The required reductions for the modified existing conveyor #371 can be achieved by appropriate machined and balanced idlers on the conveyor (SVT, 2005b).

Submissions

Conveyor affected residences still regularly experience noise levels in excess of 40 dB(A).

Assessment

The area considered for assessment of this factor is the overland conveyor and its surrounds.

The EPA's environmental objective for this factor is to protect the amenity of nearby residents from noise impacts resulting from activities associated with the proposal, by ensuring noise levels meet statutory requirements and acceptable standards.

The EPA notes that the peer reviewer (Burgess, 2005), whilst making suggestions related to information presentation and inclusion of extra information, agreed that the acoustic assessment conducted by SVT had been undertaken in an appropriate manner.

The EPA notes, in regard to conveyor #371, that recent monitoring indicates that it is in full compliance with the Regulations (Alcoa, 2005). During 2005, monitoring indicated that the noise contribution from Alcoa equipment at residences ranged from 23 to 32 dB(A). The EPA also notes that it is technically feasible for the upgraded conveyor #371 to comply with the Regulations, and that there are no residences affected by the conveyor extension.

4.5.3 Bunbury Port Facility noise

Description
The noise emissions from Alcoa's Bunbury port facility currently comply the Regulations.

SVT (2005b) concluded that provided low noise new equipment is selected and the duplicate conveyor is enclosed, the proposed changes to the Alcoa facility should have no noticeable noise impacts at nearby residences.

Submissions
There were no submissions.

Assessment
The EPA notes that the peer reviewer (Burgess, 2005b), whilst making suggestions related to information presentation and inclusion of extra information, agreed that the acoustic assessment conducted by SVT had been undertaken in an appropriate manner.

The EPA notes in regard to the upgrade of Alcoa's Bunbury Port facility that compliance with the noise regulations is marginal, inasmuch as the predicted noise levels may be "significantly contributing" to exceedances of the prescribed standard resulting from cumulative noise emissions from the Port. The EPA would be concerned if the proposed changes to plant were to result in an increase in cumulative noise emissions.

The EPA also notes that the Bunbury Port Authority has commenced a cumulative noise study, with a view to identifying noise contributions from all occupiers and establishing noise rankings and noise reduction programs where needed to provide for progressive reductions in overall emission levels over time. The EPA supports this process as a means of ensuring that Alcoa's noise emissions remain in full compliance with the noise regulations.

4.5.4 Rail Transport

Description
The number of train services associated with this proposal and the recent Pinjarra Refinery upgrade together would increase from 8 to 11 trains one way per day on the South West Main Line to Bunbury. If the Wagerup Unit 3 Expansion proposal were to be approved, train length would be increased from 28-32 wagons to 46 wagons for alumina, and from 10 to 14 wagons for caustic.

Sound pressure levels 15 metres from the train line are shown in Table 29 of the ERMP (Alcoa, 2005a).

Submissions
There will be increased cumulative impacts in noise from increased rail traffic, especially in view of expansions of other refineries.

Assessment
Other than the Wagerup Unit 3 expansion proposal, the EPA has recently assessed refinery expansion proposals for the Alcoa Pinjarra and Worsley alumina refineries. The EPA is concerned that the cumulative noise impact of these three proposals and other rail users, due to increased rail movements to the Bunbury Port, may unreasonably impact on residences along the lines.

The EPA considers that management of cumulative noise levels from train movements along the Collie-Worsley, Worsley-Brunswick, Pinjarra-Brunswick and Brunswick-Bunbury requires the collaborative effort of a number of different

stakeholders to facilitate timely investigation and implementation for any necessary noise mitigation measures.

In this regard, the EPA recommends that an inter-agency working group be established with a view to further defining the rail noise impacts, and identifying practicable operational measures, infrastructure improvements and residential noise amelioration measures that may be necessary to mitigate the noise impacts.

4.6 Greenhouse gases

Description

The greenhouse gas emission from the Wagerup refinery will increase as a result of the proposal from 1,425,000 to 2,755,000 tonnes per annum[6] of carbon dioxide equivalent for the boiler option, or 2,641,000 for the cogeneration option.

The greenhouse gas intensity, which is a measure of greenhouse gas emissions per tonne of alumina produced will improve from 603 kg CO_2 /t of alumina to 583 for the boiler option or 559 for the cogeneration option due to energy saving initiatives incorporated into the design of the proposal.

Submissions

The refinery expansion will increase greenhouse gas emissions.

Assessment

The area considered for assessment of this factor is the Wagerup refinery and its contribution to the issue of global warming.

The EPA's environmental objective for this factor is to minimise emissions to levels as low as practicable on an ongoing basis and ensure that best practicable measures and technologies are used.

The EPA notes that the proposal will increase greenhouse gas emissions from the Wagerup refinery by 1,330,000 tonnes CO_2 per annum for the boiler option or 1,216,000 tonnes CO_2 per annum for the cogeneration option. This amount is well over the trigger level of 500,000 tonnes per annum in EPA Guidance Statement No.12 titled "Guidance Statement for Minimising Greenhouse Gas Emissions" (EPA 2002).

The EPA is aware that the Australian Government has committed to limit Australia's increase in greenhouse gas emissions in 2008-2012 to no more than 8% above 1990 levels. Accordingly, the EPA considers it necessary for greenhouse gas minimisation to be kept firmly in mind when considering new development proposals which are likely to add significantly to emissions.

The EPA notes that Wagerup refinery is more energy efficient[7] than the world average for the alumina industry. Based on the 2004 greenhouse gas emission inventory the

[6] Since the ERMP, the calculation of greenhouse gas emissions has been refined and revised upwards to the emission rates shown here. The calculation is still based on 2 x 140 MW gas turbine generators for the cogeneration option and in no way impacts on air dispersion modelling carried out for the ERMP.

efficiency is 9195 MJ/tonne of alumina produced, compared to the world-wide weighted average of 11,818 MJ/tonne. The energy efficiency will be further improved by the proposal, such that it will reduce to 7,770 MJ/tonne for cogeneration option or 8758 MJ/tonne for the boiler option.

The EPA considers the proposed gas turbine cogeneration facility to be best practice and therefore preferred over the boiler option, but recognizes that implementation of this option is subject to third party considerations.

Alcoa has also pointed out that on a world-wide basis it has developed a climate change policy for its global operations. A principle component of the policy has been to reduce greenhouse gas emissions to 25% below the 1990 baseline by 2010. This was achieved in 2003. Also, life cycle assessment of aluminium as a product indicates that it has significant potential to reduce greenhouse gas emissions because of its importance as a light weight material in the manufacture of motor vehicles and other forms of transport. It is also recyclable.

The EPA notes that Alcoa has already demonstrated considerable progress in greenhouse gas emissions improvements by means of Alcoa's global initiatives such as use of energy audits and benchmarking across global Alcoa operations. Alcoa has also participated in Commonwealth Government initiatives such as the Greenhouse Challenge, Generator Efficiency Standards and Energy Efficiency Best Practice Programmes.

Summary

Having particular regard to:

(a) the fact that Alcoa Wagerup has better than average energy efficiency with respect to the world alumina industry;

(b) the improvement in energy efficiency and greenhouse gas intensity associated with this proposal; and

it is the EPA's opinion that the proposal can be managed to meet the EPA's environmental objective for this factor.

4.7 Relevant environmental principles

In preparing this report and recommendations, the EPA has had regard for the object and principles contained in s4A of the *Environmental Protection Act (1986).* Appendix 3 contains a summary of the EPA's consideration of the principles.

5. Conditions and Commitments

Section 44 of the *Environmental Protection Act 1986* requires the EPA to report to the Minister for the Environment on the environmental factors relevant to the proposal and on the conditions and procedures to which the proposal should be subject, if implemented. In addition, the EPA may make recommendations as it sees fit.

[7] Greenhouse gas emissions can be calculated by multiplying energy use associated with various fuels by an emission factor derived for those fuels. At the Wagerup refinery the fuel is mostly natural gas.

In developing recommended conditions for each project, the EPA's preferred course of action is to have the proponent provide an array of commitments to ameliorate the impacts of the proposal on the environment. The commitments are considered by the EPA as part of its assessment of the proposal and, following discussion with the proponent, the EPA may seek additional commitments.

The EPA recognises that not all of the commitments are written in a form which makes them readily enforceable, but they do provide a clear statement of the action to be taken as part of the proponent's responsibility for, and commitment to, continuous improvement in environmental performance. The commitments, modified if necessary to ensure enforceability, then form part of the conditions to which the proposal should be subject, if it is to be implemented.

5.1 Proponent's commitments

The proponent's commitments as set in the Environmental Review and Management Program and subsequently modified, as shown in Appendix 4, should be made enforceable. These include:

- continued support and implementation of the Wagerup Land Management Strategy.

5.2 Recommended conditions

Having considered the proponent's commitments and information provided in this report, the EPA has developed a set of conditions that the EPA recommends be imposed if the proposal by Alcoa to expand the Wagerup Refinery to increase production to 4.7 million tonnes per annum is approved for implementation. These conditions are presented in Appendix 4. Matters addressed in the conditions include the following:

(a) the proponent shall fulfill the commitments in the Consolidated Commitments statement set out as an attachment to the recommended conditions in Appendix 4;

(b) prior to submitting a Works Approval application the proponent shall submit a Detailed Design Report demonstrating that the proposed works adopt best practice pollution control measures to minimize emissions from the Refinery;

(c) prior to submitting a Works Approval application the proponent shall carry out data acquisition and investigations to further validate the air dispersion model used for predictions of ground level concentrations in the ERMP (May 2005) and, if necessary, make revisions to the detailed engineering design to reasonably achieve similar ground level concentrations to those predicted in the ERMP; and

(d) prior to submitting a Works Approval application the proponent shall prepare a revised Air Quality Management Plan that includes an operational performance verification monitoring program and management procedures to enable agreed emission rates to be achieved.

The EPA has also developed a set of conditions that the EPA recommends be imposed if the proposal by Alcoa to establish a Cogeneration plant at Wagerup Refinery is approved for implementation. These conditions are presented in Appendix 5. Matters addressed in the conditions include the following:

(a) prior to construction of the co-generation facility, the proponent shall prepare a Stack Emissions Management Plan to ensure that best practice technologies are used to minimise emissions from the co-generation facility, such that the Plan includes specific measures to minimise emissions and ground level concentrations of oxides of nitrogen (NO_X).

6 Other Advice

The EPA has also recently assessed expansion proposals for the Alcoa Pinjarra and Worsley alumina refineries. The EPA is concerned that the cumulative noise impact of these three proposals and other rail users, due to increased rail movements to the Bunbury Port, may unreasonably impact on residences along the lines.

The EPA considers that management of cumulative noise levels from train movements along the Collie-Worsley, Worsley-Brunswick, Pinjarra-Brunswick and Brunswick-Bunbury requires the collaborative effort of a number of different stakeholders to facilitate timely investigation and implementation for any necessary noise mitigation measures.

In this regard, the EPA recommends that an inter-agency working group be established with a view to further defining the rail noise impacts, and identifying practicable operational measures, infrastructure improvements and residential noise amelioration measures that may be necessary to mitigate the noise impacts.

7 Conclusions

The EPA has considered the proposal by Alcoa World Alumina to expand the Wagerup Refinery to increase production to approximately 4.7 million tonnes per annum and establish a Cogeneration Plant.

The EPA has noted that there have been numerous studies relating to emissions from the Wagerup refinery and health issues reported in the area, undertaken since the installation of a liquor burner in 1996.

The studies and investigations carried out to date have consistently shown that predicted and measured ground level concentrations of compounds emitted from the refinery meet established national and international air quality health standards. The studies and investigations have not demonstrated any specific causal link between:

- individual compounds, or mixture of compounds emitted from the refinery; or
- particular refinery sources,

and health issues reported in the area.

As part of the ERMP process for assessment of the proposed expansion, Alcoa commissioned a Health Risk Assessment (HRA) of emissions from the refinery. Consistent with previous studies, the HRA indicated that predicted ground level concentrations from both current emissions and predicted expansion emissions should not result in chronic health impacts or increased cancer risk to the surrounding community. Even with conservative assumptions and uncertainty estimates applied, the HRA indicated ground level concentrations of pollutants should not cause adverse health impacts. The findings of the HRA were generally consistent with those for other alumina refineries, with established air quality standards being met within close proximity to refineries.

The Department of Health has advised that on the basis of the HRA, emissions from the refinery should not present an abnormal public health risk for the general community.

Nature of the health issues

Previous investigations including analysis of complaint information, have indicated that periodic short-term ground level concentrations, above those occurring in the area for the majority of time, may occur under certain meteorological conditions. This appears to be particularly the case during winter months to the south and south-west of the Refinery. Whilst not considered to present a health risk to the general community, based on medical views presented to the EPA, such periodic short-term ground level concentrations may contribute to health symptoms in some individuals with sensitivities to chemicals.

Parameters such as odour and irritation thresholds provide an indication of the potential for health symptoms in individuals from short-term exposures to chemicals. Ambient air quality monitoring which has been undertaken in the area to date by Alcoa and government agencies has consistently found levels to be below recognized odour and irritation threshold limits. Based on the monitoring, it would appear that where individuals are experiencing health symptoms, it is at very low chemical levels.

The Wagerup Medical Practitioners Forum concluded that health symptoms being experienced by some people in the area include those that are consistent with a clinical syndrome referred to as Multiple Chemical Sensitivities (MCS) syndrome.

While there are varying views regarding MCS syndrome there is a general theme that reported health problems may be triggered in one of two ways:

- acute or definitely characterizable event, either a single episode or multiple episodes over a short period of time after which triggering of symptoms and observed sensitivities occur at very low levels of chemical exposure; or
- repeated or continuous lower-level exposures over a period of time may lead to sensitisation.

Given the incidence of reported health issues in the period following the installation of the liquor burner in 1996, this may have been a fundamental trigger for such health issues. If this is the case, then it may be that people in the area who have become

sensitised will continue to experience health issues even if emissions from the refinery are further reduced.

Furthermore, there may be people who, if they moved into the area, could be susceptible to exposure to periodic short-term concentrations arising under certain meteorological conditions. While the percentage of the general population who may be susceptible to such chemical sensitisation has not been scientifically quantified, the EPA has received advice that it may be in the order of a few percent.

The previous investigations and reviews which have been carried out into operations and impacts of the Refinery, including the three year inquiry by the WA Legislative Council Standing Committee on Environment and Public Affairs, have made various recommendations to address the reported health issues in the area. The findings and recommendations of these previous reviews have been implemented to varying degrees, although some key aspects are still continuing. To date, a formal health survey of residents in the area has not been carried out to document current health or any perceived change in health status since emission reduction measures have been implemented at the Refinery. Also, while Alcoa has implemented a land management strategy for the area, there is currently no formal statutory land management policy or strategy for the area. Neither is there a formal independent process available to people who feel they are affected by operation of the refinery so as to provide reasonable opportunity to relocate from the area without personal disadvantage.

This presents both policy and ethical questions as to whether expansion of the Refinery should be considered while there continues to be unresolved health issues related to chemical sensitivities. Hence final decision needs to be made in the context of a number of considerations, including environmental, economic, social and health factors. Some of these come within the legislative scope of the EPA's assessment, and the EPA has considered these to the extent it can within this assessment. Some considerations, particularly certain economic matters, are outside the EPA's assessment and are matters for Government to consider in its decision making process.

The primary factor for EPA consideration is air quality and potential health impacts.

The Department of Health has advised the EPA it considers that it would be inappropriate to arbitrarily introduce a new "protection of MCS" guidelines for emissions, some order of magnitude below current National/International air quality health standards, to address the issues outlined above. (Setting new, arbitrarily low guidelines for emissions may not prevent continued occurrence of health issues for people affected.) It also advised that it would be inappropriate to declare a large "no residents" zone of influence around the Refinery as, while some people have been impacted, the majority of residents are not experiencing health issues. The Department advised, with qualifications, that it was supportive of the expansion proposal if appropriate safeguards are introduced to protect and monitor the health of the community. The necessary safeguards include:

"The establishment of an adequate buffer zone around the refinery.

1. *That a set of principles are adopted to enable individuals who experience health concerns within the buffer to have adequate compensation to enable them to relocate from the area.*
2. *That the proposed community surveys are mandated to ensure that the impacts are readily identifiable."*

With respect to the proposed buffer zone, the Department of Health stressed that the justification for the zone in this instance was to allow for those individuals who may be impacted to be sensitively managed. It was not proposing that all residents be removed from the zone as this would be unnecessary. While not prescribing a definite zone, it considered that it should be a minimum of 5 km.

The EPA has reviewed other jurisdictions, nationally and internationally, to determine whether there are specific approaches which have been adopted for addressing chemical sensitivity issues. The review could not determine any specific guidelines, regulations or policy approaches being adopted elsewhere to specifically account for chemical sensitivities from industrial emissions below established air quality health standards. Similar to the policy approach applied in WA, other jurisdictions have required industries to meet established air quality standards, and implement 'best-practice' pollution control measures to minimise emissions.

The EPA therefore concurs with the Department of Health that it would not be appropriate, and nor would it be consistent with other jurisdictions, to set arbitrary lower criteria below established air quality health standards. The EPA also concurs with the Department that the most appropriate approach to addressing such issues is through sensitively managing, via an independent process, people who currently feel they are affected, and reducing and ultimately eliminating the potential for new people being affected.

Reductions in emissions and current extent of health issues

Alcoa has implemented a number of changes to operations and equipment at the refinery since 1998 to reduce emissions. As part of this, odour emissions from the plant are estimated to have been reduced from around 3,300,000 Odour Units per second (OU/s) in 1996 when the liquor burner was operating without current pollution control equipment, to about 1,350,000 (OU/s).

Alcoa has also implemented a land use management strategy to purchase properties in proximity to refinery where it considers people may be affected by operation of the refinery (referred to as Area A). Alcoa has also established zones (referred to as Area B) covering the townships of Yarloop and Hamel which are designated as economic management zones within which it purchases properties from people seeking to relocate. Areas A and B cover most properties within 5 km of the refinery. This has lead to some people relocating from the area over past years where they have felt affected.

As indicated above, there has not been any formal health survey carried out of residents in the area to document current health or any perceived change in health status since the emission reduction measures have been implemented at the Refinery.

From complaint information which is available, however, the number of properties currently experiencing health issues in the Wagerup area is reducing (relating to either the reductions in emissions or people moving out of the area), and there are currently few new properties raising complaints relating to health issues.

Requirements under which expansion of the refinery could be considered

The EPA considers that it would be preferable in situations where there have been health concerns in proximity to industrial operations, that expansion not proceed, until comprehensive health surveys had been conducted to demonstrate that there were no ongoing health issues or they had been reduced as far as practical.

Having considered the advice of the Department of Health and Department Environment, the EPA considers that approval for expansion at Wagerup could be considered provided appropriate safeguards were adopted to protect and monitor the health of the community.

Importantly, all of the following essential requirements would need to be met:

- Demonstration that there would be no general increase in ambient ground level concentrations for key pollutants from the Refinery, consistent with the predicted ground level concentrations presented in the Environmental Review and Management Program.
- Best practice was applied in design, selection, installation and commissioning of pollution control equipment integral to the expansion to minimise emissions from the Refinery. This should be subject to review by an expert Independent Design Review Team, established in consultation with Alcoa, during the design phases leading to Works Approval application.
- A technically sound, independently monitored program was agreed for commissioning performance verification to demonstrate emissions met those proposed.
- Key recommendations from previous reviews and investigations, particularly those of the CSIRO 2004 Air Quality Review, were completed in parallel with the design phases of the expansion.
- A comprehensive ambient air quality monitoring and reporting program was established for the area.
- A baseline health survey, independently managed by the Department of Health, was undertaken in the area within twelve months of approval being granted.
- A Government land use strategy be developed and implemented for the area prior to construction commencing, in association with Alcoa's land use strategy, to ensure compatible land uses in the vicinity of the Refinery.
- Periodic follow-up, independent health surveys following implementation of the expansion to monitor community health issues.
- Establishment of an independent process for assessment and diagnosis of any persons reporting health symptoms attributable to operation of the refinery.
- Establishment of a process to enable persons who have been professionally/independently assessed to be experiencing chemical sensitivity symptoms to relocate from the area without personal disadvantage.

These requirements have been considered at length by the EPA and reported on in this assessment report. It is stressed that if Government approval is granted for the expansion to proceed, all of these requirements are essential and must be implemented as a complete package.

The EPA also considers that the Cogeneration plant could be implemented.

With respect to Alcoa's Regulation 17 application to exceed noise standards prescribed in the *Environmental Protection (Noise) Regulations 1997*, the EPA has recommended that this be granted subject to conditions requiring noise reduction measures to be implemented to the existing Refinery. The EPA has also recommended that Alcoa be required to implement all reasonable and practicable measures to reduce noise as a condition of approval for expansion of the Refinery.

8 Recommendations

The EPA submits the following recommendations to the Minister for the Environment:

1. That the Minister considers the EPA' assessment report on Alcoa's proposals to expand the Wagerup Refinery to increase production to approximately 4.7 million tonnes per annum and establish a Cogeneration Plant.

2. That the Minister notes that a Health Risk Assessment carried out for the expansion indicates that emissions from the refinery should not pose an abnormal public health risk for the general community. However, the meteorological conditions in the vicinity of Wagerup refinery are such that they may lead to period occurrences of short-term ground level concentrations that may lead to health symptoms in certain individuals susceptible to chemical sensitivities. This presents both policy and ethical questions as to whether expansion of the Refinery should be considered while there continues to be unresolved health issues related to chemical sensitivities.

3. That the Minister notes that, having considered the advice of the Department of Health and Department of Environment, the EPA considers that approval for expansion at Wagerup could be considered provided the safeguards listed in this report are introduced as a complete package to protect and monitor the health of the community. Implementation of portions of the package will not provide the protection considered necessary by the EPA.

4. That if approval is granted for expansion of the Refinery, the Minister imposes conditions on Alcoa as recommended in Appendix 4 of this report.

5. That in addition to the conditions placed on Alcoa, the Government implements the following actions in association with Alcoa and the community:
   - a comprehensive ambient air quality monitoring and reporting program be established for the area;
   - a baseline health survey, independently managed by the Department of Health, be undertaken in the area within twelve months of approval being granted ;

- a Government land use strategy be developed and implemented for the area prior to construction commencing, in association with Alcoa's land use strategy, to ensure compatible land uses in the vicinity of the Refinery.
- periodic follow-up, independent health surveys be undertaken following implementation of the expansion to monitor community health issues;
- establishment of an independent process for assessment and diagnosis of persons reporting health related symptoms attributable to operation of the refinery, and
- establishment of a program to enable persons who have been professionally/independently assessed to be experiencing chemical sensitivity symptoms to relocate from the area without personal disadvantage.

6. That the Minister notes that the EPA has also concluded that the Cogeneration plant could be implemented.

7. That if approval is granted for the Cogeneration plant, the Minister imposes the conditions recommended in Appendix 5 of this report.

8. That the Minister grants the Noise regulation 17 approval to Alcoa subject to conditions requiring further noise reduction measures to be implemented to the existing refinery.

9. That the Minister notes the EPA's advice under "Other Advice" in regard to establishment of an interagency working group on cumulative rail noise impacts for the sections of railway to the Bunbury Port used by the alumina industry.

Appendix 1

List of submitters

Organisations:

Department of Environment
Department of Health
Department of Indigenous Affairs
Department of Planning and Infrastructure
Shire of Harvey
Shire of Waroona
Peel Development Commission
Bunbury Wellington Economic Alliance
Community Alliance for Positive Solutions
Conservation Council of Western Australia
The Coalition of Property Rights
Kwinana Progress Association
South West Forest Defense Foundation Inc.
Yarloop & Districts Concerned Residents Committee

Individuals:

Mr David Dwyer & Staff
Dr Moira Somers
Dr Dyann Ross, Ms Helen Seiver, Ms Betty Youd & Ms Wallea Ross
Mr Kingsley Dyson & Ms Carol Dyson
Professors D'Arcy Holman & Andrew Harper & Dr M Somers
Mr Lionel Turner
Mr Graeme Wickham & Family
Mr John E Harris
Mr Alex Jovanovich
Mr Barry Bowden
Mrs A L Donovan
T A & S M Cockerham
Mr Ray Ritchie & Ms Ann Ritchies
Mr Glen Turner
Mr John B Clark
Ms Anne Lalor & Mr Garry Lalor
Mr Paul Llewellyn
V Webb
Mr Andrew Harper
Mr Cameron Auxer
B R Chapman
Mr Luke Smith
Ms Fiona Komer
Ms Kate Vidulich
Mr Ross Milici
Ms Lyn Vidulich
Ms Julie Smith
Ms Helen Alexander
Mr Neville Smith
Mr Ron Prokopyszyn

Ms Hannah Struckman
H Vidulich
Mr Barry Clark
Mr John L Salerian
Mr Peter Gallagher
Mr Harold Edgeloe
Mr Colin Davis
Ms Suzanne Osentol
Ms Akshaya Patel
Mr John Beaven
Kerry Saeller-Muir
P Wheeler
Ms Rose Salvona
Mr Barry Chesson
Mr Peter Garside
Mr Paul Osenton
E Garside
Mr Rob Downard
M Wood
Ms Theresa Wright
Mr Brendan Evans
Ms Christine Dodd
Mr Bob Kirke
Ms Wendy Parker
Mr Guy Spagnolo
Ms Debbie Klopper
Mr Thomas Trempus
Mr Jose Martinez
Mr Gavin Goh
Ms Julia Blandford
Ms Sandra Field
J Szkrara
Mr John Wheeler
Mr Darren Joynes
Mr James Pearce
Ms Janice Bradshaw
Ms Marion Farrow
M Jones
E Johnson
Ms Jan Jones
Mr David Pisano
Mr Peter Crikis
The Resident
Mr Len Noordzy
Mr Simon Geldart
Mr Andrew Jones
Mr Maaik Noordzy
Mr Barry Field
Mr Rocky Kopp
Mr Henry Delaisse

Ms Anna Blaydon
Mr Patrick Watt
Ms Adele Peters
Ms Jane Schneider
Mr Scott Hansen
N J Szkraba
Mr John Harris
Mr Geoffrey Cattach & Ms Marie Cattach
Aldo Aldegheri
Alex David Burgueno
Alistair Rhodes
Andrew Johnson
Andrew Tennent
Angela Robertson
Bach Phan
Barrie Towns
Barry Mathews
Bernie Masters
Bill Marshall
Bob Szajntienig
Bruce Ayres
Caitlin McKinnon
Chris Phillips
Christine Baunton
Col Heap
Cosie Epiro
Craig Bovell
D V Cooper
Dale Clark
Danielle Smith
David J Williams
David Tuckwell
Dean Ilich
Dean Whiteman
Dion Gallagher
Don Glenister
Donna Cole
Eddy Lim
Elaine Doherty
Fiona Ellis
Foke Wan Loo
Frank Wittwer
G Torkington
Geoff Chapman
Gerrie Ager
Giglio Martelli
Gino Williams
Glenn Hollows
Hieu Tran
Hlwan Moe

Ian Yull
J Outschoorn
James Kelly
James Muir
Jamie & Tracey Nicholls
Jamie Thomas
Jan van Lierap
Joann Vergone
John Dobson
John Hall
John McQuade
John McQuillan
John Pugno
John Waite
Judy Charbonneau
K Lawrence
Karen Liddiard
Keith Fenn
Kerri Nicholls
Kim Doak
L Owen
Laura Ellam
Leigh Blagden
Liane Sandstrom
Libby Archell
Linda & John Cattermole
Loretta Polinelli
Louise Boylen
Louise Viereck
M Salh Fakier
Mal Callard
Marcus Lindsay
Margaret McDonald
Marion Walder
Michael A Parker
Michael Boyd
Michael Russell
Mike Edmondson
Mike McCall
Mim Bemarte
Neal Leggo
Neil Bartholomaeus
Neil Jacobs
Neil Mortimer
Owen Morton
P A Ware
P Davis
P Davis
Pat Garrett
Paul Lonsdale

Paul Power
Peter van Oss
Peter Wassell
Phil Butler
Phung Tu
Quoc Khanh Tran
R Long
Rachel Mottram
Rita Ostolidi
Rob Crawford
Robert Williams
Rose & Terry McDonnell
Samsudin Basri
Sean Mahony
Shamal Ghosh
Sharyn Gallagher
Sinead Baster
Sohail Mohideen
Stacey Rundell
Steve Wise
Sue Tonkin
Sue Ward
Suzanne Williams
Tim Gatti
Trish Gyurity
Warren Milner
Winston Elton Bott
Yasmin Wyatt

Appendix 2

References

Alcoa World Alumina (2002) Wagerup Air Emissions Inventory Final Report 25th September 2002.

Alcoa (2004) 1 June 2004 Letter: Anita Logiudice (Alcoa Wagerup Refinery) to John Macpherson (DoE) Joint Consultation and Costing of Noise Reductions. Attachment C – Table 7.1 Noise Source Ranking. Attachment D – Cumulative Calcs – Various

Air Assessments (2005) Air Dispersion Modelling of Fugitive Emissions, Wagerup Refinery. Report prepared for Alcoa World Alumina Australia, April 2005.

Alcoa World Alumina Australia (2005a) Environmental Review and Management Programme Wagerup Refinery Unit Three.

Alcoa World Alumina Australia (2005b) Wagerup Refinery Unit Three Environmental Review and Management Program Response to Submissions.

Alcoa World Alumina (2005c) Wagerup Alumina Refinery Interim Environmental Improvement Plan 2005/06

Alcoa World Alumina Australia (2005c) Wagerup Alumina Refinery Interim Environmental Improvement Plan 2005/06

Burgess, M. (2005a) Review of Environmental Noise Management Proposal for Wagerup Unit 3 Expansion for Alcoa of Australia Wagerup Expansion Team, Acoustics and Vibration Unit, School of Aerospace, Civil & Mechanical Engineering UNSW at AFDA, February 2005.

Burgess, M. (2005b) Review of Environmental Noise Management Proposal for Wagerup Unit 3 Expansion Part 2 Ore Transport System and Bunbury Port for Alcoa of Australia Wagerup Expansion Team, Acoustics and Vibration Unit, School of Aerospace, Civil & Mechanical Engineering UNSW at AFDA, March 2005.

Bisby, John A. (2005) Review of the Report: Health Risk Assessment of Atmospheric Emissions Expansion of Wagerup Refinery to 4.7 Mtpa prepared by Environ Australia Pty Ltd and Benchmark Toxicology Services for Alcoa World Alumina Australia dated 19 April 2005

Cook (2003) Six Month Report of Yarloop Community Health Clinic: Yarloop Community Clinic. Community Nurse, South West Population Health Unit.

CSIRO (2004a) Meteorological and Dispersion Modelling Using TAPM for Wagerup, Phase 1: Meteorology. Report for Alcoa World Alumina Australia by CSIRO Atmospheric Research, Vic.

CSIRO (2004b) Meteorological and Dispersion Modelling Using TAPM for Wagerup, Phase 2: Dispersion. Report for Alcoa World Alumina Australia by CSIRO Atmospheric Research, Vic.

CSIRO (2004c) Meteorological and Dispersion Modelling Using TAPM for Wagerup, Phase 3A: HRA (Health Risk Assessment) Concentration Modelling –

Current Emission Scenario. Report for Alcoa World Alumina Australia by CSIRO Atmospheric Research, Vic.

CSIRO (2004d) Meteorological and Dispersion Modelling Using TAPM for Wagerup, Phase 3B: HRA (Health Risk Assessment) Concentration Modelling – Expanded Refinery Scenario. Report for Alcoa World Alumina Australia by CSIRO Atmospheric Research, Vic.

CSIRO (2004e) Wagerup Air Quality Review. Report for Alcoa World Alumina Australia by CSIRO Atmospheric Research.

GHD (2005) Emissions to Air from Residue Disposal Area – Assessment of emissions from Diffuse Sources.

Government of Western Australia (2004) Report of the Standing Committee on Environment and Public Affairs in Relation to the Alcoa Refinery at Wagerup Inquiry. Report 11, October 2004.

Enhealth (2004) The Health Effects of Environmental Noise – Other than Hearing Loss. Department of Health and Aging, Canberra.

Emphron (2005) Oxides of Nitrogen and Particulate Monitoring at Wagerup Refinery - An Analysis of Influences Detectable in Yarloop

Environ and Benchmark Toxicology Services (2005) Health Risk Assessment of Atmospheric Emissions Expansion of Wagerup Refinery to 4.7 Mtpa. Report for Alcoa World Alumina Australia, April 2005.

Environ (2005) Odour Analysis – Unit 3 Wagerup for Alcoa Alumina Australia, November 2005.

Herring Storer Acoustics (2002) Alcoa of Australia Limited Wagerup Refinery Noise Emission Modelling and Source Ranking (Ref 9654-4-00029-4.2)

Jansen G *et al* (2003) Evaluation of Aircraft Noise – Protection of Residents. Proceedings of the 8th International Congress on Noise as a Public Health Problem, Foundation ICBEN 2003, Schiedam, The Netherlands, 2003.

Katestone Environmental (2005a) Desktop Review of CSIRO Phase 1,2 and 3A for Assessment of the Alcoa Wagerup Refinery Expansion. Report from Katestone Environmental to Alcoa World Alumina Australia, January 2005.

Katestone Environmental (2005b) Desktop Review of CSIRO Phase 2, 3A and 3B (Final Reports) for Assessment of the Alcoa Wagerup Refinery Expansion. Report from Katestone Environmental to Alcoa World Alumina Australia, March 2005.

Katestone Environmental (2005c) Desktop Review of Air Dispersion Modelling of Diffuse Area Source Emissions for the Alcoa Wagerup Refinery Expansion Prepared by Air Assessments. Report from Katestone Environmental to Alcoa World Alumina Australia, April 2005.

SKM (2003) Pinjarra Refinery Efficiency Upgrade – Air Dispersion Modelling

SVT (2003) Review of Environmental Noise Emissions from Alcoa Wagerup Refinery.

SVT (2005a) Noise Model Development Report for Wagerup 3 Expansion Project.

SVT (2005b) Environmental Noise Management Strategy for Wagerup 3 Expansion Project.

SVT (2005c) Noise Control Review for 4 dB Noise Reduction Scenario for Wagerup 3 Expansion Project for Alcoa of Australia.

Toxicos (2005) Health Risk & Toxicological Assessment – Worsley Expansion Emissions.

URS (2003) Environmental Impact Statement Alcan Gove Alumina Refinery Expansion Project. Volume 1: Main Report.

WAPC (2005) Statement of Planning Policy: Road and Rail Transport Noise (Draft). Western Australian Planning Commission, Perth.

WHO (1980) Environmental Health Criteria. World Health Organisation, Geneva.

WHO (1999) Guidelines on Community Noise. World Health Organisation, Geneva.

Appendix 3

Summary of identification of relevant environmental factors and principles

Identification of Relevant Environmental Factors and Principles

Preliminary Environmental Factors	Proposal Characteristics	Government Agency and Public Comments	Identification of Relevant Environmental Factors
BIOPHYSICAL			
Flora and vegetation	The Wagerup operations are surrounded by paddocks used for grazing of livestock. No significant remnant native vegetation will be cleared and none of the Threatened Ecological Communities (TECs) or locally significant vegetation communities identified in the vicinity of the refinery will be affected by the expansion of the refinery and Residue Disposal Area.	Shire of Harvey • Some formal assessment of the increased mining activity (including transportation issues) should be undertaken. Public • Mining or its impacts are not included in the ERMP.	Whilst the proposal will result in an increase in the rate of mining, the mining will continue to be limited to the existing mining area, for which there are existing approvals in place. Ongoing Government supervision of environmental management of flora and fauna impacts within the mining area is carried out by the Mining and Management Programme Liaison Group (MMPLG). The MMPLG is an interagency group including the Department of Conservation and Land Management (CALM), the Department of Environment (DoE), the Water Corporation and Department of Industry and Resources (DoIR). **The factor of "biophysical- flora and vegetation" is not considered to be a relevant environmental factor.**
Fauna	No areas of remnant vegetation will be cleared and consequently no significant impact on native fauna is expected.		**The factor of "biophysical- fauna" is not considered to be a relevant environmental factor.**

POLLUTION			
Atmospheric emissions			
Gases	The proposed expansion will require modifications or new equipment in: • Milling; • Digestion; • Precipitation; • Calcination; • Power generation; and • Conveyors These modifications will result in some increases and decreases to refinery emissions. Gaseous air emissions will increase as follows: • 1005 tpa NOx increases to 1974; • 70 tpa SO2 increases to 113; • 78 tpa VOCs increases to 93;	<u>Department of Environment</u> • A number of problems discovered with the reports, which should be revised and tables amended. • The uncertainty analysis included the findings of remodelling NOx using data assimilation which shows under-prediction at receptors 1 to 6 to the south. CSIRO concluded that all generated statistics should be considered to have a factor of 2 uncertainty (+100% to -50%). This must be carried forward to the HRA. • Clearly indicate emission rates for each hazard from fugitive, stack and other sources along with an indication of degree of certainty in each statistic, and references for each estimate. • The analysis presented in the ERMP, including the HRA is focused on incremental (i.e. refinery only) impacts. • Critical need to review the Alcoa and Worsley emission inventories to understand if they are broadly similar or the reasons for major differences. • Further investigate some technical issues including, TAPM's building wake scheme, further testing of wind field data in fugitive source modelling and sensitivity modelling for fugitive sources. • Contribution of the refinery to the ambient environment is said to be small, but this does not take into account short term "events" where the refinery may make a bigger contribution. • Inadequate meteorological monitoring and maintenance of equipment. • Cooling towers should be better characterised. • What will happen to Calciner 5 & 6 low volume vent emissions? Will there be any low volume vents with these calciners? • The use of best practice emission control for all the refinery (not just the expansion) has not been identified in the ERMP. • Emissions should be reposited where unacceptable short term impacts occur. • Is NOx a good tracer for all primary emissions? Not all emission	**The factor of "atmospheric emissions - gases" is considered to be a relevant environmental factor.**

		sources emit uniform NOx. and the modelling may not accurately reflect emission dispersion behaviour from other (non NOx) sources. • Calciner 3 improvements should be included in the modelled basecase. • Data assimilation of TAPM not undertaken. • It should have been possible for Environ to directly or indirectly use the peak to mean ratios from TAPM output. <u>Department of Health</u> • The ERMP should include a detailed explanation of how the increased efficiency will be achieved. • Provide evidence to confirm or refute the conclusion made by CSIRO: "there is indirect chemical evidence that there may be compounds present in the refinery emissions in significant concentrations that have been either not identified or poorly quantified …" • The ERMP should identify the sources of VOCs found at Boundary Road using robust source apportionment methods. • Provide justification of the estimate of a non-proportional increase in SO_2 emissions with production including the reason why the emissions from the liquor burner will not increase with the doubling of throughput. • Recommendations of van Emden & Power (AQ Appendix B, section 6) should be carried out. • Include an assurance that the sulphur stream is not diverted to sulphur containing organic compounds such as mercaptans and other odorous compounds. <u>Public</u> • Uncertainty in air dispersion modelling. • Refinery is located in an unsuitable position due to the influence of the escarpment. • Emissions should not be averaged as it disguises short term	

		concentrations. • Increase in production must lead to increase in emissions. • Tall stacks have made emissions worse further from the refinery. • Monitoring should be independently conducted and audited. • Slurry tanks should be monitored. • Cooling towers should be monitored. • Emission control measures on Building 50 and Calciner 3 have not been effective. • Some tables in the ERMP are incorrect. • Some emission estimates differ to reported NPI data. • Maintain a throughput limit on the licence. • The original CSIRO study proposal should be implemented. • There should be continuous ambient air monitoring at a number of locations. • Comparison of ambient monitoring to other rural environment with industries. • Why was source emission baseline compared to ambient baseline – is this a valid approach? • Two calciners and Liquor burner were off during ambient sampling. • Emissions from tall stacks are said to be only steam. • An alternative method of disposal needs to be found for oxalate other than restarting the oxalate kiln.	
Particulates/dust	Particulate emissions will increase from 60 to 65 tonnes per annum (tpa).	<u>Department of Health</u> • A robust monitoring program must be instigated along with continuous particulate monitoring and collection of meteorological data in accordance with recognised standard methods in an attempt to verify modelled fugitive particulate emissions, especially in regard to gustiness of wind. <u>Public</u> • Dust impacts and control of dust from RDAs has not been adequately demonstrated. • Assessment of dust is based solely on dust monitoring during the	**The factor of "atmospheric emissions – particulates/dust" is considered to be a relevant environmental factor.**

		winter months, with no summer data. • RDA dust emissions have a significant impact on neighbours • The review period for the RDA by the LTRMS and RPLG should be reduced from 5 to 3 yrs. Public Dust and noise will increase from Bunbury Port loading bays through the expansion.	
Odour	Odours have been source of public complaint with the existing refinery and VOC emissions will increase from 78 to 93 tonnes per annum.	Department of Environment • Validity of odour emission estimates and modelling. • Recommend that the odour/VOC relationship developed by Alcoa be independently reviewed. • Modelled odour impacts not representative of complaints. • Odour modelling of the cooling pond with plume rise should be considered exploratory. Public • There will be an increase in odour emissions as a result of increased production at the refinery. • Uncertainty of odour emission rates.	**The factor of "atmospheric emissions - odours" is considered to be a relevant environmental factor.**
Health impacts		Department of Health • ERMP to include a summary table in the main document which gives, for each receptor and each chemical compound, the ground level concentration (fugitive and point source), its human guideline value, toxicological endpoint, averaging time, the calculated hazard quotient and bounds of uncertainty, i.e. an error estimate. • Demonstrate why the principal metal components of the feed-stock are not a health risk to susceptible individuals, including vanadium, zirconium, thorium, rubidium, niobium and strontium, irrespective of their radionuclide status. • Demonstrate that PM2.5 is not a health risk with this project. • Table 1.0, AQ Appendix F should be expanded to include all chemicals detected or which are reasonably certain to be present in Wagerup refinery emissions and indicate reasons for inclusion or	**The factor of "atmospheric emissions – health impacts" is considered to be a relevant environmental factor.**

		rejection of each substance in the HRA. If a hazard index is used as a screen, indicate the toxicological criteria value, its reference and calculated value. If selection was based on "professional opinion" provide justification statements. Final selection should be benchmarked against comparable alumina refinery inventories. • The actual value used in each HI calculation needs to be shown, given the differences in the reference values shown in the ERMP and appendices. NEPM values which are presented but NOT used in the HRA need to be clearly identified to prevent confusion. • Clearly indicate emission rates for each hazard from fugitive, stack and other sources along with an indication of degree of certainty in each statistic, and references for each estimate. • Justification of the expected size fractionation of TSP and expected compositions of those fractions. • Clarify total mercury emissions under the current and proposed scenarios, its sources and control measures. • Include information which gives an assurance that the growth of the RDA will not increase the risk to human health given the dynamic nature of the RDA. • That the proposed community surveys are mandated to ensure that impacts are readily identifiable. • The establishment of an adequate buffer zone around the refinery. • That a set of principles are adopted to enable individuals who experience health concerns within the buffer to have adequate compensation to enable them to relocate from the area. <u>Department of Environment</u> • The HRA should consider the refinery in isolation to the cogeneration units. NOx emissions primarily relate to power generation and are not process related. • Compare substances modelled with those in the Worsley ERMP. • The buffer should be formalised through the Government. <u>Department of Planning and Industry</u> • It is recommended that a buffer be defined, and possibly include areas where there are restrictions on land use and development	

		controls on land use and development and an area in which notification is recommended regarding the potential impacts of the refinery. <u>Shire of Harvey</u> • A number of key community issues raised within the ERMP have not been addressed. • Social and economic impact of the Land Management strategy is not adequately addressed in the ERMP. • Formalisation of Governments position on a buffer. <u>Public</u> • The existing refinery emissions have adverse health impacts and are making people sick. • The ERMP does not address current health and amenity impacts. • The ERMP has not identified a causative agent for complaints. • Demonstrate that PM2.5 is not a health risk with this project. • The HRA is based on a dose-response relationship and is not predictive or correlates to illness. • Clarify total mercury emissions under the current and proposed scenarios, its sources and control measures. • Refinery emissions should be decreased due to existing health impacts. • An increase in refinery production will result in increased health impacts. • A full health impact assessment for residue dust and radiation. • Only 27 compounds have been included in the HRA. • Mine workers should not have been included in the Healthwise health survey • Alcoa do not recognise the correlation between refinery pollution and complaints as found in the 2003 AWN/CSIRO study. • The refinery poses a radiation risk and the increased rates of thyroid cancer in Healthwise study (2004) is not unexpected. • EPA to be provided a full copy of the Community Health Nurse report 2002/03.	

		• Conservatism has not been carried forward to the HRA (as per expert review report.) • The health survey results should be available for inclusion in ERMP or prior to the expansion. • Ensure a mechanism is in place for adequate follow-up surveys of participants and any trends acted upon. • An independent body should undertake the health survey. • The health survey should include people who lived in area and have now moved. • Health survey should not include people from outside local area as this will influence the results. • Chemical illness in workers or community members adjacent to Wagerup since 1996 is not addressed in the ERMP. • Alcoa Medical Services is unresponsive in meeting the health needs of employees and other affected by chemical illness. • The throughput limit should be decreased if complaints from a wider area are received. • The buffer should be formalised through the government. • The existing buffer should be increased in size. • Alcoa will not purchase properties outside the buffer area, even though those residents suffer the same impacts.	
Greenhouse gases	Greenhouse gas emissions will increase from 1,342,000 tonnes per annum of CO_2 equivalent to 2,544,000 (Boiler option) or 2,255,000 (Cogeneration option).	<u>Public</u> • The refinery expansion will increase greenhouse gas emissions.	**The factor of "atmospheric emissions -greenhouse gases" is considered to be a relevant environmental factor.**
Non chemical emissions			
Noise	The existing refinery does not meet the	<u>Department of Environment</u>	**The factor of "non chemical emissions - noise" is considered to be a relevant environmental factor.**

	Environmental Protection (Noise) Regulations 1997 and Alcoa has submitted a application under Regulation 17 for a variation from the assigned levels.	• Adverse comments of the SVT "Audit" in 2003 have not been dealt with in the ERMP. • It is unclear if the Alcoa-owned residences which they permit to be occupied are included in the discussion. • Like to see a study along the entire length of old and new sections of the conveyor and various transfer stations. • There should be a sign-off process for the detailed construction noise management plans for the various construction phases • A study of all sectors of track between Pinjarra and the Port and include cumulative noise impacts from all three upgrade proposals (Pinjarra, Wagerup and Worsley). • The use of best practice noise control for all the refinery (not just the expansion) has not been identified in the ERMP. • Is no increase in noise impacts the best practicable outcome for noise. Unclear if this mitigation of impacts only involves mitigation of activities within the refinery or whether the realisation of the above would involve acoustic treatment or other remedies applicable at receiving premises. <u>Shire of Harvey</u> • Existing noise levels are in excess of the prescribed levels and this matter is still yet to be resolved. • Increased impacts (noise, vibration dust, traffic delays) in towns from increased road and rail traffic. <u>Public</u> • Noise levels at a number of residents still needs to be resolved. • Noise levels will increase through the expansion. • Increased heavy rail traffic will result in greater noise levels and vibration having further negative impacts on residents. • Increased impacts (noise, vibration dust, traffic delays) in towns from increased road and rail traffic. • Cumulative noise impacts of all sectors of track between Pinjarra and the Port for all three upgrades (Pinjarra, Wagerup and Worsley).	

Radiation	A baseline study of the residue area and background levels has been completed. There were no significant issues. The proposal will not result in a change the radiological status of the area and surrounds.		**The factor of "non chemical emissions - radiation" is not considered to be a relevant environmental factor.**
Light spill	Increased lighting will be required.		**The factor of "non chemical emissions – light spill" is not considered to be a relevant environmental factor.**
Water			
Groundwater quality	No deterioration of groundwater quality is likely as a result of the proposal. Groundwater monitoring has identified existing contamination in certain locations beneath the refinery and residue area. A groundwater Remediation 5 Year Plan is being implemented.	<u>Department of Environment</u> • Lack of groundwater (site) investigation in vicinity of the proposal area • Is acid sulphate soil an issue for the proposal. • Have not demonstrated the reasoning of utilising surface water verses the use of groundwater from the Harvey River Main Drain and how this would be managed. <u>Public</u> • There will be further contamination of groundwater from the RDA's and refinery • Alcoa has a significant number of spills indicating poor environmental management. • The Wagerup stormwater containment system is badly damaged and is causing contamination.	The Residue Disposal Area is an existing facility with existing management procedures relating to groundwater impacts. The proposal does not raise new groundwater contamination issues and ongoing operations are more appropriately managed under the under Part V of the Environmental Protection act 1986 by means of the Environmental Licence. Changes to water supply arrangements are also subject to a licence application. **The factor of "groundwater quality" is not considered to be a relevant environmental factor.**
Surface water quality	No impact is predicted as a result of the proposal.	<u>Public</u> • The Wagerup stormwater containment system is badly damaged and is causing contamination.	The risk of contaminated water leaving the property is low and manageable. The existing refinery has management systems in place to capture all stormwater runoff and process spill water that is not contained within bunds. The storm sewer and surge pond for the refinery have been designed for a 1:100 year storm. The design and capacity will be reviewed

			as part of the detailed engineering design to ensure the proposal can be accommodated. **The factor of "water - surface water quality" is not considered to be a relevant environmental factor.**
Water supply	The water requirement will increase from 4,800 to 9,600 million litres per annum. Increased supply from the Harvey River Main Drain is being evaluated. Another option is water from the Harvey Water Cooperative which may become available through irrigation water efficiency upgrades.	<u>Shire of Harvey</u> • The additional water requirements for the proposal should not impact on the environmental and aesthetic flows within existing natural watercourses. <u>Public</u> • The refinery expansion will result in a deterioration of the water quality in Yarloop. • The expansion would result in an over commitment of scarce water resources in the region, reducing levels and quantity available. • Why was Harvey pump-back built on Logue Brook?	Any additional water resource requirements will be subject to a licence application which will ensure that environmental water requirements are met. **The factor of "water - supply" is not considered to be a relevant environmental factor.**
Land			
Liquid and solid wastes	Bauxite residue will increase from 4.8 to 9.6 Mtpa. Other non process wastes and process wastes such as red scale, white scale and spilled process chemicals, my also increase in line with production.	<u>Shire of Waroona</u> • Alcoa to benchmark it efforts to find alternative disposal options for residue. <u>Public</u> • Residue samples are washed prior to analysis to remove leachable compounds • An alternative method of disposal needs to be found for oxalate other than restarting the oxalate kiln.	The Wagerup refinery has an existing waste management program within an Environmental Management System (EMS). Waste streams are grouped into categories for disposal in accord with Government regulations and internal Alcoa guidelines. Bauxite residue is managed within the framework of the Long Term Residue Management Strategy (LTRMS) which is prepared in consultation with the local community, local government and Residue Planning Liaison Group (RPLG) **The factor of "land – liquid and solid wastes" is not considered to be a relevant environmental factor.**

SOCIAL SURROUNDINGS			
Public Safety Risk	The levels of public risk associated with the existing plant and the expansion comply with all relevant Off-site Individual Risk from Hazardous Industrial Plant criteria.		**The factor of "social surroundings – public safety risk" is not considered to be a relevant environmental factor.**
Visual amenity	An additional taller multiflue for Calciner units 4, 5 and 6 will be visible. If the Cogeneration option is selected 2 cooling towers will be visible. Alternatively, if the boiler option is chosen a 75 metre stack for the Boilers will be visible. The residue area will increase in height from 20 to 40 metres, although this increase in height is proposed without the proposal, at a later date. Overall the effect on visual amenity will not change significantly.	<u>Shire of Waroona</u> • Further planting on the northern end of Somers Rd is required to screen the RDAs. <u>Public</u> • Increased visual amenity impacts of RDA.	**The factor of "social surroundings – visual amenity" is not considered to be a relevant environmental factor.**
Heritage	There will be no impact on archaeological heritage and ethnographic issues. Twenty seven Aboriginal archaeological sites have been recorded within an 8 kilometre radius of the	<u>Department of Indigenous Affairs</u> • Noted that works will be confined within the existing boundaries and that previous surveys did not locate any significant sites.	**The factor of "social surroundings – heritage" is not considered to be a relevant environmental factor.**

	refinery but the proposal will be within the existing boundary of the refinery.		
Other		<u>Public</u> • Cooling towers are the source of Legionnaire's disease outbreak on several occasions • The ERMP and Alcoa have not addressed the issue of community dislocation. • Social and economic impact of the Land Management strategy is not adequately addressed in the ERMP. • The refinery and the expansion make it difficult to sell property in the area • Alcoa does not have community support for the expansion and therefore not proceed. • The working group process was not independent, open or fair. • The selection of the working group members was not fair or representative of the community. • Why the ECU study cut short and no final report or outcomes. • Concern over the Alcoa complaint response system. • Limited time for consultation on the expansion. • Selection of expert reviews was not fair. • Alcoa intimidates people to stop complaints. • Open Forum issues not published • A full social impact assessment should be undertaken.	The proposal did not include additional cooling towers and the assessment is confined to the proposal. Social issues can not be directly considered under the *Environmental Protection Act 1986.* **It is considered that there are no "other" environmental factors**

PRINCIPLES		
Principle	**Relevant Yes/No**	**If yes, Consideration**
1. The precautionary principle *Where there are threats of serious or irreversible damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation.* *In application of this precautionary principle, decisions should be guided by –* *(a) careful evaluation to avoid, where practicable, serious or irreversible damage to the environment; and* *(b) an assessment of the risk-weighted consequences of various options.*		
	Yes	Principle 1 was considered by the EPA in assessing air emission impacts on community health. Although there was no definitive scientific evidence to establish a specific causative link between refinery emissions and reported health incidents, and air quality is predicted to continue to meet relevant health standards, the EPA has noted that incidences of health symptoms have been reported by some individuals. Opinions have been expressed that these may be related to refinery emissions. The EPA has recommended measures to provide confidence that health related incidents do not increase due to the proposal and that a process to care for the interests of persons currently complaining of health impacts is put in place. The impacts of the proposal on air quality are not considered irreversible as they are not residual and can be controlled, as necessary, by changes in throughput and application of new technologies..
2. The principle of intergenerational equity *The present generation should ensure that the health, diversity and productivity of the environment is maintained and enhanced for the benefit of future generations.*		
	Yes	Principal 2 was considered by the EPA in assessing water supply in relation to meeting environmental water requirements and minimization of water use. The EPA also noted that the proposal will not effect the long term storage volume requirement for bauxite residue, although it will increase the rate of accumulation. Alcoa continues to carry out research on reuse options for bauxite residue.
3. The principle of the conservation of biological diversity and ecological integrity *Conservation of biological diversity and ecological integrity should be a fundamental consideration.*		
	No	

4. Principles relating to improved valuation, pricing and incentive mechanisms *(1) Environmental factors should be included in the valuation of assets and services.* *(2) The polluter pays principles – those who generate pollution and waste should bear the cost of containment, avoidance and abatement.* *(3) The users of goods and services should pay prices based on the full life-cycle costs of providing goods and services, including the use of natural resources and assets and the ultimate disposal of any waste.* *(4) Environmental goals, having been established, should be pursued in the most cost effective way, by establishing incentive structure, including market mechanisms, which enable those best placed to maximize benefits and/or minimize costs to develop their own solution and responses to environmental problems.*		
	Yes	Principle 4(2) was considered by the EPA in assessing air emissions and noise. The proponent will bear the cost of installing best practice technology to minimize emissions. The proponent is also funding its own Wagerup Land Management Plan to provide persons living in the designated Areas A and B with assistance to relocate if that is their choice.
5. The principle of waste minimisation *All reasonable and practicable measures should be taken to minimize the generation of waste and its discharge into the environment.*		
	No	Alcoa's existing waste management plans will continue to apply.

Appendix 4

Recommended Environmental Conditions and Proponent's Consolidated Commitments for the 4.7 Mtpa Expansion Proposal

RECOMMENDED CONDITIONS AND PROCEDURES

STATEMENT THAT A REVISED PROPOSAL MAY BE IMPLEMENTED (PURSUANT TO THE PROVISIONS OF THE ENVIRONMENTAL PROTECTION ACT 1986)

WAGERUP ALUMINA REFINERY – PRODUCTION TO A MAXIMUM CAPACITY OF 4.7 MILLION TONNES PER ANNUM AND ASSOCIATED BAUXITE MINING

Proposal: The construction and operation of the Wagerup Alumina Refinery to a maximum production capacity of 4.7 million tonnes per annum and its associated bauxite mining, as documented in Schedule 1 of this Statement.

Proponent: Alcoa World Alumina Australia

Proponent Address: PO Box 252, APPLECROSS WA, 6953

Assessment Numbers: 1527, 1366, 895 and 317

Reports of the Environmental Protection Authority: Bulletins 1215, 1006, 779 and 423

Previous Implementation Statements: Statement Nos. 564, 390 and 95.

The revised proposal may be implemented subject to the following conditions and procedures.

Changes to conditions and procedures of Implementation Statement No. 564

Conditions 4, 7, 8, 9 and 10 of Implementation Statement 390 are deleted.

Condition 6 of Implementation Statement 564 is amended by removing the words "odour", "and any refinery expansion".

Procedure 5 of Implementation Statement 564 is amended by removing the words "odour", "and any refinery expansion" and "3 amenity values of land use affected by any refinery expansion".

1 Implementation

1-1 The proponent shall implement the proposal as documented and described in schedule 1 of this statement and previous Assessment Bulletins, subject to the conditions and procedures of this Implementation Statement and Statements 564 and 390.

2 Proponent Environmental Management Commitments

2-1 The proponent shall fulfil the environmental management commitments contained in schedule 2 of this statement.

3 Proponent Nomination and Contact Details

3-1 The proponent for the time being nominated by the Minister for the Environment under section 38(6) or (7) of the *Environmental Protection Act 1986* is responsible for the implementation of the proposal until such time as the Minister for the Environment has exercised the Minister's power under section 38(7) of the Act to revoke the nomination of that proponent and nominate another person as the proponent for the proposal.

3-2 If the proponent wishes to relinquish the nomination, the proponent shall apply for the transfer of proponent under section 38(6a) and provide the name and address of the person who will assume responsibility for the proposal, together with a letter from that person which states that the proposal will be carried out in accordance with the conditions and procedures of this statement, and documentation on the capability of that person to implement the proposal and fulfil the conditions and procedures.

3-3 The nominated proponent shall notify the Department of Environment of any change of the name and address of the proponent within 30 days of such change.

4 Time limit of approval to commence

4-1 The proponent shall provide evidence to the Department of Environment that the revised proposal has been substantially commenced within five years from the date of this statement or the approval granted in this statement shall lapse and be void.

4-2 The proponent shall make an application for any extension of approval for the substantial commencement of the revised proposal to the Minister for the Environment prior to the expiration date of this statement, which shall demonstrate that:

1. the environmental factors of the proposal reported in Bulletin 1215 have not changed significantly;
2. new, significant, environmental factors have not arisen; and
3. all relevant government authorities and stakeholders have been consulted.

5 Compliance Reporting

5-1 The proponent shall submit compliance reports in accordance with a schedule acceptable to the Department of Environment and with the compliance monitoring guidelines, and shall:

1. describe, or update, the state of implementation of the proposal;
2. provide verifiable evidence of compliance with the conditions, procedures and commitments;
3. review the effectiveness of corrective and preventative actions contained in the environmental management plans and programs;
4. provide verifiable evidence of the fulfilment of requirements specified in the environmental management plans and programs;
5. identify all confirmed non-conformities and non-compliances and describe the related corrective and preventative actions taken; and
6. identify potential non-conformities and non-compliances and provide evidence of how these are being assessed for corrective action.

6 Performance Review

6-1 The proponent shall submit a Performance Review Report every five years after the start of production to the Environmental Protection Authority, which addresses:

1. the major environmental issues associated with implementing the project; the environmental objectives for those issues; the methodologies used to achieve these; and the key indicators of environmental performance measured against those objectives;
2. the level of progress in the achievement of sound environmental performance, including industry benchmarking, and the use of best available technology where practicable;
3. significant improvements gained in environmental management, including the use of external peer reviews;
4. stakeholder and community consultation about environmental performance and the outcomes of that consultation, including a report of any on-going concerns being expressed; and
5. the proposed environmental objectives over the next five years, including improvements in technology and management processes.

7 Decommissioning Plan

7-1 Within two years following publication of this Statement, the proponent shall prepare a Preliminary Decommissioning Plan for approval by the Department of Environment, which describes the framework to ensure that the site is left in an environmentally acceptable condition, and provides:

1. the rationale for the siting and design of plant and infrastructure as relevant to environmental protection;
2. a conceptual description of the final landform at closure;
3. a plan for a care and maintenance phase; and
4. initial plans for the management of noxious materials.

7-2 At least six months prior to the anticipated date of closure, or at a time agreed by the Environmental Protection Authority, the proponent shall submit a Final Decommissioning Plan designed to ensure that the site is left in an environmentally acceptable condition prepared on advice of the Environmental Protection Authority, for approval of the Department of Environment.

The Final Decommissioning Plan shall address:

1. removal or, if appropriate, retention of plant and infrastructure in consultation with relevant stakeholders;
2. rehabilitation of all disturbed areas to a standard suitable for the agreed new land use(s); and
3. identification of contaminated areas, including provision of evidence of notification and proposed management measures to relevant statutory authorities.

7-3 The proponent shall implement the Final Decommissioning Plan required by condition 7-2 until such time as the Minister for the Environment determines, on advice of the Department of Environment, that the proponent's decommissioning responsibilities are complete.

7-4 The proponent shall make the Final Decommissioning Plan required by condition 7-2 publicly available in a manner approved by the Department of Environment.

8 Best Practice Pollution Control Measures to be Applied

8-1 Prior to submitting a Works Approval application (under Part V of the *Environmental Protection Act 1986)* for works included in the revised proposal, as documented and described in Schedule 1, the proponent shall submit a Detailed Design Report demonstrating that the proposed works adopt best practice pollution control measures to minimise emissions from the Refinery, to the requirements of the Minister for the Environment, on the advice of the Environmental Protection Authority. The Detailed Design Report shall set out the base emission rates for major sources for the Refinery and the design emission targets for the expanded works. In particular, the Detailed Design Report shall demonstrate that the design of the expansion works will reasonably achieve the following reductions from base emission rates:

1. at least a 75% reduction in peak and average emission rates of Volatile Organic Compounds (VOCs) and odour from the 25A slurry tank vents;
2. at least a 50% reduction in peak and average emission rates VOCs and odour from clarification tanks – 35A green liquor;
3. reduction to negligible emissions of VOCs and odour from clarification tanks – 35J causticisation;
4. at least a 50% reduction in peak and average emission rates VOCs and odour from cooling towers;
5. reduction to negligible emissions of VOCs and odour from calciner low volume vent emissions (vacuum pumps, Dorrco and Filter Scroll Hoods);
6. the mass of VOCs discharged to the cooling pond shall not increase by more than 50%; and
7. no increase in particulate emissions from the Residue Disposal Area.

8-2 The Detailed Design Report shall address normal operations, shut down and start up, and equipment failure conditions.

Note: The term "base emission rates" means emission rates determined from monitoring since July 2002.

9 Air Dispersion Model Validation

9-1 Prior to submitting a Works Approval application (under Part V of the *Environmental Protection Act 1986)* for works included in the revised proposal, as documented and described in Schedule 1, the proponent shall carry out data acquisition and investigations to further validate the air dispersion model used for the predictions of ground level concentrations in the Environmental Review and Management Program (May 2005). The data acquisition and investigations shall be carried out to the requirements of the Minister for the Environment on advice from the Environmental Protection Authority and shall include:

1. twelve months of meteorological data from an escarpment meteorological station;
2. twelve months of vertical profile temperature and wind velocity measurements using methods acceptable to the Department of Environment;
3. twelve months of meteorological data (wind speed, direction and temperature) from up to two additional meteorological stations located on the coastal plain, using methods and at locations acceptable to the Department of Environment;

4. investigation into the validity of the building wake dispersion scheme used in the air dispersion model, by a suitably qualified modeller;
5. investigation into the validity of modelled multiflue plume rise behaviour, in light of recent findings reported in literature, by a suitably qualified modeller;
6. twelve additional months of base case emission rate data for key sources; and
7. any revised emission rates from the Detailed Design Report referred to in condition 8-1.

9-2 The proponent shall use the results of the data acquisition and investigations referred to in condition 9-1 to validate the performance of the dispersion model and demonstrate no significant increase in ground level concentrations predicted in the Environmental Review and Management Program (May 2005), both in the near field and the far field, up to ten kilometres from the multiflue stacks. This work shall be carried out to the requirements of the Minister for Environment on advice from the Department of Environment.

9-3 In the case that the validation of the dispersion modelling referred to in condition 9-2 does not demonstrate the requirements of condition 9-2, the proponent shall make revisions to the detailed engineering design and repeat the air dispersion modelling to achieve the requirements of condition 9-2.

Note: The "key sources" referred to in condition 9-1 are the liquor burner, calciners, 25A tank vents, 35A tanks, 35J tanks and cooling towers.

10 Operational Performance Verification

10-1 Prior to submitting a Works Approval application (under Part V of the *Environmental Protection Act 1986)* for works included in the revised proposal, as documented and described in Schedule 1, the proponent shall prepare a revised Air Quality Management Plan to the requirements of the Minister for the Environment on advice from the Environmental Protection Authority that includes:
1. a performance verification monitoring program;
2. management procedures to enable the design emission rates referred to in conditions 8-1 and 8-2 to be achieved.

10-2 The proponent shall implement the Air Quality Management Plan referred to in condition 10-1 throughout the commissioning and operational phase of the expanded Refinery to the requirements of the Minister for the Environment on advice from the Environmental Protection Authority.

10-3 The proponent shall make the Air Quality Management Plan referred to in condition 10-1 publicly available to the requirements of the Minister for the Environment on advice from the Environmental Protection Authority.

10-4 In the case that the performance monitoring referred to in condition 10-1 demonstrates an exceedance of design emission rates referred to in conditions 8-1 and 8-2 and the management procedures referred to in condition 10-1 are unable to prevent a continuation of the exceedance, the proponent shall make revisions to operational procedures and/or engineering design to ensure compliance with the design emission rates.

11 Noise

11-1 Prior to issue of any Works Approval (under Part V of the *Environmental Protection Act,1986)* for works included in the revised proposal, as documented and described in Schedule 1, the proponent shall revise the Noise Management Plan submitted in Section 10 of the Wagerup Refinery Unit Three Expansion ERMP (May 2005) to the requirements of the Department of Environment to reasonably demonstrate that the design and construction of the expansion works include all reasonable and practicable measures to control noise emissions. The Plan shall include details of:

1. all significant noise sources, options considered for noise control, noise control measures proposed to be adopted and design target Sound Power Levels;
2. acoustic modelling of noise emission levels in the surrounding environment utilising the design target Sound Power Levels;
3. procedures for verifying that the design target Sound Power Levels have been achieved and total noise emissions from the works meet those predicted in the acoustic modelling undertaken in respect of 2;
4. procedures for approval of noise emissions during construction and commissioning under noise regulation 13; and
5. parties engaged in the design, acoustic modelling and noise verification as covered by 1. to 4.

11-2 The proponent shall make the Noise Management Plan required by condition 11-1 publicly availability in a manner approved by the Department of Environment following approval of the report required by condition 11-1.

11-3 The proponent shall implement the Noise Management Plan required under condition 11.1 to the requirements of the Minister for the Environment on advice from the Environmental Protection Authority

Procedures

1. <u>Independent Design Review Team</u>

The Department of Environment, in consultation with Alcoa World Alumina Australia, shall establish an Independent Design Review Team (IDRT) including specialists in design, construction, commissioning and monitoring of large industrial plants and pollution control equipment. The IDRT shall review the engineering design details for the Wagerup Unit 3 Expansion leading to the Works Approval application to advise the Department of Environment on whether the design meets best practice and is reasonably likely to achieve the emissions performance levels specified in the Environmental Review and Management Program (May 2005).

2. <u>Health Surveys</u>

Within 12 months following publishing of this Statement, the Department of Health will arrange for the conduct of an independent health survey to determine and document the health status of the general population in the Wagerup area. Periodic, follow-up independent health surveys will be undertaken to monitor any health changes in the area following the commissioning of the expanded Refinery.

3. Assessment and Diagnosis of Health Symptoms

Within 12 months following publishing of this Statement, the Department of Health, will arrange for the establishment of an independent process for the assessment and diagnosis of any people in the area who believe that they have health symptoms attributable to emissions from the Wagerup Alumina Refinery.

Notes

1. Where a condition states "on advice of the Environmental Protection Authority", the Environmental Protection Authority will provide that advice to the Department of Environment for the preparation of written notice to the proponent.

2. The Environmental Protection Authority may seek advice from other agencies or organisations, as required, in order to provide its advice to the Department of Environment.

3. The Minister for the Environment will determine any dispute between the proponent and the Environmental Protection Authority or the Department of Environment over the fulfilment of the requirements of the conditions.

4. The proponent is required to apply for a Works Approval and Licence for this project under the provisions of Part V of the *Environmental Protection Act 1986*.

Schedule 1

The Proposal (Assessment No. 1527)

The proponent proposes to expand the Wagerup Alumina Refinery by construction of a third production unit. The production increase to approximately 4.7 million tones per annum alumina is to be achieved by a combination of new equipment and the upgrade of existing equipment to achieve an increase in both capacity and efficiency. As the Wagerup Refinery has been the subject of previous assessments, this represents a revised proposal pursuant to s 45B of the *Environmental Protection Act 1986*.

Although the expansion will result in an increase in the rate of bauxite mining, there is no proposed increase to the approved mining area.

The main characteristics of the expansion proposal are summarised in Table 1 below.

Table 1: Key Proposal Characteristics

Element	Units	Current Refinery	4.7 Mtpa Expansion
Refinery Area			
Refinery footprint	hectares	183	183
Production			
Alumina production	Mtpa	Approximately 2.4	Approximately 4.7
Raw Materials			
Bauxite mining rate	Mtpa	9	16
Caustic Soda (dry)	tpa	141,000	282,000
Lime	tpa	110,000	200,000
Water	MLpa	4,800	9,600
Residue Disposal			
Bauxite residue	Mtpa	4.8	9.6
Main Equipment Components			
Milling		• 3 SAG mills	• Increased milling capacity
Ore stockpiles		• Stockpile reclaimer and conveyor • 2 stockpiles plus one emergency	• New reclaimer and conveyors • New dust suppression and cleaning system for conveyor
Slurry storage		• 4 slurry tanks	• New slurry tanks
Digestion		• Digester banks and flash vessels • Vapour condenser	• Increased digestion capacity • New and upgraded pumps
Evaporation		• Evaporation units • Heat interchange units	• New evaporation units • New heat interchanger
Lime		• 1 lime silo	• Upgrade lime storage and associated equipment
Clarification		• Sand removal units • Washers, thickeners • Filter tanks and presses	• New filter presses • New and upgraded washer facilities • New cyclone system
Residue Area		• Approx. 180 hectares required for drying and storing residue	• Dry stacking area not to exceed 275 hectare drying area • New sand separation • Sand Lake wet sand area not to be increased by more than 50% • No wet stacking area • Oxalate pond not to exceed 1 hectare • Upgrade RDA sprinkler system
Precipitation		• Precipitators and seed filters • Thickeners and liquor tanks • Cooling towers and cyclone clusters	• New precipitators and seed filters • New thickeners and liquor tanks • Additional cooling capacity

Element	Units	Current Refinery	4.7 Mtpa Expansion
			• New cyclone clusters
Oxalate removal		• Decommissioned oxalate kiln	• Oxalate kilns with RTO (regenerative thermal oxidizer)
Liquor Burning		• liquor burner	• Install a RTO
Calciners		• 4 calciner units • 100 metre multiflue for calciners 1, 2, 3.	• Upgrade calciner 3 • 2 new calciners with multiflue • No.4 calciner to new multiflue
Alumina Storage		• 2 alumina storage bins and alumina conveyors	• Additional alumina storage • Upgrade or additional conveyor
Powerhouse		• Turbo-alternators and boilers • Gas turbine with steam generator	• 2 new 270 tonnes per hour boilers with 2 x 35 MW steam turbines
Port Facilities		• Alumina storage and handling facilities • Caustic storage	• Upgraded alumina handling facilities
Water Supply		• Licenced surface water sources	• Increased surface water supply

Abbreviations: Mtpa = million tonnes per annum
tpa = tonnes per annum
MLpa = million litres per annum
MW = megawatts

Schedule 2

Proponent
Environmental Management Commitments

December 2005

WAGERUP ALUMINA REFINERY

PRODUCTION TO A MAXIMUM CAPACITY OF 4.7 MILLION TONNES PER ANNUM AND ASSOCIATED MINING

(Assessment No. 1527)

ALCOA WORLD ALUMINA AUSTRALIA

Proponent's Environmental Management Commitments – December 2005

Wagerup Alumina Refinery Production to a Maximum Capacity of 4.7 Million Tonnes Per Annum and Associated Mining (Assessment No. 1527*)*

Note: The term "commitment" as used in this schedule includes the entire row of the table and its six separate parts as follows:

- a commitment number;
- a commitment topic;
- the objective of the commitment;
- the 'action' to be undertaken by the proponent;
- the timing requirements of the commitment; and
- the body/agency to provide technical advice to the Department of Environment.

No.	Topic	Objective	Action	Timing	Advice
1	Separation Distance	To provide residents near to the Refinery with an option to relocate.	Continue to support and implement the Wagerup Land Management Strategy (January 2002) as enhanced by correspondence with individual residents in Area A and B (letters dated 24 February 2005 and 21 April 2005)	Ongoing	

Appendix 5

Recommended Environmental Conditions
for the
Co-generation Plant Proposal

RECOMMENDED CONDITIONS AND PROCEDURES

STATEMENT THAT A PROPOSAL MAY BE IMPLEMENTED (PURSUANT TO THE PROVISIONS OF THE ENVIRONMENTAL PROTECTION ACT 1986)

WAGERUP GAS-FIRED CO-GENERATION FACILITY

Proposal: The construction and operation of a natural gas fired co-generation facility at Wagerup Alumina Refinery, as documented in Schedule 1 of this Statement.

Proponent: Alcoa World Alumina Australia

Proponent Address: PO Box 252, APPLECROSS WA, 6953

Assessment Number: 1527

Reports of the Environmental Protection Authority: Bulletin 1215

1 Implementation

1-1 The proponent shall implement the proposal as documented and described in schedule 1 of this statement, subject to the conditions and procedures of this Statement.

2 Proponent Environmental Management Commitments

2-1 The proponent shall fulfil the environmental management commitments contained in schedule 2 of this statement.

3 Proponent Nomination and Contact Details

3-1 The proponent for the time being nominated by the Minister for the Environment under section 38(6) or (7) of the *Environmental Protection Act 1986* is responsible for the implementation of the proposal until such time as the Minister for the Environment has exercised the Minister's power under section 38(7) of the Act to revoke the nomination of that proponent and nominate another person as the proponent for the proposal.

3-2 If the proponent wishes to relinquish the nomination, the proponent shall apply for the transfer of proponent under section 38(6a) and provide the name and address of the person who will assume responsibility for the proposal, together with a letter from that person which states that the proposal will be carried out in accordance with the conditions and procedures of this statement, and documentation on the capability of that person to implement the proposal and fulfil the conditions and procedures.

3-3 The nominated proponent shall notify the Department of Environment of any change of the name and address of the proponent within 30 days of such change.

4 Time limit of approval to commence

4-1 The proponent shall provide evidence to the Department of Environment that the revised proposal has been substantially commenced within five years from the date of this statement or the approval granted in this statement shall lapse and be void.

4-2 The proponent shall make an application for any extension of approval for the substantial commencement of the revised proposal to the Minister for the Environment prior to the expiration date of this statement, which shall demonstrate that:

1. the environmental factors of the proposal reported in Bulletin 1215 have not changed significantly;
2. new, significant, environmental factors have not arisen; and
3. all relevant government authorities and stakeholders have been consulted.

5 Compliance Reporting

5-1 The proponent shall submit compliance reports in accordance with a schedule acceptable to the Department of Environment and with the compliance monitoring guidelines, and shall:

1. describe, or update, the state of implementation of the proposal;
2. provide verifiable evidence of compliance with the conditions, procedures and commitments;
3. review the effectiveness of corrective and preventative actions contained in the environmental management plans and programs;
4. provide verifiable evidence of the fulfilment of requirements specified in the environmental management plans and programs;
5. identify all confirmed non-conformities and non-compliances and describe the related corrective and preventative actions taken; and
6. identify potential non-conformities and non-compliances and provide evidence of how these are being assessed for corrective action.

6 Performance Review

6-1 The proponent shall submit a Performance Review Report every five years after the start of production to the Environmental Protection Authority, which addresses:

1. the major environmental issues associated with implementing the project; the environmental objectives for those issues; the methodologies used to achieve these; and the key indicators of environmental performance measured against those objectives;
2. the level of progress in the achievement of sound environmental performance, including industry benchmarking, and the use of best available technology where practicable;
3. significant improvements gained in environmental management, including the use of external peer reviews;
4. stakeholder and community consultation about environmental performance and the outcomes of that consultation, including a report of any on-going concerns being expressed; and
5. the proposed environmental objectives over the next five years, including improvements in technology and management processes.

7 Stack Emissions

7-1 Prior to construction of the co-generation facility, the proponent shall prepare a Stack Emissions Management Plan to ensure that best practice technologies are used to minimise emissions from the co-generation facility, to the requirements of the Minister for the Environment on advice from the Environmental Protection Authority. The Plan shall address:

1. specific measures to minimise stack emissions and ground level concentrations of oxides of nitrogen (NO_x).

7-2 The proponent shall implement the Stack Emissions Management Plan required by condition 7-1.

Notes

1. Where a condition states "on advice of the Environmental Protection Authority", the Environmental Protection Authority will provide that advice to the Department of Environment for the preparation of written notice to the proponent.

2. The Environmental Protection Authority may seek advice from other agencies or organisations, as required, in order to provide its advice to the Department of Environment.

3. The Minister for the Environment will determine any dispute between the proponent and the Environmental Protection Authority or the Department of Environment over the fulfilment of the requirements of the conditions.

4. The proponent is required to apply for a Works Approval and Licence for this project under the provisions of Part V of the *Environmental Protection Act 1986*.

Schedule 1

The Proposal (Assessment No. 1527)

Alcoa World Alumina Australia proposes to construct and operate a natural gas fired cogeneration facility, with two gas turbine generators each with a nominal generation capacity of 140 megawatts electrical output and equipped with heat recovery steam generators, on a site located at the Wagerup Alumina Refinery.

The main characteristics of the expansion proposal are summarised in Table 1 below.

Table 1: Key Proposal Characteristics

Element	Units	Cogeneration Plant Proposal
Gas turbines	MW	2 x 140 MW-capacity gas turbine generators
Steam generators	tph-	2 x 430 tph heat recovery steam generators (HRSG)

Abbreviations: MW = megawatts
tph = tonnes per hour

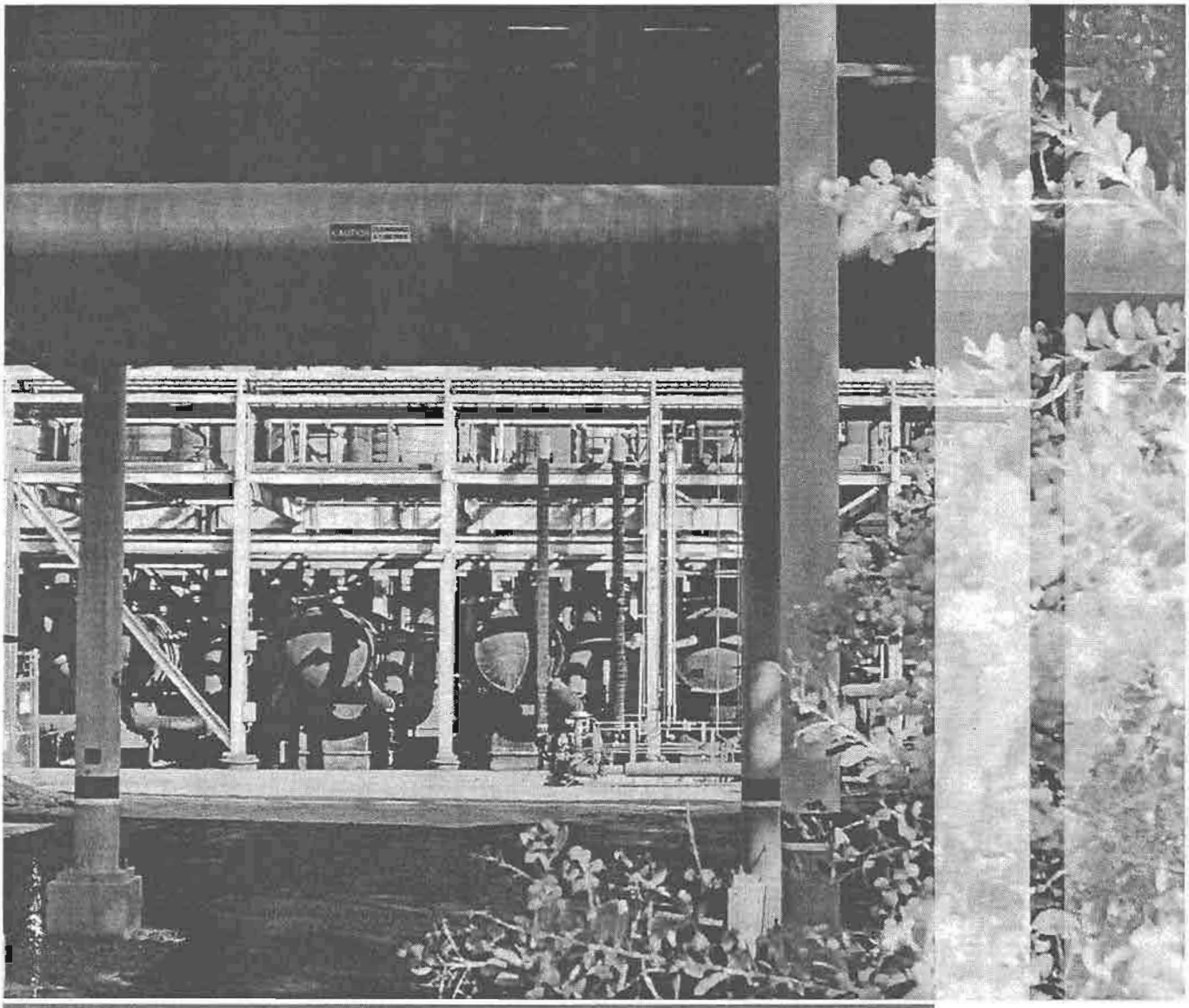
Appendix 6

Wagerup Alumina Refinery Interim Environmental Improvement Plan - CSIRO Wagerup Air Quality Action Plan 2005/06

wagerup alumina refinery

INTERIM ENVIRONMENTAL IMPROVEMENT PLAN 2005/06

12 August 2005



ALCOA

australia's aluminium

CSIRO Wagerup Air Quality Action Plan for 2005/06

	CSIRO Recommendation	Action	Target Date
1	Emission Database	Completed. Awaiting Review by TAP.	2005
2	Cooling Towers	Completed. Awaiting Review by TAP.	2005
3	Time Series Database	Data base established for CSIRO Modelling, requires process for updating to ensure currency and relevance for future use.	2005
4	In-Stack Acetaldehyde Measurement	Trial new Fast Loop OPSIS technology on Calciner Stack.	2005/06
5	Dust and Rainfall Studies	Research program scoped and being reviewed by TAP for implementation 2005/06.	2005/06
6	Analysis of RDA Filter Samples	Completed. Awaiting Review by TAP.	2005
7	Residue Area Emissions	Completed. Awaiting Review by TAP.	2005
8	Dust Control Procedures	Completed. Awaiting Review by TAP.	2005
9	Escarpment Weather Station	Weather station installed and commissioned. Currently collecting data for review.	2005/06
10	Complaints Data Analysis	Completed. Awaiting Review by TAP.	2005
11	Upper Air Meteorological Measurements	Use of LIDAR and/or SODAR to gather more data on upper air meteorological conditions, to develop a better understanding of the complex air flows that prevail over the Wagerup region and to facilitate more accurate modelling of plume grounding under various meteorological conditions.	2005/06
12	Methylene Chloride	Completed. Awaiting Review by TAP.	2005
13	Short Term Variations in Emissions	CCWA completed a six week field study using a portable HAPSITE Gas Chromatograph Mass Spectrometer (GC/MS). TAPM Modelling completed by CSIRO. Determine capabilities and requirements to model shorter time intervals.	2005/06
14	Chemical Fingerprinting	Trial the use of the Proton Transfer Reaction Mass Spectrometer (PTRMS) to determine capability of measuring and sourcing ambient air contaminants.	2005/06
15	Short Term Events Detection and Characterisation	Long Path OPSIS has been commissioned at Boundary Rd. Data requires continued collection, interpretation and reporting.	2005/06
16	Dispersion Modelling	Completed. Awaiting Review by TAP.	2005
17	Meandering Plume Model	TAPM Modelling completed by CSIRO. Determine capabilities and requirements to model shorter time intervals.	2005/06
18	Design of Future Air Quality Studies	TAP to independently review the Action Plan and research programs to suggest future directions of air quality research.	2005/06

Appendix 7

Submission from the Independent (Non-Government, Non-Industry) Members of the Wagerup Medical Practitioners' Forum

Professor C. D'Arcy J. Holman
CHAIR IN POPULATION HEALTH
HEAD OF SCHOOL

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CRN 214736
51

Environmental Protection Authority
PO Box K822
Perth. WA 6842

Dear Sir or Madam

Submission on ERMP: Wagerup Refinery Unit Three Expansion

The independent members of the Wagerup Medical Practitioners' Forum are those members who are independent from industry and government, and who have maintained an active participation in the Forum since it was established at the request of the WA Department of Health in 2001.

As the independent members of the Forum, we are pleased to respond to your invitation to comment on the proposed Wagerup Refinery Unit Three Expansion through the ERMP process, and attach our submission for this purpose.

Yours faithfully
The Independent Members of the Wagerup Medical Practitioners' Forum

Professor D'Arcy Holman
Chairperson

Dr Brian Galton-Fenzi

Professor Andrew Harper

ABSENT (FROM ABILITY TO SIGN)
Dr Michael Phillips

Dr Moira Somers

23 June 2005

Environmental Review and Management Program

Wagerup Refinery Unit Three Expansion

Submission by the Independent Members of the Wagerup Medical Practitioners' Forum

We represent the common view of the five independent members of the Wagerup Medical Practitioners' Forum, who have examined the effects on health of the Wagerup Alumina Refinery since 2001 when the Forum began. Professionally, we consist of a professor of public health, three experts in occupational and environmental health and a general practitioner with first-hand experience in treating patients from the refinery surrounds.

The following are key areas of consideration that provide a contextual background to the development of our position on the proposal to expand the Wagerup refinery to almost double its existing alumina production capacity:

- The evidence arising from earlier investigation and assessment clearly indicates that the geography and topography of the area was never suitable for the placement of an aluminium refinery.
- The history of workers at the existing refinery, in our professional opinion, shows that some workers have suffered acute and chronic adverse health consequences as the result of working at the refinery.
- The available evidence indicates that some of the neighbouring community members, including the people of the township of Yarloop, in our professional opinion, have suffered acute and chronic adverse health consequences as a result of the close proximity of the existing refinery.
- Alcoa was initially slow to respond to these health problems, and, while Alcoa's responsiveness has improved, there has been insufficient duration or consistency of an improved performance on this issue to give us confidence that Alcoa has accepted ownership of the problems. For example:

    a. When the company's response has been to measure exposure, or, more accurately, to measure an aspect of exposure such as 'odour', 'noise' or levels of particular air pollutants, the measurement has been used to advocate for refinery activity as though measurement itself were an intervention to reduce adverse health consequences.
    b. In the cycle of community agitation, followed by engineering measures to reduce emissions, Alcoa has used the engineering changes to justify an increase in production without evidence of improved health outcomes.
    c. The initiative to address new illness among workers and the community has been taken by workers and the community, rather than by Alcoa.

- There has been no formal health assessment of residents to document current health or any perceived change in health status since the engineering modifications, despite the intention to do so.
- Following the installation of the last set of engineering control measures, including the increased height of the stack, the Department of Health's community nurse in the Town of Yarloop continued to receive health complaints.

- The local community has experienced a great deal of outrage and disruption as the result of health and social issues caused by the impact of the refinery.
- Despite a long history of causing adverse health effects, emission levels of pollutants from the refinery have been measured consistently below threshold levels of public health concern for individual pollutants. Thus the exact cause of the health problems in terms of a single chemical or a mixture of chemicals remains unknown.

Alcoa's expansion proposal gives us no basis on which to assure the local community that their health will not be further compromised by emissions from the refinery. Our reasons for this conclusion are as follows:

- There are considerable uncertainties surrounding this public health problem, including the lack of identification of a causal agent and the complex ecological system of environmental, biological and psychosocial factors that are likely to be at play in producing health effects. No-one can model with sufficient certainty what the short and longer-term health consequences of expansion would be. The most relevant point of certainty is that the history to date has been one of adverse health effects for community members.
- There is no new information presented in the proposal of a nature that would give us confidence in the safety of an expansion. The key arguments appear to be the ones that have not to date been helpful in resolving the problems: that emissions will be well within threshold limits; that further engineering controls will be applied; and that additional measurements will be made on pollutants and the health of the community.
- There is no proposal to increase the buffer zone, which will remain at a very small 1.2km, compared with the buffers of 6-8km around the Pinjarra and Worsley refineries. These refineries do not appear to have caused the same intensity of health problems.
- There is no proposal to provide local residents with genuine choices, such that those residents affected adversely by the proposed expansion would be able to leave the area freely, without economic loss or hardship.
- We are concerned that Alcoa's existing land policy has resulted in an increasing number of nearby tenants for whom Alcoa is the landlord. The tenant of a landlord, who is also a neighbouring producer of noxious emissions, may have a reduced freedom to voice concerns about health problems for fear of eviction.
- We note that in considering alternatives to expansion of Wagerup, Alcoa identifies (on p.43) that establishing a new refinery would face the difficulty of finding a site with sufficient separation distances from neighbouring properties to avoid potential conflicts between industry and other land uses. Given that the existing buffer is only 1.2km, it is difficult to see how the existing site meets this criterion of a 'sufficient separation distance'.

The economic benefits of the proposed expansion of the refinery to Western Australia, which are clearly of considerable magnitude, must be balanced against two counter-considerations:

- The short and long term costs of any worsening of health problems and social dysfunction in the local community.
- The ethics (in terms of social justice) of making a decision that could lead to the local community carrying most of the burden of potential health and social costs so that Alcoa and the State can gain economic benefits.

In summary, we do not support the proposal to expand the Wagerup refinery in the existing circumstance of an inadequate buffer zone. Our judgment is that, in the face of much

uncertainty, the problematic history of the relationship between the refinery and the local community is the most reliable guide to what the future would hold if the refinery was to expand. On this basis we consider that the risk of further compromising the health and social functioning of the local community to be too high; and the trade off of this risk against the broader economic benefits to be unjust.

ENDS

Appendix 8

Wagerup Refinery Location Map

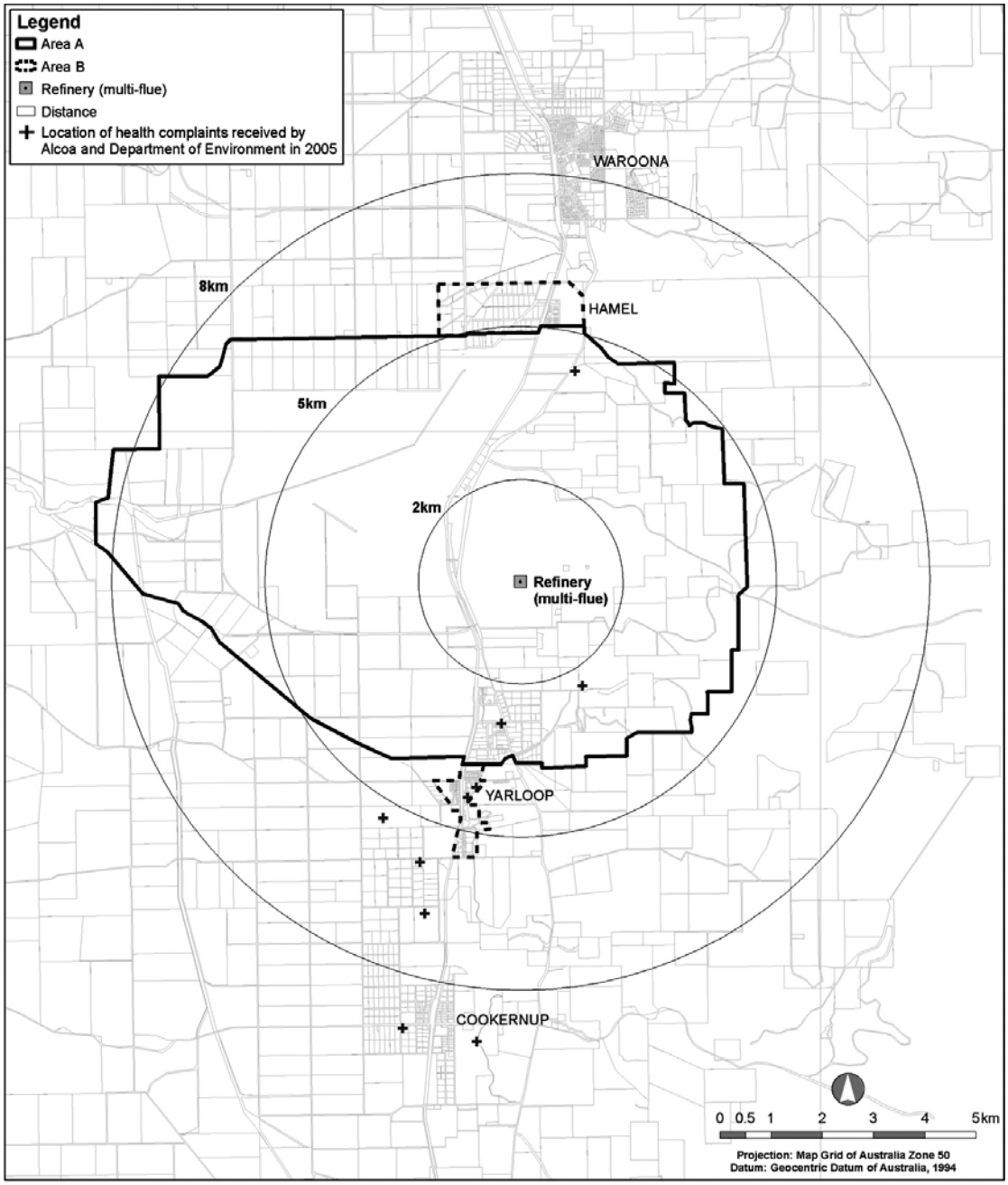

Figure 1 Wagerup Refinery Location Map

Appendix 9

Summary of Submissions and
Proponent's Response to Submissions

(The summary of submissions is integrated with the proponent's response to submissions and is attached in electronic format as a CD.)