

# **Worsley Alumina - Efficiency and Growth Increase of Existing Operations to 4.4Mtpa Alumina Production**

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**Worsley Alumina Pty Ltd**

**Report and recommendations  
of the Environmental Protection Authority**

**Environmental Protection Authority  
Perth, Western Australia  
Bulletin 1209  
November 2005**

### **Environmental Impact Assessment Process Timelines**

<b>Date</b>	<b>Progress stages</b>	<b>Time (weeks)</b>
<b>21/06/04</b>	<b>Level of assessment set (following any appeals upheld)</b>	
<b>23/05/05</b>	<b>Proponent document released for public comment</b>	<b>45</b>
<b>01/08/05</b>	<b>Public comment period closed</b>	<b>10</b>
<b>05/09/05</b>	<b>Final proponent response to the issues raised</b>	<b>5</b>
<b>28/11/05</b>	<b>EPA report to the Minister for the Environment</b>	<b>12</b>

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## Summary and recommendations

Worsley Alumina Pty Ltd (Worsley) proposes to upgrade the Worsley refinery in order to increase production to 4.4 million tonnes per annum (Mtpa). Worsley has approval under Part IV of the *Environmental Protection Act, 1986* for production of 3.7Mtpa, and the refinery currently operates at 3.25Mtpa. This report provides the Environmental Protection Authority's (EPA's) advice and recommendations to the Minister for the Environment on the environmental factors relevant to the proposal.

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.

The EPA is also required to have regard for the principles set out in Section 4A of the *Environmental Protection Act, 1986*.

### Relevant environmental factors and principles

The EPA decided that the following environmental factors relevant to the proposal required detailed evaluation in the report:

- (a) Conservation of biodiversity;
- (b) Surface water and groundwater;
- (c) Air quality;
- (d) Greenhouse gases; and
- (e) Noise.

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

- (a) The precautionary principle;
- (b) The principle of intergenerational equity;
- (c) The principle of the conservation of biological diversity and ecological integrity;
- (d) Principles relating to improved valuation, pricing and incentive mechanisms; and
- (e) The principle of waste minimisation.

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

### Conclusion

The EPA has considered the proposal by Worsley Alumina Pty Ltd to upgrade the Worsley refinery in order to increase production to 4.4Mtpa.

The EPA notes that none of the proposed mining envelopes are in areas which are proposed to be reserved for conservation. Notwithstanding this, the EPA considers that the proposed clearing and mining has potential to have significant impact on the environmental values of the State Forest if not planned, investigated, managed, and rehabilitated to a very high standard.

The EPA notes the results of the flora and fauna surveys that have been undertaken to date for the proposed expansion. However, the EPA considers that there is a need for further comprehensive investigations to be undertaken in order to establish a better understanding of the biodiversity of the areas within and in proximity to the proposed new mining areas. The EPA has recommended a condition (Condition 6 in Appendix 4) requiring the proponent to undertake comprehensive biodiversity related investigations which focus on the areas within and in proximity to the proposed new mining areas, and to prepare a biodiversity investigations report.

The EPA considers that there are areas within which mining or transport corridor construction activities associated with the proposed expansion should not be permitted in order to protect their biodiversity values. To safeguard these areas, and any others identified by the biodiversity investigations, the EPA has recommended that a condition (Condition 7 in Appendix 4) be imposed on the proponent preventing it from undertaking any mining or transport corridor construction activities that would result in the direct or indirect disturbance of heathland, significant vegetation complexes, threatened ecological communities, granite outcrops, significant populations of DRF, populations of Threatened Fauna, stream zones, and the habitat of Threatened or Priority Fauna.

The EPA has also recommended a condition (Condition 8 in Appendix 4) requiring the proponent to prepare transport corridor route plans which show the route and area of disturbance for each proposed transport corridor. The transport corridor route plans will need to outline how the selected route complies with the requirements of the biodiversity investigations report and recommended Condition 7.

As part of the Agreement Act, Worsley is required to undertake long-term planning and submit a rolling Ten Year Mine Plan which includes details of long-term exploration and mining plans. Consistent with this, the EPA has recommended a condition (Condition 9 in Appendix 4) requiring the proponent to prepare a bauxite mining plan to demonstrate how the requirements of the biodiversity investigations have been addressed for each specific area that will be subject to mining or transport corridor construction activities.

The EPA has recommended a condition (Condition 10 in Appendix 4) requiring the proponent to prepare a rehabilitation plan which will ensure that the planning and implementation of rehabilitation is undertaken in a manner consistent with industry best practice, and that rehabilitated areas will ultimately develop sustainable systems compatible with surrounding areas.

In line with the 10 year mine planning, the EPA considers this provides adequate planning and time for Worsley to undertake the detailed salinity and water resource management assessments necessary prior to commencing clearing in any mine area. This includes development of predictive tools to estimate the extent of water table rise

and any impacts on salinity. The water resource management plan proposed by Worsley should include upper-limit criteria for salinity which must be demonstrated to be achievable through the modelling and other assessment. These criteria should relate to both water use and protection of stream ecosystem.

The EPA notes that the mining extension area covers a small area of a number of public drinking water catchments. Close consultation will need to be maintained with the Water and Rivers Commission and the Water Corporation on the detailed salinity and water resources assessments in these areas. The assessments will need to demonstrate that there is negligible risk of adverse water quality impacts in these areas, prior to mining being allowed. Particular consideration also needs to be given to rehabilitation of any areas mined in the drinking water catchments to manage long-term stream flow rates.

The EPA has recommended a condition (Condition 11 in Appendix 4) requiring the proponent to not carry out any ground disturbing activities in areas proclaimed as water reserves or catchment areas under the *Metropolitan Water Supply, Sewerage, and Drainage Act, 1909*, or the *Country Areas Water Supply Act, 1947*, prior to the preparation of a water resource management plan for mining (in accordance with Commitment No. 8 in this report). The water resource management plan will need to demonstrate that the activities are likely to have negligible impact on the quality of water supplies from the catchment.

The EPA considers that the water resource management plan for the refinery that the proponent has committed to prepare and implement, together with the surface water, groundwater, and underdrainage monitoring program that is maintained by the proponent under the requirements of the existing environmental licence conditions and the *Alumina Refinery (Worsley) Agreement Act, 1973*, will adequately address water use within the refinery and the management of surface water and groundwater.

The refinery will use low NO<sub>x</sub> burners, flue gas desulphurisation, and baghouses to minimise NO<sub>x</sub>, SO<sub>2</sub>, and particulate emissions respectively. The EPA considers that this demonstrates the implementation of best practicable technology by the proponent in relation to minimising the discharge of atmospheric emissions.

Air dispersion modelling indicates that cumulative NO<sub>x</sub>, SO<sub>2</sub>, and ozone ground level concentrations will not exceed the relevant NEPM standards. Maximum 24-hour average PM<sub>10</sub> ground level concentrations due to the refinery in isolation are predicted to be well below the NEPM standard at all receptors. Air toxics are also predicted to be low.

The proposed expansion will not require an increase in the bauxite residue disposal area (BRDA) footprint. Although fugitive particulate emissions from the BRDA's were not included in the air dispersion modelling that was undertaken for the ERMP document, additional cumulative modelling that was subsequently undertaken indicates that the proposed expanded refinery and the BRDA's do not significantly contribute to predicted exceedances of the 24-hour PM<sub>10</sub> and PM<sub>2.5</sub> NEPM standards at a number of sensitive receptors. The predicted exceedances are predominantly due to emissions from the existing power stations in the Collie area.

The EPA notes that a thermal oxidiser has been installed on the liquor burner and that odorous emissions from this source are now expected to be negligible. Odour modelling that was undertaken for the ERMP document did not include emissions from large area sources such as the BRDA's and the refinery catchment lake. However, the EPA has recommended a condition requiring the proponent to prepare and implement an air quality management plan that will include measures to adequately address the issue of odour management. The condition will include:

- an air quality improvement plan addressing priority areas including VOC emissions from the calciner;
- a field odour assessment study;
- an assessment of odour from the refinery catchment lake; and
- an emissions monitoring program with emphasis on odour emissions from significant point and area sources.

The EPA notes that the health risk assessment (HRA) has concluded that there is a good degree of confidence that emissions from the refinery are very unlikely to cause direct acute or chronic health effects on the surrounding population, and that the Department of Health concurs with this conclusion. The HRA did not consider the impact of fugitive particulate emissions from the BRDA's. However, as part of the proponent's response to submissions, acute hazard indices have been recalculated in order to take particulate emissions from the BRDA's into consideration. While the revised hazard indices exceed the target acute hazard index determined in the HRA at a number of receptors, the EPA notes that it is due to a number of conservative assumptions in the air dispersion modelling and related calculations, such as the inclusion of the proposed Collie B Power Station which is now unlikely to be built in the short to medium term, and emissions from the Muja A & B power stations which are scheduled to be decommissioned in 2007. Overall, the EPA considers that there still remains a good degree of confidence that the proposed expansion is unlikely to cause direct acute or chronic health effects on the surrounding population.

The energy efficiency of the proponent's operations following the expansion is estimated to be 10,832MJ/t of alumina, which is about 7% less than the world weighted average of 11,644MJ/t of alumina. The proposed expansion will include a coal-fired cogeneration facility that will generate about 700,000tpa more greenhouse gases than an alternative gas turbine cogeneration facility that was recently assessed by the EPA. While the EPA considers that a gas turbine cogeneration facility would represent the least greenhouse intensive means of meeting the required demand for additional process steam and electricity, and thus constitute best practice, the EPA is satisfied that the proposed coal-fired cogeneration facility is still more efficient than other alternative means of separately generating steam and electricity.

The EPA notes that noise modelling for the proposed refinery expansion predicts that noise levels at the nearest residences will comply with the assigned noise levels under the *Environmental Protection (Noise) Regulations, 1997*. Modelling also indicates that noise emissions from the existing conveyor will comply with the Agreement Act following the expansion, and that no noise sensitive premises are currently located within the predicted 35dB(A) noise contour of the proposed new conveyor system.

Mining activities may potentially impact on the noise amenity of a small number of premises that are located near the proposed new mining areas of Hotham North Extension, Central, and Brookton. However, the EPA considers that the proponent's proposed noise management measures are adequate in terms of ensuring that any impact on nearby residents will be minimised.

Cumulative noise levels are predicted to rise in the vicinity of the Worsley-Brunswick, Collie-Worsley, and Brunswick-Bunbury railway lines as a result of the increased number of rail movements that would be required for Worsley's proposed expansion. A review of the ERMP noise assessment found that the increase in noise during the day due to extra train movements for Worsley's expansion was unlikely to be significant. However, the increase during night-time may be significant between Worsley Siding to Brunswick Junction and Brunswick to Bunbury. The review determined that it would be useful to obtain additional information on maximum noise levels and how frequently they occur during night-time for the different sections as sleep disturbance may possibly become an issue with the proposed expansion. The review also determined that a more detailed analysis is required to examine the distance to residences along the length of the railway and to consider the impact of other projects and the changing conditions along the track, including topography and train operation (notch settings, length, and locomotive type etc).

The EPA recognises that there are other users of the existing railways which also contribute to cumulative noise levels. The EPA considers that it is beyond the proponent's ability to manage cumulative noise levels associated with rail movements along the Worsley-Brunswick, Collie-Worsley, and Brunswick-Bunbury railway lines. The EPA considers that an alternative approach to managing cumulative rail transportation noise levels is required. The EPA provides further advice on this matter in Section 5 of this report.

The EPA has therefore concluded that it is unlikely that the EPA's objectives would be compromised, provided there is satisfactory implementation by the proponent of their commitments and the recommended conditions set out in Appendix 4, and summarized in Section 4.

## **Recommendations**

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

1. That the Minister notes that the proposal being assessed is the upgrade of the Worsley refinery in order to increase production to 4.4Mtpa;
2. That the Minister considers the report on the relevant environmental factors and principles as set out in Section 3;
3. That the Minister notes that the EPA has concluded that it is unlikely that the EPA's objectives would be compromised, provided there is satisfactory implementation by the proponent of the recommended conditions set out in Appendix 4, and summarised in Section 4, including the proponent's commitments; and
4. That the Minister imposes the conditions and procedures recommended in Appendix 4 of this report.

## **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 Worsley Alumina Pty Ltd to upgrade the Worsley refinery in order to increase production to 4.4Mtpa is approved for implementation. These conditions are presented in Appendix 4. Matters addressed in the conditions include the following:

- (a) that the proponent shall fulfil the commitments in the Consolidated Commitments statement set out as an attachment to the recommended conditions in Appendix 4;
- (b) compliance audit and performance reviews;
- (c) preparation and implementation of biodiversity investigations and a biodiversity investigations report;
- (d) the protection of biodiversity in environmentally sensitive areas, including those identified in the biodiversity investigations;
- (e) preparation and implementation of transport corridor route plans;
- (f) preparation and implementation of bauxite mining plans;
- (g) preparation and implementation of a rehabilitation plan;
- (h) preparation and implementation of a water resource management plan;
- (i) preparation and implementation of a greenhouse gas emissions management plan;
- (j) preparation and implementation of an air quality management plan; and
- (k) preparation and implementation of decommissioning plans.



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# 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 proposal by Worsley Alumina Pty Ltd, to upgrade the Worsley refinery in order to increase production to 4.4 million tonnes per annum (Mtpa).

The proposal was referred to the EPA on 3 June 2004, and on 21 June 2004 the level of assessment was set at Environmental Review and Management Programme (ERMP) under Section 38 of the *Environmental Protection Act, 1986*. The ERMP document was made available for a public review period of 10 weeks commencing on 23 May 2005 and ending on 1 August 2005.

The EPA's decision to assess the proposal at the level of ERMP was based on five main environmental factors, namely conservation of biodiversity, surface water and groundwater, air quality, greenhouse gases, and noise.

The proposal was determined to be a controlled action under the *Environmental Protection and Biodiversity Conservation Act, 1999* (EPBC Act) in regard to listed threatened species and communities, and listed migratory species. The EPA is undertaking the environmental impact assessment of the proposal under the bilateral agreement between the Commonwealth and Western Australian Governments.

Further details of the proposal are presented in Section 2 of this report. Section 3 discusses the environmental factors and principles relevant to the proposal. The conditions and commitments to which the proposal should be subject, if the Minister determines that it may be implemented, are set out in Section 4. Section 5 provides other advice by the EPA, Section 6 presents the EPA's conclusions and Section 7, the EPA's recommendations. Appendix 5 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 proposal

Worsley Alumina Pty Ltd proposes to upgrade the Worsley refinery in order to increase production to 4.4Mtpa. The proposed production rate will require an increase in the rate of mining from 13.2Mtpa (dry) to approximately 16.5Mtpa (dry). In the long term, mining is proposed to extend into additional areas to those currently approved. The proposal will result in an increase in annual ground disturbance and rehabilitation from about 140 hectares per annum (ha/a) to about 240ha/a, situated in cleared farmland, remnant vegetation on farmland, and within areas of State Forest.

The currently approved mining envelope is referred to as the Primary Bauxite Area (PBA). The PBA comprises the Saddleback, Marradong and Hotham North mining envelopes as shown in Figure 1. Currently mining only occurs within the Saddleback mining envelope. Mined bauxite is crushed in primary and secondary crushers at the

Saddleback mine site and transported by the overland bauxite conveyor to the refinery (Figure 2). Existing environmental approval allows extension of the existing overland bauxite conveyor from the Saddleback mining envelope to the Marradong and Hotham North mining envelopes.

The proposal is to expand the mining area to include the East Quindanning, Morgans, Hotham North Extension, Central and Brookton envelopes as shown in Figure 2. The total area of the proposed new mining envelopes is 75,016 hectares of which approximately 21% (15,950 hectares) has been designated as bauxite resource. The area delineated as bauxite resource that is within the forested area is 12,803 hectares. Additional exploration and close-spaced drilling is required to determine the economic “proven” bauxite reserves in order to construct a detailed mine plan that will determine the actual areas and extent of clearing.

The proposed expansion of mining activities will require the installation of three additional primary crushers within the proposed mining envelopes and relocation within mining areas as bauxite mining is completed. The secondary crusher will remain at the Saddleback location but an additional crushed ore stockpile will be required to provide extra surge material to feed the overland bauxite conveyor.

The proposal includes the following additional conveyors (Figure 2):

- 34km conveyor extension from the Hotham North mining envelope which will cross both the Albany Highway and the Wandering-North Bannister Road;
- 16km spur from the south east of the Central mining envelope to the Luptons mining envelope; and
- 28km extension from the Central mining envelope to the Brookton mining envelope.

Indicative mine planning for the East Quindanning and Morgan mining envelopes to the south of the current mining operation has not been completed at this stage. However, bauxite transport options will include overland bauxite conveyor spurs in combination with haul truck transport.

The proposal includes the following upgrades to the refinery:

- an increase in bauxite feed and flow through the digestion;
- an expansion of separation and bauxite residue washing and filtration facilities;
- a new precipitation train and seed thickener;
- a new hydrate filtration building and an additional gas fired calciner; and
- a coal-fired cogeneration facility that will produce 350 tonnes of steam per hour (equivalent to 204 megawatts) and 35 megawatts of electrical power. [Note - The EPA has assessed an alternative gas turbine cogeneration facility for the proposed expansion (EPA, 2005)].

The proposal does not include any change to the footprint of the BRDA's. However, the deposition rate will increase from approximately 11.8Mtpa to 16Mtpa.

The main characteristics of the proposal are summarised in Table 1 below. A detailed description of the proposal is provided in Chapter 1 - Section 4 of the ERMP document (Strategen, 2005).

**Table 1: Summary of key proposal characteristics**

<b>Element</b>	<b>Description</b>
<b>Bauxite-Alumina Project</b>	
Alumina Production	4.4Mtpa.
Greenhouse gases	3.7Mtpa of CO <sub>2-e</sub> .
<b>Bauxite Mining</b>	
Mining areas	Refer to Figure 1.
Mining rate	Approximately 16.5Mtpa (dry).
Additional area of ground disturbance	Up to approximately 16,000ha.
Water supply sources	Groundwater and surface water in the vicinity of mining areas.
Water usage	Additional 170ML/a.
Crushing plant	3 additional primary crushers.
<b>Bauxite transport</b>	
Existing cable belt conveyor	
Capacity	Increase to 3,200tpa.
Operation	Up to 140 hours per week (unchanged).
New transport	Conventional idler-type conveyors and/or truck transport.
<b>Worsley Refinery</b>	
Refinery lease area	2,500ha (unchanged).
Operation	24 hours per day 365 days per year (unchanged).
Bauxite stockpiles	Increase by approximately 0.5Mt.
Milling and digestion plant	1 additional mill, 1 additional desilication tank and 8 new slurry heaters.
Separation	Extension of residue washing tanks and expansion of capacity of causticiser circuit.
Precipitation	1 additional precipitation train, 1 additional seed thickener.
Calcination	1 additional gas-fired calciner with baghouse and a new hydrate filtration building.
Liquor purification	Liquor burning and emission control system as for current production.
Power and steam raising	Addition of a coal-fired cogeneration facility with baghouse designed to produce 350 tonnes of steam per hour (equivalent to 204MW) and 35MW of electrical power.
Bauxite Residue Disposal Areas	Increase deposition rate from approximately 11.8Mtpa to 16Mtpa. No change to footprint of BRDA's.
Water supply source	Normally a freshwater lake located on the Augustus River (No change).
Raw water usage (average)	Additional 0.5GL/a.
<b>Air emissions</b>	
Sulphur dioxide (SO <sub>2</sub> )	Up to approximately 12,220tpa.
Nitrogen oxides (NO <sub>x</sub> )	Up to approximately 6,890tpa.
Particulates	Up to approximately 520tpa.
Carbon monoxide (CO)	Up to approximately 940tpa.
Total volatile organic compounds (VOCs)	Up to approximately 270tpa.

**Abbreviations**

BRDA's Bauxite residue disposal area  
 GL/a gigalitres per annum  
 ha hectares  
 ML/a megalitres per annum

MW megawatts  
 Mt megatonnes  
 Mtpa million tones per annum  
 tpa tones per annum

The potential impacts of the proposal initially predicted by the proponent in the ERMP document (Strategen, 2005) and their proposed management are summarised in the "Summary of relevant environmental factors" table in the Executive Summary.

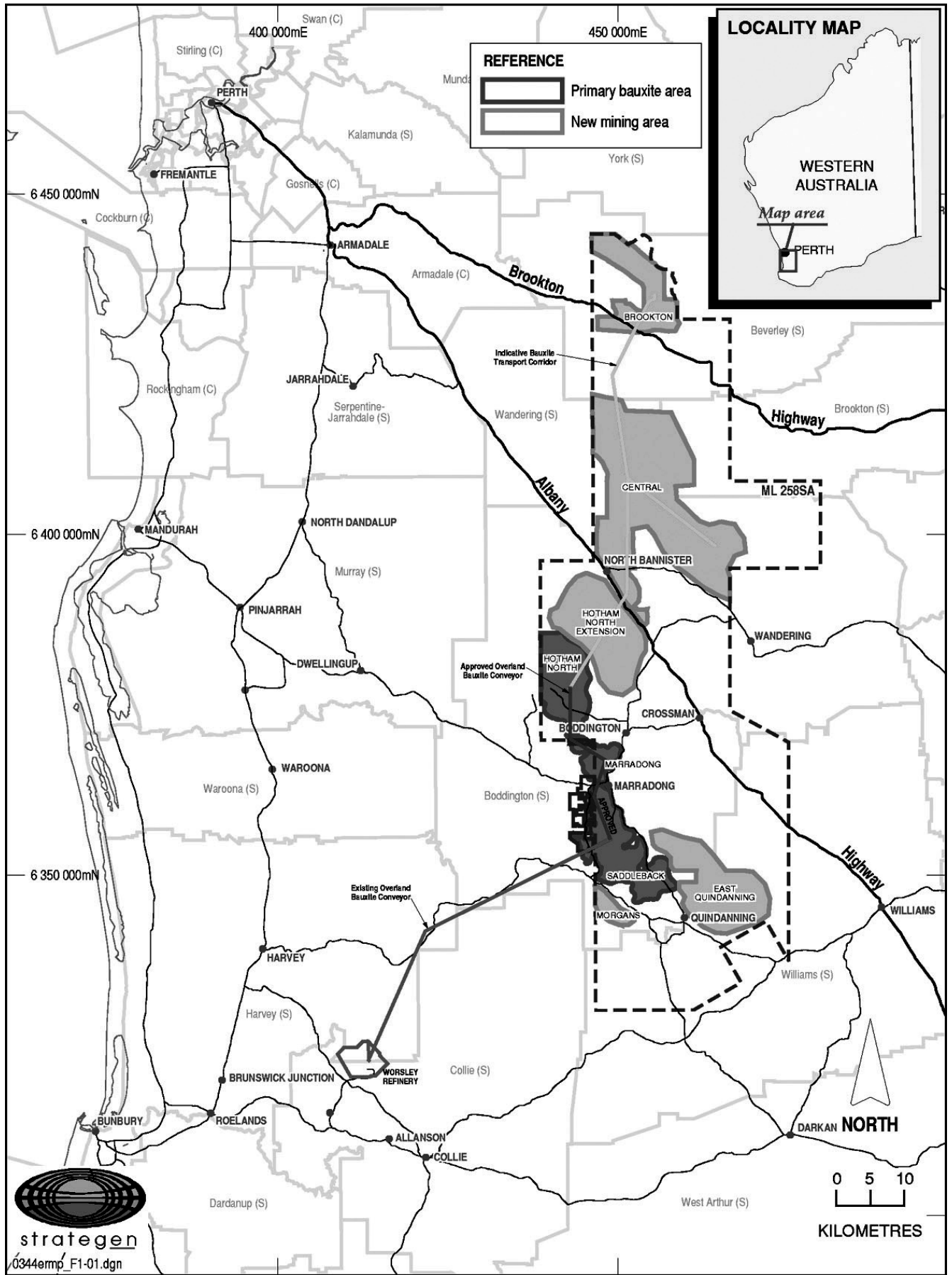


Figure 1: Regional location (Source: Figure 1.1 from Strategen, 2005)

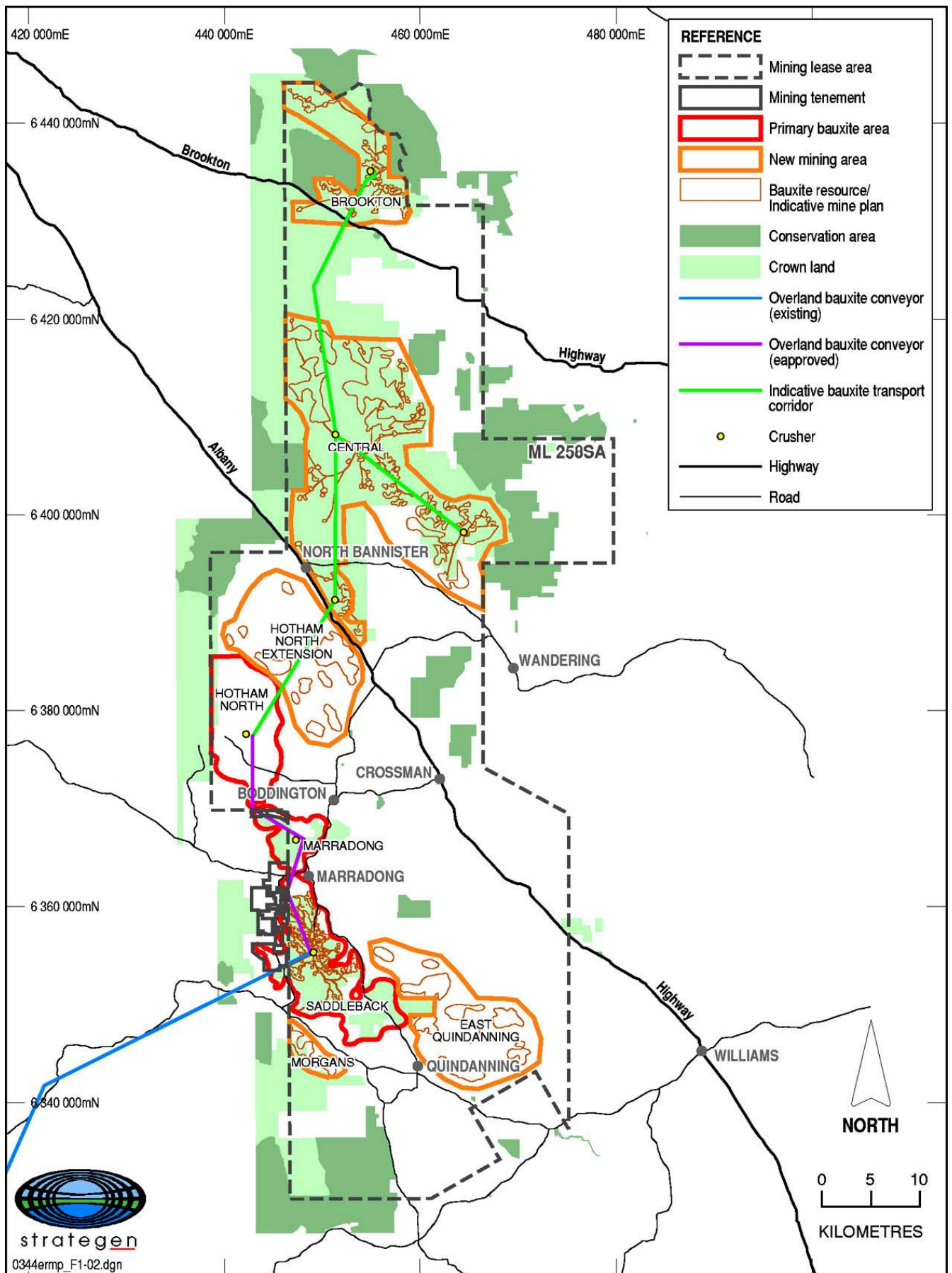


Figure 2: Existing and proposed mining envelopes (Source: Figure 1.3 from Straten, 2005)

### **3. 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 traffic, visual amenity, and recreation 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) Conservation of biodiversity;
- (b) Surface water and groundwater;
- (c) Air quality;
- (d) Greenhouse gases; and
- (e) Noise.

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 3.1 - 3.5. 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) The principle of intergenerational equity;
- (c) The principle of the conservation of biological diversity and ecological integrity;
- (d) Principles relating to improved valuation, pricing and incentive mechanisms; and
- (e) The principle of waste minimisation.



### 3.1 Conservation of biodiversity

#### Description

##### *Vegetation and flora*

The Worsley project area occurs within the Darling Botanical District of the South West Botanical Province and is broadly classified as eucalypt woodland. The natural vegetation of the surrounding area is comprised of Jarrah (*Eucalyptus marginata*) and Marri (*Corymbia calophylla*) forests to the west and Marri and Wandoo (*Eucalyptus wandoo*) forests to the east. Additionally, Powderbark (*Eucalyptus accedens*) is dominant on the breakaways, granite heaths occur to the north and east and extensive but localised Banksia low woodlands occur on sand sheets.

The northern mining envelopes (Brookton and Central) sit mainly in State Forest dominated by *E. marginata* over *Dryandra* sp. or *E. accedens*. The three southern mining envelopes (Hotham North Extension, Morgans and East Quindanning) mainly occur on private agricultural land with pockets of native vegetation. However, the western section of Morgans also occurs within State Forest.

The vegetation of the Brookton and Central mining envelopes is generally in very good condition. However, they have been impacted by timber cutting, and dieback is present in some areas. In total only four species of weeds were recorded by Bennett (2004) in the Brookton and Central mining envelopes. The pockets of native vegetation in Hotham North Extension, Morgans and East Quindanning are surrounded by, or near to, agricultural land and have been subjected to grazing pressures and weeds. Areas of native vegetation on private land may retain significant biodiversity values and play an important role in maintaining ecological linkage in a fragmented environment. Current information is not adequate to fully determine their values.

The total area of the proposed mining extension is 74,000 hectares (ha), which includes 54,774ha of remnant vegetation. Disturbance within this area will be in discrete pods (plus associated transport routes) over a 30 to 35 year life of the project. A precise estimate of the mining pod areas requires higher intensity exploration. However, at this stage approximately 12,800ha of bauxite resource has been identified. The proposal is to mine and rehabilitate approximately 240ha per year.

A vegetation and flora survey was conducted within the proposed northern Brookton and Central mining envelopes as part of the preparation of the ERMP document (Bennett, 2004). Desktop studies were carried out for the southern Hotham North Extension, Morgans and East Quindanning mining envelopes.

Vegetation complex mapping by Mattiske and Havel (1998) indicated that twelve vegetation complexes occur within the mining envelope. Of these vegetation complexes four have less than 30% pre-European extent remaining:

- Michibin - 19.6%;
- Dalmore 2 - 19.5%;

- Lukin 2 - 13.9%; and
- Williams - 10.9%.

Additionally, Beard's (1981) mapping of the vegetation of the Swan area indicated that five vegetation associations occur within the mining envelope. Of these vegetation associations, two have less than 30% pre-European extent remaining:

- 946 - 17.9%; and
- 4 - 23.5%.

Of the four vegetation complexes identified within the study area as having less than 30% pre-European extent remaining, three have potential bauxite reserves:

- Michibin;
- Dalmore 2; and
- Lukin 2.

The two Beard vegetation associations with less than 30% pre-European extent remaining (946 and 4) were also identified on potential bauxite reserves. Whereas the poorly represented Williams Vegetation Complex was identified within the project area, but is not located on a currently identified bauxite resource.

Based on preliminary estimates, the potentially affected areas of the poorly represented vegetation complexes and associations listed above are anticipated to be less than:

- Michibin - 1.1%;
- Dalmore 2 - 4.6%;
- Lukin 2 - 0.2%;
- 946 - 0.004%; and
- 4 - 0.2%.

No Declared Rare Flora (DRF) were located by Bennett (2004). However, three species are listed as possibly occurring in the mining envelope area. Eleven Priority species were recorded by Bennett (2004). Fourteen other species with significance due to restricted distribution or extent of distribution were recorded. Heath communities and granite rock communities, which are encouraged for conservation are scattered throughout the Brookton and Central mining envelopes. No regional studies have been undertaken at a scale that would allow for the identification of possible Threatened Ecological Communities (TECs) in the proposed new mining envelopes.

#### *Fauna*

The Worsley project area includes seven broad habitat types:

- Wandoo woodland - large hollows may be used by cockatoos and other hollow dependent vertebrate fauna;
- Jarrah forest;

- Dryandra thickets - food source for Carnaby's Black Cockatoo, important for nectarivorous birds and mammals, and for sheltering fauna such as kangaroos and wallabies;
- Sheoak woodland;
- Heath - important for nectarivorous birds and mammals such as the Honey Possum, and for sheltering fauna such as kangaroos and wallabies;
- Granite outcrops and lateritic breakaways - can support specialized fauna, including some reptile species, rocky pools can be important for breeding frogs and some invertebrates; and
- Streams and dams - important source of drinking water for terrestrial fauna and as a breeding site for frogs.

The two northern mining envelopes are almost completely vegetated, while the three southern mining envelopes have been subject to land clearing and agricultural activity, thus diminishing native habitat.

Baseline surveys of the existing mining area of Saddleback were undertaken between 1980 and 1983 with subsequent surveys following, the most recent being between 1996 to 1998. A baseline survey of the proposed mining envelope of East Quindanning was undertaken between 2000 and 2001.

Recent investigations into the type, number and abundance of fauna in the project area consisted of a desktop review of literature. Additionally, the northern Central and Brookton mining envelopes were target surveyed for Critical Weight Range mammals and Black-Cockatoos. However, the three southern mining envelopes were not field surveyed, as these mining envelopes are located on private property, which has been subjected to land clearing and grazing by agricultural animals.

A total of 215 vertebrate species may inhabit the study area including 31 mammals, 114 birds, 54 reptiles, and 16 amphibians.

The following species, which are listed under either the *WA Wildlife Conservation Act, 1950* or the *Commonwealth Environment Protection and Biodiversity Conservation Act, 1999* (EPBC Act, 1999) may be present:

- *Morelia spilota imbricata* (South West Carpet Python);
- *Calyptorhynchus latirostris* (Carnaby's Black-Cockatoo);
- *Calyptorhynchus baudinii* (Baudin's Black-Cockatoo);
- *Leipoa ocellate* (Malleefowl);
- *Falco peregrinus* (Peregrine falcon);
- *Merops ornatus* (Rainbow Bee-eater);
- *Apus pacificus* (Fork tailed Swift);
- *Phascogale calura* (Red tailed Phascogale);
- *Dasyurus geoffroii* (Chuditch);
- *Pseudocheirus occidentalis* (Western Ringtail Possum);

- *Myrmecobius fasciatus* (Numbat); and
- *Setonix brachyurus* (Quokka).

The following species that are not listed under State or Commonwealth Acts but are listed as Priority species by CALM may be present:

- *Ctenotus delli* (Darling Range Ctenotus);
- *Calyptorhynchus banksii naso* (Forest Red-tailed Black Cockatoo);
- *Ninox connivens* (Barking Owl);
- *Tyto novaehollandiae novaehollandiae* (Masked Owl);
- *Burhinus grallarius* (Bush Stone-Curlew); and
- *Falcunculus frontatus* (Crested Shrike-tit).

Species that are not listed under Acts or in publications but are considered to be at least of local significance because of their pattern of distribution are:

- 4 species of spiders [i.e. 3 of suborder Mygalomorphae (Trap Door Spiders) and 1 of suborder Araneomorphae (Weaver Spiders)];
- *Lophoictinia isura* (Square-tailed Kite);
- *Stagonopleura oculata* (Red-eared Firetail);
- *Platycercus icterotis* (Western Rosella);
- *Eopsaltria griseogularis* (Western Yellow Robin);
- *Pachycephala pectoralis* (Golden Whistler);
- *Phylidonoris melanops* (Tawny-crowned Honeyeater);
- *Petroica multicolour* (Scarlet Robin);
- *Artamus cinereus* (Black-faced Woodswallow);
- *Artamus cyanopterus* (Dusky Woodswallow);
- *Myiagra inquieta* (Restless Flycatcher);
- *Strepera versicolor* (Grey Currawong); and
- *Cinclorhamphus mathewsi* (Rufous Songlark).

There were no threatened invertebrate species recorded as occurring in the project area according to CALM's Threatened Fauna database and the EPBC database. However, four species of spider may be of conservation interest, but no formal assessment has been undertaken.

Several introduced species were recorded during field surveying, these being the Black Rat, Red Fox, Rabbit and Feral Cat. However, these species were observed in few sites in relatively low numbers. Fox control is undertaken in the State Forest areas under CALM's Western Shield program.

Forest clearing may result in loss of habitat, direct fauna deaths, reduction in carrying capacity, fragmentation and isolation of habitat and habitat continuums. Project

operations may result in disturbance of fauna due to noise, light and injury due to vehicle movements.

## **Submissions**

The main issues raised in the submissions in relation to the conservation of biodiversity included:

- the requirements of EPA Guidance Statement No. 51 have not been met;
- there have been errors in survey methodology application, analysis, and interpretation;
- lack of information to justify success of the proposed rehabilitation of disturbed areas;
- a mid term audit of performance under the Forest Management Plan 2004-2013 is to be provided to the EPA by the end of 2008, with an end of term audit in December 2012;
- the sustainability of continued clearing and mining in Jarrah forests;
- the destruction of forested areas;
- the success rate of rehabilitation in mined areas;
- the potential for the spread of weeds from the proposed conveyor;
- the proposed bauxite conveyor alignments have not been adequately assessed in terms of impacts such as the potential to spread dieback;
- lack of information to adequately meet the requirements of EPA Guidance Statement No. 56;
- the field investigation within the project area is inadequate to properly assess the impact on fauna;
- in accordance with Action 5.1 of the Forest Management Plan 2004-2013, protection of 'indicative fauna habitat zones' in and adjacent to mining envelopes should be ensured;
- faunal surveys should be undertaken prior to commencement of mining activities in all areas;
- long-term faunal surveys should be undertaken to identify impacts of habitat disturbance/loss on faunal groups;
- detailed fauna surveys as committed by Worsley in the Scoping document not being completed or undertaken;
- fauna surveys carried out to date are not in compliance with EPA Guidance Statement No. 56 and EPA Position Statement No. 3;
- proponent commitments and compliance considered to be inadequate;
- implications of habitat destruction and fragmentation for native fauna species;
- the rate and overall change to landscape from increased mining needs to be properly addressed;
- an independent assessment of biodiversity should be carried out in conjunction with monitoring of areas adjacent to mining activities;

- modification to the landscape, specifically removal of caprock and large quantities of earth; and
- not enough information is known about the below ground biota, it's interactions in ecosystems and the impact mining will have on it.

### **Assessment**

The area considered for assessment of this factor is the mine sites, transport corridors, and the surrounding areas.

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

- maintain the abundance, species diversity, geographic distribution and productivity of terrestrial flora, vegetation communities, and fauna; and
- protect Declared Rare and Priority Flora, and Specially Protected (Threatened) and Priority Fauna consistent with provisions of the *Wildlife Conservation Act, 1950*.

The EPA notes that the proposal would result in the clearing of approximately 13,000ha for mining plus additional areas used for ore transportation over a 30 to 35 year period. About two thirds of this area is within State Forest reserved under the *Conservation and Land Management Act, 1984*. Consideration of an adequate representative and comprehensive conservation estate for the State Forest was addressed through the Forest Management Plan (2004).

The EPA notes that none of the proposed mining envelopes are in areas which are proposed to be reserved for conservation. Notwithstanding this, the EPA considers that the proposed clearing and mining has potential to have significant impact on the environmental values of the State Forest if not planned, investigated, managed, and rehabilitated to a very high standard.

The EPA notes the results of the flora and fauna surveys that have been undertaken to date for the proposed expansion. However, the EPA considers that there is a need for further comprehensive investigations to be undertaken in order to establish a better understanding of the biodiversity of the areas within and in proximity to the proposed new mining areas. In this regard the EPA has recommended a condition (Condition 6 in Appendix 4) requiring the proponent to undertake comprehensive biodiversity investigations, which focus on the areas within and in proximity to the proposed new mining areas, and to prepare a biodiversity investigations report. The EPA notes that Worsley's mining plans and its environmental performance are reviewed by the Environmental Management Liaison Group (EMLG) pursuant to the *Alumina Refinery (Worsley) Agreement Act, 1973* and Ministerial Statement 423 which cover Worsley's current operations. Accordingly, the EPA considers that the recommended condition should also include a requirement for the proponent to seek comments and advice on the biodiversity investigations from the EMLG.

The EPA considers that there are areas within which mining or transport corridor construction activities associated with the proposed expansion, should not be permitted (such as poorly represented vegetation complexes and associations, eg. Michibin, Dalmore, Lukin, Williams etc) in order to protect biodiversity values. To safeguard these areas, and any others identified by the biodiversity investigations referred to

above, the EPA recommends that a condition (Condition 7 in Appendix 4) be imposed on the proponent preventing it from undertaking any mining or transport corridor construction activities that would result in the direct disturbance of heathland, significant vegetation complexes and associations, TECs, granite outcrops, significant populations of DRF, populations of Threatened Fauna, stream zones, and the habitat of Threatened or Priority Fauna. The comprehensive biodiversity related investigations and biodiversity investigations report that have been recommended will further refine the areas that are recommended to be protected from mining and associated disturbance. The EPA considers that this condition should also require the proponent to ensure that mining and transport corridor construction and operational activities do not cause or contribute to:

- any significant adverse impact on any groundwater dependent ecosystems;
- an increase in severity of weeds or pests in State Forest;
- the increased spread of forest disease;
- the elevation of any species or ecological communities to a higher category of threat; and
- disturbance in defined buffer areas around ecological linkages and areas of zero disturbance.

The EPA has also recommended a condition (Condition 8 in Appendix 4) requiring the proponent to prepare transport corridor route plans which show the route and area of disturbance for each proposed transport corridor, for endorsement by the Minister for the Environment. The transport corridor route plans will need to outline how the selected route complies with the requirements of the biodiversity investigations report and Condition 7, and ensure that transport corridor routes are selected to minimise the risk to biodiversity values from the introduction and spread of forest disease outside areas identified in the biodiversity investigations report.

As a further safeguard, the EPA has recommended a condition (Condition 9 in Appendix 4) requiring the proponent to prepare a bauxite mining plan for each specific area that will be subject to mining or transport corridor construction activities which:

- incorporates the findings contained in the biodiversity investigations report;
- ensures that the areas of any proposed mining or transport corridor construction activities, including corridor and technology options considered during planning, are consistent with the areas of zero disturbance, ecological linkages, and buffers identified in the biodiversity investigations report, and take into account the location of indicative fauna habitat zones as identified and in accordance with the requirements of the Forest Management Plan (2004);
- sets out the management and mitigation measures that will be undertaken to ensure that mining or transport corridor construction activities will comply with the recommended condition 7;
- sets out any monitoring and auditing that will be undertaken before, during, and following mining or transport corridor construction activities; and
- demonstrates how the proponent's implementation of the proposal will protect the key biodiversity values identified in the biodiversity investigations report.

Once mining activities have ceased it is imperative that the affected areas are rehabilitated such that the post-mining landform is stable, sustainable, and integrated into the surrounding environment. It is expected that State Forest areas will be rehabilitated to a range of local native vegetation types consistent with that normally associated with the equivalent landform. It is also expected that private land areas will be rehabilitated to a mix of farm land and a range of native vegetation types appropriate to the landform that will at least maintain the area under native vegetation and improve ecological linkage. In order to achieve this goal, the EPA has recommended a condition (Condition 10 in Appendix 4) requiring the proponent to prepare a rehabilitation plan which will ensure that the planning and implementation of rehabilitation is undertaken in a manner consistent with industry best practice, and that rehabilitated areas will ultimately develop sustainable systems compatible with surrounding areas. Importantly, the plan should establish the rehabilitation criteria to be achieved prior to mining commencement. In particular, in developing the rehabilitation plan, the proponent should have regard for the matters identified in Appendix 4 of the ERMP document (URS Australia Pty Ltd, 2004) relating to the assessment of ecosystem sustainability.

The EPA acknowledges the various concerns that have been expressed by CALM in relation to the conservation of biodiversity. The EPA considers that CALM's concerns have been satisfactorily addressed by the above-mentioned conditions that the EPA has recommended be imposed on the proponent.

### **Summary**

Having particular regard to the:

- (a) conservation reserve system established through the Forest Management Plan (2004);
- (b) results of the flora and fauna surveys that have been undertaken for the proposed expansion; and
- (c) recommended conditions regarding biodiversity investigations, the protection of biodiversity, transport corridor route plans, bauxite mining plans, and rehabilitation;

it is the EPA's opinion that the proposal can be managed to meet the EPA's environmental objective for this factor provided the necessary planning, investigation, and management is carried out to a very high standard.

## **3.2 Surface water and groundwater**

### **Description**

The proposed mining extension areas lie across the following three major catchments:

- Avon River;
- Swan Coast; and
- Murray River.



The main watercourses are the Dale, Murray, Williams and Hotham rivers and the upper tributaries of the South Dandalup, Canning, Serpentine, and Lower Helena rivers, as well as smaller ephemeral watercourses draining into these systems.

The mining proposal is to be undertaken in the 'low rainfall area' of the Darling range with annual rainfall generally less than 800mm/yr. Salinity loads are generally higher in catchments in lower rainfall areas with stream salinity rising with increasing cleared area and decreasing annual rainfall.

There is a potential for the groundwater table to rise in the proposed mining areas due to clearing. However, in recent years the water table rise in the existing mining envelope has been partly offset due to a decline in average annual rainfall. A rising water table has the potential to increase stream salinity, water-logging, and the spread of dieback.

Rehabilitation of the mined areas also has the potential to reduce stream flow in the future if it uses more water than the forest it is replacing.

The proposed transport corridors cross watercourses and have the potential to result in sediment transport into natural waterways and disturbance to some in-stream and riparian vegetation. Construction may require disturbance to some Comprehensive, Adequate and Representative (CAR) informal reserves.

There are a number of public water supply catchments within the mining envelope; South Dandalup, Serpentine, Canning, and Mundaring (Lower Helena). These are currently at least 96% forested. Clearing for the proposed mining is not expected to disturb more than 5% of any catchment.

An additional 170ML of water per annum will be required for bauxite mining operations. This additional water will be obtained from surface water and groundwater sources in the vicinity of the mining areas. The additional 0.5GL of water per annum that will be required by the refinery will be sourced from the existing freshwater lake which is located on the Augustus River. The proponent has initiated a water use efficiency program that includes a requirement for water use efficiency to improve by 10% over the period 2002-2007. The proponent is also investigating a number of options to supplement refinery water supplies. These include:

- provision of water by a service provider;
- additional nearby local and regional surface water sources;
- water from coal mine dewatering; and
- increasing the existing allocation from the Augustus River.

The refinery catchment lake which adjoins the refinery process area stores all stormwater and recirculated process water from the plant, as well as residue liquor and stormwater collected from the BRDA's. The bauxite residue within the BRDA's is known to contain heavy metals such as chromium, cadmium, lead, and mercury etc.

A groundwater underflow collection system is located beneath the clay liner of the BRDA's and the high density polyethylene liner of the solar evaporation ponds. Uncontaminated groundwater collected by this system is directed to the fresh water

lake. In the event that the groundwater is found to be contaminated, it would be directed to the refinery catchment lake. A surface water, groundwater, and underdrainage monitoring program is maintained by the proponent under the requirements of the existing environmental licence conditions and the *Alumina Refinery (Worsley) Agreement Act, 1973*. The above monitoring program evaluates pH, conductivity, and the presence of Cl, Na, Fe, Al, Ca, SO<sub>4</sub>, Mn, CO<sub>3</sub>, HCO<sub>3</sub>, and TDS (Total Dissolved Solids). The presence of heavy metals has only been evaluated intermittently.

### **Submissions**

The main issues raised in the submissions in relation to water included:

- degradation of water quality due to salinisation caused by clearing;
- reduction of down-stream water quality as a result of mining activities;
- potential for pollution of groundwater from waste products generated in the refinery;
- potential negative impacts on surface water systems as a result of mining in catchments;
- reduction of water quantity due to mining requirements and over-dense rehabilitation;
- concerns over the planned use of potable water for industrial purposes, as it would place undue pressure on Catchment areas;
- concerns over the source of additional water if it is required and the need for information on alternative sources; and
- the need to ensure that sufficient environmental flows are available for the Brunswick River and its tributaries.

### **Assessment**

The area considered for assessment of this factor is the Worsley Alumina Refinery and catchments covering the mine sites and transport corridors.

The EPA's environmental objectives for this factor is to maintain the quality of surface water and groundwater so that existing and potential uses, including ecosystem maintenance, are protected.

The EPA notes that the proposed mining has the potential to affect the quality, particularly salinity, and quantity of stream flow in the catchments covering the mining areas. This is important for both the use of the resources, particularly in the public drinking water catchments, and the protection of the stream ecosystems.

There is generally limited information available on the response of groundwater systems and stream flow to mining in low rainfall areas of the south-west Jarrah Forest. Most of the studies have been carried out in the high rainfall zone. Worsley has conducted some studies to evaluate the impacts of its existing Boddington Bauxite Mine operations on groundwater and stream hydrology, with monitoring in both mined areas and a controlled catchment with no mining. The studies showed an average watertable rise between 5 and 10m in response to mining. This was largely offset, however by an

overall decline in water levels due to reduced rainfall. To date no increase in regional salinity has been observed due to Worsley's existing mining operations.

As part of the preparation of the ERMP document, Worsley commissioned a salinity assessment of the proposed mining areas with the objective of characterising the hydrogeological setting and salinity processes and assessing the potential for increased salinisation as a consequence of mining (Appendix 6 Strategen, 2005). This preliminary assessment concluded that the risk of mining induced salinisation of surface water was low and should be manageable, using careful mine scheduling possibly supplemented in some situations by groundwater extraction and localised stream damming, with water from both used for dust suppression.

The salinity assessment has been reviewed by the Department of Agriculture (George, 2004). The review found that the salinity assessment was suitable as a regional scaled HAZARD evaluation and concurred with the assessment finding that the risk to stream salinity levels from mining is likely to be reduced because groundwater levels have dropped as a result of reduced rainfall.

Worsley has utilised the results of both the salinity assessment and peer review to develop an approach to further assessment and management of the risk of salinity as a result of the proposed mining.

These are addressed through the following commitments made by Worsley in regard to surface water and groundwater:

- Worsley will prepare and implement a Water Resource Management Plan - Mining which takes into account changing rainfall patterns and which will address the following:
  - assessment of salinity hazard and salt storage in soils in proposed mining areas;
  - development of predictive tools to estimate the extent of watertable rise due to mining operations;
  - monitoring of groundwater salinity and levels in and near mining areas;
  - monitoring of regional water quality (salinity) of streams and groundwater;
  - contingency measures for salinity management;
  - assessment of water dependent ecosystems in new mining areas;
  - a process for selection of water supplies for the mine, including the evaluation of alternatives;
  - improvement in the efficiency of water use;
  - monitoring of water usage, groundwater level and any groundwater dependent ecosystems which may be affected by Worsley's groundwater abstraction;
  - working arrangements for exploration and mining in public drinking water supply areas;
  - establishment of appropriate stream buffer zones;
  - spills management; and
  - sediment control and drainage management in all areas where Worsley operates;

- Worsley will incorporate the following watercourse protection measures into the Construction Management Plan:
  - minimisation of disturbance to streams and associated riparian vegetation during construction of stream crossings;
  - workforce education regarding the protection of watercourses; and
- the Operation Management Plan will include maintenance of the transport corridor as a controlled drainage system.

Worsley has also committed to prepare and implement a Water Resource Management Plan for the Refinery that takes into account changing rainfall patterns and addresses the following:

- strategic water source planning;
- improvement in the efficiency of water use at the refinery;
- protection of water quality in the Augustus River, which is located downstream of the refinery;
- maintenance of environmental water provisions which will be reviewed, as appropriate, during renewal of Worsley's Surface Water Licence;
- surface and groundwater quality monitoring; and
- management and cleanup of spills and onsite contamination.

The EPA notes that only discrete areas within the proposed 74,000ha extension area will be disturbed by mining operations to access the widely distributed ore pods over the 30-35 year life of project. This will involve clearing and rehabilitation of about 240ha per year. As part of the Agreement Act, Worsley is required to undertake long-term planning and submit a rolling Ten Year Mine Plan which includes details of long-term exploration and mining plans.

The EPA considers this provides adequate planning and time for Worsley to undertake the detailed salinity and water resource management assessments necessary prior to commencing clearing in any mine area. This includes development of predictive tools to estimate the extent of water table rise and any impacts on salinity. The water resource management plan for mining proposed by Worsley should include upper-limit criteria for salinity which must be demonstrated to be achievable through the modelling and other assessment. These criteria should relate to both water use and the protection of stream ecosystems.

The EPA notes that the mining extension area covers a small area of a number of public drinking water catchments. Close consultation will need to be maintained with the Water and Rivers Commission and the Water Corporation on the detailed salinity and water resources assessments in these areas. The assessments will need to demonstrate that there is negligible risk of adverse water quality impacts in these areas, prior to mining being allowed. Particular consideration also needs to be given to rehabilitation of any areas mined in the drinking water catchments to manage long-term stream flow rates.

The EPA has recommended a condition (Condition 11 in Appendix 4) requiring the proponent to not carry out any ground disturbing activities in areas proclaimed as water reserves or catchment areas under the *Metropolitan Water Supply, Sewerage, and Drainage Act, 1909*, or the *Country Areas Water Supply Act, 1947*, prior to the preparation of a water resource management plan for mining (in accordance with Commitment No. 8 in Appendix 4 of this report). The water resource management plan will need to demonstrate that the activities are likely to have negligible impact on the quality of water supplies from the catchment.

The EPA considers that the water resource management plan for the refinery that the proponent has committed to prepare and implement, together with the surface water, groundwater, and underdrainage monitoring program that is maintained by the proponent under the requirements of the existing environmental licence conditions and the *Alumina Refinery (Worsley) Agreement Act, 1973*, will adequately address water use within the refinery and the management of surface water and groundwater.

### **Summary**

Having particular regard to the:

- (a) management measures that will be used to minimise potential impacts on surface water and groundwater;
- (b) the recommended condition requiring the proponent to not carry out any ground disturbing activities in areas proclaimed as water reserves or catchment areas under the *Metropolitan Water Supply, Sewerage, and Drainage Act, 1909*, or the *Country Areas Water Supply Act, 1947*, prior to the preparation of a water resource management plan for mining (in accordance with Commitment No. 8 in this report); and
- (c) commitments made by the proponent;

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

## **3.3 Air quality**

### **Description**

#### *Air pollutant emission rates*

In association with preparation of the ERMP, Worsley has constructed a comprehensive inventory of average mass emission rates for the major point sources at the refinery at the current production rate of 3.25Mtpa (Appendix 8 Strategen, 2005). The Version 2 inventory contains over 500 substances from 13 primary sources at the refinery. The inventory was subject to an independent review by Pacific Air and Environment (PAE) which overall, found good agreement between emission rates for compounds common to the inventory and published data for other refineries.

The Version 1 inventory is a component of the Air Emissions Impact Assessment (AEIA) project being undertaken by Worsley for the refinery. The focus of stage 1 has been on the construction of a comprehensive inventory of average mass emission rates. Stages 2 and 3 are to be undertaken with additional emission data collected to investigate secondary sources, variability in emission rates due to process variability, and performance of additional emission controls planned as part of the expansion.

The inventory does not include emissions from diffuse sources such as the BRDA's (dust and odour) and the refinery catchment lake (odour and VOCs) due to the inherent difficulties in measurement of emission concentrations and mass emission rates from such sources. Worsley is currently evaluating proposed techniques and plans to also include this in the Stage 3 sampling program.

The emissions inventory data has been used to predict emissions for the refinery upgrade, which have in turn been used for the air dispersion modelling and health risk assessment (HRA) undertaken for the ERMP.

The major atmospheric emissions from the refinery are sulphur dioxide (SO<sub>2</sub>), nitrogen oxides (NO<sub>x</sub>), carbon monoxide (CO), particulates, volatile organic compounds (VOCs), and associated odour. Other emissions include metals and polycyclic aromatic hydrocarbons (PAHs).

The change in emissions due to the proposed development is largely dependant on the fuel option (coal or natural gas) that will be adopted for additional electricity and steam generation. The proposed increase in emissions under the worst case scenario (i.e. the coal-fired cogeneration option) is shown in Table 2 below. For the gas-fired cogeneration option only NO<sub>x</sub> emissions are predicted to increase beyond existing levels, and there will be a reduction in the other major gaseous emissions. Odour emissions are predicted to reduce substantially for both options due to the proposed digestion emission control system.

**Table 2: Atmospheric emissions**

<b>Pollutant</b>	<b>Existing (3.25Mtpa)</b>	<b>Proposed (4.4Mtpa)</b>	<b>Percentage increase</b>
Sulphur dioxide (tpa)	9,955	12,221	+ 23
Nitrogen oxides (tpa)	4,228	6892	+ 63
Carbon monoxide (tpa)	715	942	+ 32
Particulates (TSP) <sup>1</sup> (tpa)	476	522	+ 10
Volatile organic compounds <sup>2</sup> (tpa)	221	266	+ 20
Odour (Odour units/sec)	9,626,000	5,000,000	- 48

<sup>1</sup> TSP - Total Suspended Particulates (Excludes fugitive sources).

<sup>2</sup> Specific VOCs are listed in the ERMP document (Strategen, 2005).

Air dispersion modelling was undertaken by Environmental Alliances and Pacific Air and Environmental to assess the potential impact of the proposed Worsley expansion in association with existing (Collie A and Muja A, B, C, and D) and proposed (Collie B and Bluewaters I & II) power station emissions. A hybrid of The Air Pollution Model (TAPM) and the USEPA models CALMET and CALPUFF were utilised. The CSIRO was also engaged to conduct independent air dispersion modelling (using TAPM alone) to compare results with that of the hybrid models. The predicted SO<sub>2</sub> ground level

concentrations from refinery emissions were compared with measured ambient concentrations of SO<sub>2</sub> and the results suggest that the model's predictive performance is satisfactory.

Air dispersion modelling was used to predict the potential impact at sensitive receptors located near the Worsley Refinery (within approximately 15km) and at sensitive receptors close to existing power stations in the Collie region (typically 30 to 40km from the Worsley Refinery). Details of the modelling results are provided in Section 2.8 of the ERMP document (Strategen, 2005).

### *Sulphur dioxide*

Modelling of the proposed refinery emissions, in isolation, predicts the maximum 1-hourly ground level concentration of SO<sub>2</sub> to be approximately 300µg/m<sup>3</sup> (52% of the National Environmental Protection Measure (NEPM) Standard of 570µg/m<sup>3</sup>) at a sensitive receptor near the refinery. The maximum 1-hourly ground level concentration of SO<sub>2</sub> was predicted to be slightly higher (310µg/m<sup>3</sup>) when all sources of SO<sub>2</sub> were modelled.

Modelling predictions indicate that the proposal is not likely to have a significant impact on SO<sub>2</sub> levels at sensitive receptors near the Collie and Muja Power Stations. The maximum 1-hourly SO<sub>2</sub> ground level concentration is not expected to increase beyond existing levels and only a minor increase (5%) in the annual ground level concentration of SO<sub>2</sub> is predicted.

### *Nitrogen dioxide*

The maximum 1-hourly NO<sub>2</sub> ground level concentration, from all sources, is predicted to be approximately 56µg/m<sup>3</sup> (23% of the NEPM standard of 246µg/m<sup>3</sup>) at receptors within 15km of the Worsley Refinery (EA and PAE, 2005). The Worsley Refinery does not contribute to the predicted maximum 1-hour NO<sub>2</sub> ground level concentration at any sensitive receptors near Collie or Muja Power Stations.

### *Particulates*

The refinery particulate emissions (PM<sub>10</sub> and PM<sub>2.5</sub>) are not expected to change significantly as a result of the proposed expansion. The Bauxite Residue Disposal Areas (BRDA's) are the most significant dust source under dry windy conditions. The expansion will not require an increase in the BRDA footprint, and particulate emissions may decrease due to an increase in the wet area as a result of a higher deposition rate. The proponent has implemented a dust management program to reduce fugitive emissions from the BRDA's.

Fugitive particulate emissions from the BRDA's were not included in the dispersion modelling. The maximum 24-hour average PM<sub>10</sub> ground level concentrations arising from point sources at the Worsley Refinery alone are predicted to be well below the NEPM standard at all receptors. Modelling predicts that the refinery expansion will have a very minor impact on particulate levels near the Collie and Muja Power Stations. However, modelling of the existing and proposed power station emissions predicts that the maximum 24-hour average PM<sub>10</sub> ground level concentrations at receptors near Collie will exceed the NEPM standard. Monitoring data indicates that the PM<sub>10</sub> NEPM

standard is occasionally exceeded at Collie. Smoke from wood heaters and bushfires can contribute to the exceedances.

Particulate emissions are also generated at the mine site and to a lesser extent along the transport corridor. Mine site particulates are generated from earthworks, load and haul operations, blasting, crushing, materials handling, burning and wind erosion. Particulate levels at the nearby towns of Boddington and Brookton may potentially increase as a result of the proposed extension of mining operations and increase in mining rate. The rate of mining will increase from approximately 13.5Mtpa to 16Mtpa and annual clearing and rehabilitation will increase from 140 hectares per annum (ha/a) to 240ha/a.

The proponent estimated its mine site PM<sub>10</sub> particulate emissions to be 2,300tpa for the National Pollutant Inventory reporting year of 2003/04. Air dispersion modelling has not been undertaken to predict impacts on towns in the vicinity of the mine site. However, the proponent recently implemented a dust monitoring plan to determine particulate impacts on Boddington. A continuous photometric air sampler (PM<sub>10</sub>) is located between the mine and townsite and another sampler is located upwind of the mine to record background particulate levels.

### *Ozone*

Modelling was undertaken to determine if the proposed additional NO<sub>x</sub> emissions from either the coal or gas-fired cogeneration facilities is likely to have an effect on regional ozone levels. The annual maximum hourly averaged concentration occurs in the coastal region about 10km north of Bunbury and was predicted to be 53ppb which is well below the NEPM standard (100ppb and 80ppb for 1-hour and 4-hourly concentrations, respectively). The assessment concluded that the Worsley expansion will have a negligible effect on ozone concentrations in the region.

### *Odour*

The most significant sources of odours from the refinery are VOC emissions from the Digestion area vents and potentially from the BRDA's and refinery catchment lake. A thermal oxidiser has been installed on the liquor burner and odorous emissions from this source are now expected to be negligible. Another significant reduction in odorous emissions is expected following the installation of a digestion emission control system during 2005. An average odorous emission rate for the refinery was constructed from the mass emission inventory, and odour ground level concentrations (3-minute 99.5 percentile) were derived at receptors within 15km of the refinery for the existing and proposed expansion. The odour modelling did not include emissions from large area sources such as the BRDA's and the refinery catchment lake.

The odour concentration which corresponds to an odour intensity level of 'distinct' was previously found to be 4.9 odour units/m<sup>3</sup>, 3-minute average, 99.5<sup>th</sup> percentile concentration (WEC, 2003). The maximum odour concentration for the existing operations is predicted to be 24.6 odour units/m<sup>3</sup> which is approximately 5 times the derived screening guideline value. However, the maximum odour concentration is predicted to be below the screening guideline value, with the exception of one receptor (approximately 5.3 odour units/m<sup>3</sup>), following the expansion and implementation of the digestion emissions control system. Worsley plans to conduct field and community



odour surveys to verify the level of refinery odour at sensitive receptors following commissioning of the expansion.

#### *Health risk assessment*

Toxikos was engaged to conduct a health risk assessment (HRA) to assess the possibility of direct health effects and impacts on the surrounding community from Worsley Refinery emissions. The results of the HRA are reported in full in Appendix 10 of the ERMP document (Strategen, 2005).

The HRA addressed acute and chronic exposures from the existing refinery operations in isolation and the proposed expansion (worst case with coal-fired boiler) both in isolation and cumulatively (with existing and proposed power stations). The assessment involved, exposure assessment, toxicity assessment and risk characterisation. The concept of 'concentration of no toxicological concern' was employed as a conservative screening tool to determine whether minor components of emissions in the direct inhalation exposure pathway needed to be included in the HRA. The concentration of no toxicological concern was determined to be  $0.03\mu\text{g}/\text{m}^3$  (i.e. direct systemic health effects as a result of exposure to chemicals below that concentration were considered to be very unlikely) (Toxikos, 2005).

Direct exposure to air emissions via inhalation was the primary consideration in the risk assessment. The likelihood of an adverse health outcome from exposure to the contaminants was obtained by adding hazard quotients (ratio of the ground level concentration of contaminant to its air quality guideline) for each contaminant to obtain the overall hazard index.

A method was developed to account for contaminants that do not have an air quality guideline value. Such substances were considered to be uncharacterised while substances that do have an air guideline value were considered to be characterised. Based on the assumption that the distribution of air guideline values between characterised and uncharacterised substances is similar, the hazard index for acute and chronic effects can be adjusted to produce a target hazard index according to the ratio of the number of characterised to uncharacterised contaminants at the receptor locations. Using this approach, the target hazard indices for acute and chronic exposures were determined to be 0.5 and 0.8 respectively. Hazard index values less than one generally indicate that there is no cause for concern. Values greater than one generally also do not present cause for concern because of the inherent conservatism embedded in the exposure portions of a preliminary health risk assessment. Hazard index values that are around 10 present some concern regarding possible health risks (Toxikos, 2005). The target hazard indices are compared with the calculated hazard indices for representative receptors in Section 2.9.5, Chapter 5 of the ERMP document (Strategen, 2005).

The general conclusions by Toxikos (2005) were as follows:

- the emissions of major importance to health are  $\text{SO}_2$ ,  $\text{NO}_2$ , and particulate matter;
- other emissions even collectively, contribute little to direct health risks; and
- overall there is a good degree of confidence that emissions from the refinery are very unlikely to cause direct acute or chronic health effects on the surrounding population.

The HRA did not consider the impact of fugitive particulate emissions from the BRDA's.

### **Submissions**

The main issues raised in the submissions in relation to atmospheric emissions included:

- the reliability and proposed operational configuration of the regenerative thermal oxidisers (RTOs) when operating at 4.4Mtpa was questioned;
- more detail should be given concerning the proposed “flue gas desulphurisation” technology and any associated waste streams;
- is the baghouse for Calciner 6 best practice, and will it be sufficient to deal with acetaldehyde emissions?
- the inventory does not include chromium VI emissions;
- there is no commitment to upgrade emissions control on old calciners;
- a table of high emission rates does not necessarily include all substances of significance;
- the improved pollution control on the Liquor Burning Facility and the Digestion Facility have not been confirmed to date;
- the use of the other power stations emissions data is questioned;
- the BRDA's and Refinery Catchment Lake represent potentially significant odour/VOC and particulate sources, but these fugitive emission sources have not been included in the emissions inventory and HRA;
- a specific commitment to establish a Continuous Emissions Monitoring System for the significant emission points is recommended;
- the Liquor Burner odour criteria of 4.9 odour units/m<sup>3</sup> (3 minute average, 99.5 percentile) is not considered to be protective in relation to odours from liquor burners;
- Worsley should commit to proceed with odour emission quantification, field odour assessment and odour reduction to achieve and maintain acceptable odour levels;
- monitoring of ozone should also be undertaken at the new site J monitoring station;
- the stacks and vents tend to be short and wake affected;
- the proponent should commit to refine/correct the emissions modelling in the DoE coordinated study of Collie air quality., and more work also needs to be undertaken to gather all the important emissions information;
- ministerial conditions/commitments should include the further work specified in Worsley's Air Quality Management Plan;
- the Department of Health concurs with the findings of the HRA report that predicted air emissions are unlikely to significantly contribute to adverse health effects in the Collie region;
- the Department of Health considers that dust issues relating to impact on public health have been adequately investigated and the proposed management strategies are anticipated to be adequate;

- will fallout of particulates contaminate the Harris Dam drinking water?
- the Shire of Harvey expects adequate monitoring of air emissions and compliance with State emission limits, with penalties for breaches;
- the ability of the liquor burner to control odours;
- the effect of odours produced by the refinery on public health; and
- the impact of predicted concentrations of NO<sub>2</sub> and SO<sub>2</sub> on the health of nearby residents and 'organic farmers' produce.

### **Assessment**

The area considered for assessment of this factor is the Worsley Alumina Refinery, the mine sites, transport corridors, and the surrounding areas, including residences in and around the town of Collie.

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

- atmospheric emissions do not adversely affect the environment or health, welfare and amenity of nearby land users by meeting statutory requirements (including Section 51 of the Environmental Protection Act, 1986) and acceptable standards;
- atmospheric emissions, both individually and cumulatively, meet appropriate criteria, do not cause environmental or human health impacts; and
- all reasonable and practicable measures are used to minimise the discharge of atmospheric emissions.

The EPA notes that the proponent has made the following commitment in regard to air quality:

- Worsley will prepare and implement an Air Quality Management Plan which will include the following:
  - an air quality improvement plan addressing priority areas. This will include mercury emissions from digestion, fugitive dust emissions from residue areas, VOC emissions from the calciner, a program for the Air Emissions Impact Assessment project, and community consultation;
  - field odour assessment study;
  - assessment of odour from the refinery catchment lake;
  - ambient air monitoring program;
  - emissions monitoring program with emphasis on odour emissions from significant point and area sources;
  - actions to control fugitive and point source particulate emissions;
  - incident and complaints response; and
  - program for annual reporting on air quality.

The EPA notes that the refinery will use low NO<sub>x</sub> burners, flue gas desulphurisation, and baghouses to minimise NO<sub>x</sub>, SO<sub>2</sub>, and particulate emissions respectively. The EPA considers that the use of low NO<sub>x</sub> burners, flue gas desulphurisation, and baghouses

demonstrates the implementation of best practicable technology by the proponent in relation to minimising the discharge of atmospheric emissions.

The EPA notes the results of air dispersion modelling which indicate that cumulative NO<sub>x</sub>, SO<sub>2</sub>, and ozone ground level concentrations will not exceed the relevant NEPM standards. The EPA understands that the maximum 24-hour average PM<sub>10</sub> ground level concentrations due to the refinery in isolation are predicted to be well below the NEPM standard at all receptors. Air toxics are also predicted to be low. However, the EPA also notes that cumulative modelling which includes existing and proposed power station emissions indicates that the maximum 24-hour average PM<sub>10</sub> ground level concentrations at receptors near Collie will exceed the NEPM standard. The EPA is aware that the PM<sub>10</sub> NEPM standard is occasionally exceeded at Collie mainly due to existing background sources.

The EPA notes that the BRDA's are considered to be the most significant dust source under dry windy conditions. The EPA also notes that the proposed expansion will not require an increase in the BRDA footprint, and that particulate emissions may decrease due to an increase in the wet area as a result of a higher deposition rate. The EPA notes that the proponent has implemented a dust management program to reduce fugitive emissions from the BRDA's.

The EPA notes that fugitive particulate emissions from the BRDA's were not included in the air dispersion modelling that was undertaken for the ERMP document. However, the EPA understands from the proponent's response to submissions that additional air dispersion modelling has been undertaken in order to address the concern that was raised in the submission from the Department of Environment's (DoE's) Air Quality Division. The results indicate that for the scenario which involves emissions from the expanded refinery, the BRDA's, and existing power stations in the Collie area, the predicted maximum 24-hour PM<sub>10</sub> ground level concentration is 110µg/m<sup>3</sup> which is 220% of the NEPM standard of 50µg/m<sup>3</sup>, and occurs at Allanson Primary School located about 5km west-north-west of Collie. However, the BRDA's and the proposed expanded refinery do not significantly contribute to this exceedance as it is predominantly due to emissions from the existing power stations in the Collie area. Modelling also predicts that annual average PM<sub>2.5</sub> ground level concentrations are below the NEPM standard of 8µg/m<sup>3</sup> at all sensitive receptors. Modelling also predicts that 24-hour PM<sub>2.5</sub> ground level concentrations exceed the NEPM standard of 25µg/m<sup>3</sup> at a number of sensitive receptors, most likely due to existing power station emissions. The BRDA's and the proposed expanded refinery will not significantly affect PM<sub>2.5</sub> ground level concentrations at the sensitive receptors. The issue of ambient PM<sub>2.5</sub> will require further consideration in the proponent's proposed air quality management study.

The EPA notes that a thermal oxidiser has been installed on the liquor burner and that odorous emissions from this source are now expected to be negligible. The EPA also notes that another significant reduction in odorous emissions is expected following the installation of a digestion emission control system during 2005. The EPA considers the proposed improvements to the digestion emission control system to be consistent with best practicable approach.

The EPA notes that odour modelling predicts the maximum odour concentration to be below the derived screening guideline value of 4.9 odour units/m<sup>3</sup>, with the exception of

one receptor (approximately 5.3 odour units/m<sup>3</sup>), following the expansion and implementation of the digestion emissions control system. The EPA understands that the proponent plans to conduct field and community odour surveys to verify the level of refinery odour at sensitive receptors following commissioning of the proposed expansion.

The EPA notes that the odour modelling that was undertaken did not include emissions from large area sources such as the BRDA and the refinery catchment lake. However, the EPA has recommended a condition requiring the proponent to prepare and implement an air quality management plan that will include measures to adequately address the issue of odour management. The condition (Condition 12 in Appendix 4 of this bulletin) will include:

- an air quality improvement plan addressing priority areas including VOC emissions from the calciner;
- a field odour assessment study;
- an assessment of odour from the refinery catchment lake; and
- an emissions monitoring program with emphasis on odour emissions from significant point and area sources.

The EPA notes that the HRA has concluded that there is a good degree of confidence that emissions from the refinery are very unlikely to cause direct acute or chronic health effects on the surrounding population, and that the Department of Health concurs with this conclusion. The EPA also notes that the HRA did not consider the impact of fugitive particulate emissions from the BRDA's. However, the EPA understands from the proponent's response to submissions that acute hazard indices have been recalculated in order to take particulate emissions from the BRDA's into consideration. The EPA notes that at Receptor 18 and Receptor 21, which are located to the north-north-west of the refinery, and would most likely be concurrently exposed to cumulative emissions from the refinery, BRDA's and power stations in the Collie area, the calculated acute hazard indices increase from 0.75 to 1.24 and from 1.1 to 1.27 respectively (based on maximum ground level concentrations). While these exceed the target acute hazard index determined in the HRA, the EPA notes that it is due to a number of conservative assumptions in the air dispersion modelling and related calculations, such as the inclusion of the proposed Collie B Power Station which is now unlikely to be built in the short to medium term, and emissions from the Muja A & B power stations which are scheduled to be decommissioned in 2007. The EPA notes that acute hazard indices based on 99.5<sup>th</sup> percentile ground level concentrations (i.e. those predicted to occur on two days of the year) for both Receptor 18 and Receptor 21 are less than one, which generally indicates that there is no cause for concern. In view of the above, the EPA considers that there still remains a good degree of confidence that the proposed expansion is unlikely to cause direct acute or chronic health effects on the surrounding population.

Having particular regard to the:

- (a) results of the air dispersion modelling undertaken for the ERMP document;

- (b) HRA’s conclusion that emissions from the refinery are very unlikely to cause direct acute or chronic health effects on the surrounding population, which is supported by Department of Health;
- (c) impact of particulate emissions from the BRDA’s on cumulative PM<sub>10</sub> and PM<sub>2.5</sub> ground level concentrations and hazard indices;
- (d) use of best practice pollution control technology in the refinery in the form of low NO<sub>x</sub> burners, flue gas desulphurisation, and baghouses to minimise NO<sub>x</sub>, SO<sub>2</sub>, and particulate emissions respectively;
- (e) commitment made by the proponent; and
- (f) recommended condition requiring the development and implementation of an air quality management plan;

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

### 3.4 Greenhouse gases

#### Description

Western Australia’s greenhouse gas emissions were estimated to be approximately 66Mtpa of carbon dioxide equivalents (CO<sub>2-e</sub>) for 2002 (Western Australian Greenhouse Taskforce, 2004). Western Australia contributes 12% of the total Australian greenhouse gas emissions of 539Mtpa of CO<sub>2-e</sub> (2002 estimate). On a world scale, Australia is estimated to contribute about 1% of the global greenhouse gas emissions (Western Australian Greenhouse Taskforce, 2004).

Worsley estimates that it currently emits 2.61Mtpa of CO<sub>2-e</sub> of which approximately 1.46Mtpa (55%) is produced by the coal-fired cogeneration facility. The proposed expansion, which will include a coal-fired cogeneration facility, is expected to increase Worsley’s greenhouse gas emissions by 1.11Mtpa to a total of approximately 3.72Mtpa of CO<sub>2-e</sub> as shown in Table 3 below. The proposed increase in greenhouse gas emissions represents approximately 0.2% of Australia’s baseline level.

**Table 3: Proposed increase in greenhouse gas emissions**

<b>Greenhouse Gas Emissions</b>	<b>Existing (3.25Mtpa)</b>	<b>Approved (3.7Mtpa)</b>	<b>Proposed (4.4Mtpa)</b>
CO <sub>2-e</sub> (Mtpa)	2.61	3.15	3.72

The proposed coal-fired cogeneration facility is the major source (62%) of the expected increase in greenhouse gas emissions. The thermal efficiency of the coal-fired cogeneration facility is about 79% [higher heating value (HHV)]. The energy efficiency of Worsley’s operations following the expansion is estimated to be 10,832MJ/t of alumina which is well below the world weighted average of 11,644MJ/t of alumina (International Aluminium Institute, 2004). Worsley’s greenhouse gas intensity (tonnes of CO<sub>2-e</sub> per tonne of alumina) reduced by 12% following the introduction of a gas-fired cogeneration facility in 2000.

## **Submissions**

The main issues raised in the submissions in relation to greenhouse gases included:

- the effect of additional greenhouse gases on public health and the environment; and
- the increase in greenhouse gas emissions from the liquor burning facility.

## **Assessment**

The EPA considers this proposal to be a significant contributor to Western Australia's greenhouse gas emissions. The EPA's objectives in regard to this environmental factor from both a global and Australian context, consistent with the State and National greenhouse Strategies, are to:

- minimise greenhouse gas emissions in absolute terms and reduce emissions per unit of product to as low as reasonably practicable; and
- mitigate greenhouse gas emissions, mindful of relevant Commonwealth and State environmental policies, including EPA Guidance Statement No. 12.

The EPA is aware that the Australian Government has committed to limit Australia's increase in greenhouse 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 generate significant emissions. To achieve this, the EPA expects that potential greenhouse gas emissions from proposed projects are adequately addressed in the planning, design and operation of projects, and that:

- best practicable measures are applied to maximise energy efficiency and minimise emissions;
- comprehensive analysis is undertaken, where residual impacts occur, to identify and implement appropriate offsets; and
- proponents undertake an on-going programme to monitor and report emissions and periodically assess opportunities to further reduce greenhouse gas emissions over time.

The EPA notes that the proponent has made the following commitment in regard to greenhouse gas emissions:

- Worsley will prepare and implement a Greenhouse Gas and Energy Conservation Plan for the project that:
  - maintains an inventory and reports project greenhouse emissions and greenhouse intensity;
  - evaluates and adopts best practice technology to improve project greenhouse intensity;
  - identifies, evaluates and implements greenhouse reduction and offset measures; such measures may be 'no regrets' or 'beyond no regrets measures'; and
  - maintains Worsley's participation in the Australian Greenhouse Challenge Plus program.

EPA Guidance Statement No. 12 - *Guidance Statement for Minimising Greenhouse Gas Emissions* outlines the EPA's expectations for the minimisation of greenhouse gas emissions from new proposals. The EPA expects the proponent to use best practicable measures to maximise energy efficiency and minimise greenhouse emissions to the lowest practicable level (EPA, 2002).

The EPA notes that the energy efficiency of the proponent's operations following the expansion is estimated to be 10,832MJ/t of alumina, which is about 7% less than the world weighted average of 11,644MJ/t of alumina.

The EPA notes that the proposed coal-fired cogeneration facility will have a thermal efficiency of about 79% HHV. However, the EPA has assessed another proposal from the proponent to utilise a gas turbine cogeneration facility in the refinery as an alternative to the coal-fired cogeneration facility that forms part of this proposal (EPA, 2005). The EPA notes that the gas turbine cogeneration facility will have a thermal efficiency of about 77% HHV, and that it would generate about 700,000tpa less greenhouse gases than the proposed coal-fired cogeneration facility. The EPA understands that the coal-fired cogeneration facility's slightly higher thermal efficiency is mainly due to it using return condensate from the plant, and having a higher ratio of steam production to electricity production in comparison to the gas turbine cogeneration facility (i.e. about 85.4% steam to 14.6% electricity versus about 63.6% steam to 36.4% electricity respectively). Generating electricity with steam is inherently less thermally efficient than generating steam for direct input into the refinery. Given the similar thermal efficiencies between the two alternative cogeneration facilities, the lower greenhouse gas emissions from the gas turbine cogeneration facility is mainly due to natural gas having a significantly lower carbon content than coal.

Nevertheless, while the EPA considers that a gas turbine cogeneration facility would represent the least greenhouse intensive means of meeting the required demand for additional process steam and electricity, and thus constitute best practice, the EPA is satisfied that the proposed coal-fired cogeneration facility is still more efficient than other alternative means of separately generating steam and electricity.

The EPA recommends that the standard ministerial condition (i.e. Condition 11 in Appendix 4 of this report) which is applied to all proposals with large greenhouse gas inventories, be imposed on this proposal. This condition requires a greenhouse gas emissions management plan to be prepared and implemented.

Having particular regard to the:

- (a) thermal efficiency of the coal-fired cogeneration facility being significantly greater than other alternative means of separately generating steam and electricity;
- (b) commitment made by the proponent; and
- (c) recommended condition requiring the development and implementation of a greenhouse gas management plan;

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



## 3.5 Noise

### Description

The proposed expansion may potentially impact on noise levels at sensitive premises as a result of increased noise emissions from the following main areas of Worsley's operations:

- refinery plant and equipment;
- bauxite conveying;
- bauxite mining; and
- rail and truck movements.

Noise from the refinery, mining, and conveying is subject to the *Environmental Protection (Noise) Regulations, 1997*. Noise from rail and truck movements is not subject to the Regulations.

#### *Refinery noise*

A small increase of about 0.4dB(A) in the total sound power levels from the refinery is expected following the expansion. SVT Engineering Consultants (2004) developed an acoustic model to predict the noise impacts of the expansion at the nearest residences. Noise levels at the nearest residences are predicted to comply with the assigned noise levels under the *Environmental Protection (Noise) Regulations, 1997*, but are expected to increase by 0.1 to 0.4dB(A) following the expansion.

#### *Bauxite conveying*

The expansion may potentially impact on noise levels in the vicinity of the bauxite transport corridors as a result of:

- increased operating capacity of the existing 51km bauxite conveyor; and
- operation of a new conveyor system to transport ore from proposed new mining areas.

The proponent engaged SVT Engineering Consultants to develop sound power levels for the existing bauxite conveyor and model noise emissions for the existing and proposed conveyor capacity to determine potential impacts on sensitive premises. The specific noise levels and monitoring requirements for the existing bauxite conveyor are prescribed in the Agreement Act (i.e. the noise from the operation of the conveyor shall not exceed 60dB(A) for 90% of any 15-minute period, at a distance of 900m from the conveyor). Modelling indicates that noise emissions from the conveyor will comply with the Agreement Act following the expansion and that there will be little variation in noise impacts on sensitive premises.

Worsley is proposing to install a new conveyor system to transport ore from the new mining areas. The new conveyor will use a conventional idler-type of system which has been shown to be significantly quieter than the existing cable belt conveyor. Noise

modelling of the proposed new conveyor system indicates that no noise sensitive premises are currently located within the predicted 35dB(A) noise contour.

### *Mining noise*

Mining activities that may potentially affect noise levels at sensitive premises include:

- blasting of caprock and ore;
- mining and transport of ore and other materials; and
- crushing of ore.

Although mining operations occur on a continuous basis, blasting is generally restricted to between 11:30am and 1:30pm each day, with the exception of Sundays and public holidays. All blasts are monitored at nearest sensitive premises and airblast levels were well below the levels set by the *Environmental Protection (Noise) Regulations, 1997* for the 2002 to 2004 period. Ten blasts were also monitored for ground vibration during this period and were below the limit required by the Australian Standard AS 2187.2 (1993) Part 2.

The proposal to increase the rate of mining and to move into new mining areas will increase the risk of noise at some sensitive premises. Worsley identifies the potentially most affected residence before each blast and monitors airblast levels at that location. Ground vibration measurement is undertaken whenever an new area is blasted for the first time or if the distance from the blast to the nearest residence is less than 0.7km.

Noise modelling predicts that unless special noise management measures are undertaken the proposal may potentially impact on the noise amenity of a small number of premises that are located near the proposed new mining areas of Hotham North Extension, Central, and Brookton. Worsley's management measures include:

- restricting out of hours mining operations or limiting use of mining equipment;
- reducing mining noise levels by progressively acquiring equipment with lower noise emission levels;
- limiting machinery speed and load;
- bunding; and
- compensatory agreement.

### *Rail noise*

The expansion will result in an increase in the number of daily train movements for Worsley's operations as shown in Table 4 below.

**Table 4: Daily train movements and predicted noise impacts**

Rail track	Daily Rail Movements			Noise Impact
	Existing	Proposed	Increase	Increase in $L_{Aeq}$ dB(A)
Worsley - Brunswick	12	20	8	2.1 – 2.2
Collie - Worsley	2	4	2	2.5 – 3.0
Brunswick - Bunbury	20	28	8	1.5

Seven day continuous noise logging was conducted in order to estimate day and night  $L_{Aeq}$  noise levels for the existing and proposed train movements (SVT, 2004). The predicted increase in noise impacts (maximum  $L_{Aeq}$ ) as a result of the additional rail movements is shown in Table 4.

## **Submissions**

The main issues raised in the submissions in relation to noise included:

- more evidence is required to determine if noise at the Ballingal property is tonal or not;
- further information, including maximum noise levels and number of events, is required to determine the extent of the impact of night-time rail noise between Worsley siding and Brunswick Junction;
- a number of questions were raised concerning the State Agreement, including whether it had precedence over the *Environmental Protection (Noise) Regulations, 1997* and whether it applied to future conveyors;
- a number of questions were raised in relation to the mine, including operating hours, tonality of noise emissions, modelling considerations and noise complaints;
- an approximate doubling of train movements on the Refinery to Collie and Refinery to Bunbury Port is considered to be significant with the port environs being the most contentious;
- the cumulative noise impact of increased rail traffic due to all of the proposed expansions in the region was sought;
- concern was expressed that the proposal would result in an increase in noise from mining, including blasting and transport (duration of conveyor operation); and
- noise impacts should also consider recreational stakeholders such as bushwalkers. Transport and crusher noise will impact on at least three known walk areas.

## **Assessment**

The area considered for assessment of this factor is the Worsley Alumina Refinery, the mine sites, transport corridors, and the surrounding areas, including residences in and around the town of Collie.

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

- noise emissions from construction and operation of the proposed power station comply with the *Environmental Protection (Noise) Regulations, 1997*; and
- cumulative noise emissions from existing and proposed industrial and mining activities in the area meet acceptable standards.

The EPA notes that the proponent has made the following commitments in regard to noise:

- Worsley will prepare and implement a Noise and Vibration Management Plan that will address the following:

- forecasting of operational noise;
- measures to ensure compliance with noise regulations. These will include mine planning and day to day noise forecasting;
- measures to control noise emissions from mining equipment;
- monitoring of operational and blast noise and vibration;
- implementation of corrective and preventative actions where in-house targets are exceeded;
- response to complaints; and
- community consultation;
- prepare a Noise Management Plan - Bauxite Transport which will address the following:
  - the use of noise emissions modelling in the siting of transport corridors;
  - monitoring of noise emissions from conveyor systems;
  - operational procedures and standards, including corrective actions for ensuring compliance with Agreement Act requirements; and
  - identification of potential noise sensitive premises;
- Worsley will prepare and implement a Noise Management Plan - Refinery which will include the following:
  - noise monitoring program;
  - maintenance of refinery noise model;
  - actions to ensure compliance with noise regulations; and
  - establishment of noise standards for use in acquisition of new noise emitting equipment.

The EPA notes that noise modelling for the proposed refinery expansion predicts that noise levels at the nearest residences will comply with the assigned noise levels under the *Environmental Protection (Noise) Regulations, 1997*.

The EPA notes that modelling indicates that noise emissions from the existing conveyor will comply with the Agreement Act following the expansion, and that no noise sensitive premises are currently located within the predicted 35dB(A) noise contour of the proposed new conveyor system.

The EPA notes that mining activities may potentially impact on the noise amenity of a small number of premises that are located near the proposed new mining areas of Hotham North Extension, Central, and Brookton. However, the EPA considers that the proponent's proposed noise management measures are adequate in terms of ensuring that any impact on nearby residents will be minimised.

The EPA notes that cumulative noise levels are predicted to rise in the vicinity of the Worsley-Brunswick, Collie-Worsley, and Brunswick-Bunbury railway lines as a result of the increased number of rail movements that would be required for Worsley's proposed expansion. A review of the ERMP noise assessment was undertaken by Lloyd

Acoustics Pty Ltd for the DoE. The review found that the increase in noise during the day due to extra train movements for Worsley's expansion was unlikely to be significant. However, the increase during night-time may be significant between Worsley Siding to Brunswick Junction and Brunswick to Bunbury. The review determined that it would be useful to obtain additional information on maximum noise levels and how frequently they occur during night-time for the different sections as sleep disturbance may possibly become an issue with the proposed expansion. The review also determined that a more detailed analysis is required to examine the distance to residences along the length of the railway and to consider the impact of other projects and the changing conditions along the track, including topography and train operation (notch settings, length, and locomotive type etc).

The EPA recognises that there are other users of the existing railways which also contribute to cumulative noise levels. Accordingly, the EPA considers that it is beyond the proponent to manage cumulative noise levels associated with rail movements along the Worsley-Brunswick, Collie-Worsley, and Brunswick-Bunbury railway lines. The EPA considers that an alternative approach to managing cumulative rail transportation noise levels is required. The EPA provides further advice on this matter in Section 5 of this report.

## **Summary**

Having particular regard to the:

- (a) results of the noise modelling undertaken for the ERMP document;
- (b) need for an alternative approach for the management of cumulative rail transportation noise levels; and
- (c) the commitments made by the proponent;

it is the EPA's opinion that the proposal can be managed to meet the EPA's environmental objective for this factor provided that the alternative approach for the management of cumulative rail transportation noise levels is satisfactorily implemented.

## **3.6 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*. Table 5 contains a summary of the EPA's consideration of the principles.

## **4. 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.

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.

#### **4.1 Proponent's commitments**

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

Project wide:

1. Environmental management;
2. Greenhouse gases;
3. Closure;
4. Waste disposal (other than bauxite disposal);

Mining operations:

5. vegetation, flora, fauna and rehabilitation;
6. Forest disease;
7. Rehabilitation;
8. Water resources;
9. Dust;
10. Noise and vibration;
11. European heritage and recreation;

Bauxite transport corridors:

12. Relevant environmental factors - construction;
13. Relevant environmental factors - operation;
14. Noise;

Refinery:

15. Air emissions;
16. Noise; and
17. Water resources.

## **4.2 Recommended conditions**

Having considered the proponent's commitments and the information provided in this report, the EPA has developed a set of conditions that the EPA recommends be imposed if the proposal by Worsley Alumina Pty Ltd to upgrade the Worsley refinery in order to increase production from 3.25 million tonnes per annum (Mtpa) to 4.4Mtpa, is approved for implementation.

These conditions are presented in Appendix 4. Matters addressed in the conditions include the following:

- (a) that the proponent shall fulfil the commitments in the Consolidated Commitments statement set out as an attachment to the recommended conditions in Appendix 4;
- (b) compliance audit and performance reviews;
- (c) preparation and implementation of biodiversity investigations and a biodiversity investigations report;
- (d) the protection of biodiversity in environmentally sensitive areas, including those identified in the biodiversity investigations;
- (e) preparation and implementation of transport corridor route plans;
- (f) preparation and implementation of bauxite mining plans;
- (g) preparation and implementation of a rehabilitation plan;
- (h) preparation and implementation of a water resource management plan;
- (i) preparation and implementation of a greenhouse gas emissions management plan;
- (j) preparation and implementation of an air quality management plan; and
- (k) preparation and implementation of decommissioning plans.

## **5 Other advice**

### **5.1 Rail noise**

As well as assessing the Worsley expansion project, the EPA is also assessing a proposed expansion of Alcoa's Wagerup refinery which will also require additional train movements through to Bunbury port. The EPA is concerned that the cumulative noise impacts from these projects, together with any other increase in traffic along these railway lines may unreasonably impact on residences along the lines.

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

Ensuring the timely investigation and implementation of noise mitigation measures will require further work, particularly in terms of projections of the number of train movements (particularly at night), types of trains, and the location of sensitive premises. This information has not been available to the EPA during this assessment.

The EPA considers that this further work would most appropriately be pursued through a working group comprising of Worsley Alumina Pty Ltd, other private operators and users of the railway lines in question, the Department for Planning and Infrastructure (DPI), the Public Transport Authority (PTA), Main Roads Western Australia (MRWA), the Bunbury Port Authority, the DoE, and relevant local government authorities.

## **6 Conclusions**

The EPA has considered the proposal by Worsley Alumina Pty Ltd to upgrade the Worsley refinery in order to increase production to 4.4Mtpa.

The EPA notes that none of the proposed mining envelopes are in areas which are proposed to be reserved for conservation. Notwithstanding this, the EPA considers that the proposed clearing and mining has potential to have significant impact on the environmental values of the State Forest if not planned, investigated, managed, and rehabilitated to a very high standard.

The EPA notes the results of the flora and fauna surveys that have been undertaken to date for the proposed expansion. However, the EPA considers that there is a need for further comprehensive investigations to be undertaken in order to establish a better understanding of the biodiversity of the areas within and in proximity to the proposed new mining areas. The EPA has recommended a condition (Condition 6 in Appendix 4) requiring the proponent to undertake comprehensive biodiversity related investigations which focus on the areas within and in proximity to the proposed new mining areas, and to prepare a biodiversity investigations report.

The EPA considers that there are areas within which mining or transport corridor construction activities associated with the proposed expansion should not be permitted in order to protect their biodiversity values. To safeguard these areas, and any others identified by the biodiversity investigations, the EPA has recommended that a condition (Condition 7 in Appendix 4) be imposed on the proponent preventing it from undertaking any mining or transport corridor construction activities that would result in the direct or indirect disturbance of heathland, significant vegetation complexes, threatened ecological communities, granite outcrops, significant populations of DRF, populations of Threatened Fauna, stream zones, and the habitat of Threatened or Priority Fauna.

The EPA has also recommended a condition (Condition 8 in Appendix 4) requiring the proponent to prepare transport corridor route plans which show the route and area of disturbance for each proposed transport corridor. The transport corridor route plans will need to outline how the selected route complies with the requirements of the biodiversity investigations report and recommended Condition 7.



As part of the Agreement Act, Worsley is required to undertake long-term planning and submit a rolling Ten Year Mine Plan which includes details of long-term exploration and mining plans. Consistent with this, the EPA has recommended a condition (Condition 9 in Appendix 4) requiring the proponent to prepare a bauxite mining plan to demonstrate how the requirements of the biodiversity investigations have been addressed for each specific area that will be subject to mining or transport corridor construction activities.

The EPA has recommended a condition (Condition 10 in Appendix 4) requiring the proponent to prepare a rehabilitation plan which will ensure that the planning and implementation of rehabilitation is undertaken in a manner consistent with industry best practice, and that rehabilitated areas will ultimately develop sustainable systems compatible with surrounding areas.

In line with the 10 year mine planning, the EPA considers this provides adequate planning and time for Worsley to undertake the detailed salinity and water resource management assessments necessary prior to commencing clearing in any mine area. This includes development of predictive tools to estimate the extent of water table rise and any impacts on salinity. The water resource management plan proposed by Worsley should include upper-limit criteria for salinity which must be demonstrated to be achievable through the modelling and other assessment. These criteria should relate to both water use and protection of stream ecosystem.

The EPA notes that the mining extension area covers a small area of a number of public drinking water catchments. Close consultation will need to be maintained with the Water and Rivers Commission and the Water Corporation on the detailed salinity and water resources assessments in these areas. The assessments will need to demonstrate that there is negligible risk of adverse water quality impacts in these areas, prior to mining being allowed. Particular consideration also needs to be given to rehabilitation of any areas mined in the drinking water catchments to manage long-term stream flow rates.

The EPA has recommended a condition (Condition 11 in Appendix 4) requiring the proponent to not carry out any ground disturbing activities in areas proclaimed as water reserves or catchment areas under the *Metropolitan Water Supply, Sewerage, and Drainage Act, 1909*, or the *Country Areas Water Supply Act, 1947*, prior to the preparation of a water resource management plan for mining (in accordance with Commitment No. 8 in this report). The water resource management plan will need to demonstrate that the activities are likely to have negligible impact on the quality of water supplies from the catchment.

The EPA considers that the water resource management plan for the refinery that the proponent has committed to prepare and implement, together with the surface water, groundwater, and underdrainage monitoring program that is maintained by the proponent under the requirements of the existing environmental licence conditions and the *Alumina Refinery (Worsley) Agreement Act, 1973*, will adequately address water use within the refinery and the management of surface water and groundwater.

The refinery will use low NO<sub>x</sub> burners, flue gas desulphurisation, and baghouses to minimise NO<sub>x</sub>, SO<sub>2</sub>, and particulate emissions respectively. The EPA considers that

this demonstrates the implementation of best practicable technology by the proponent in relation to minimising the discharge of atmospheric emissions.

Air dispersion modelling indicates that cumulative NO<sub>x</sub>, SO<sub>2</sub>, and ozone ground level concentrations will not exceed the relevant NEPM standards. Maximum 24-hour average PM<sub>10</sub> ground level concentrations due to the refinery in isolation are predicted to be well below the NEPM standard at all receptors. Air toxics are also predicted to be low.

The proposed expansion will not require an increase in the bauxite residue disposal area (BRDA) footprint. Although fugitive particulate emissions from the BRDA's were not included in the air dispersion modelling that was undertaken for the ERMP document, additional cumulative modelling that was subsequently undertaken indicates that the proposed expanded refinery and the BRDA's do not significantly contribute to predicted exceedances of the 24-hour PM<sub>10</sub> and PM<sub>2.5</sub> NEPM standards at a number of sensitive receptors. The predicted exceedances are predominantly due to emissions from the existing power stations in the Collie area.

The EPA notes that a thermal oxidiser has been installed on the liquor burner and that odorous emissions from this source are now expected to be negligible. Odour modelling that was undertaken for the ERMP document did not include emissions from large area sources such as the BRDA's and the refinery catchment lake. However, the EPA has recommended a condition requiring the proponent to prepare and implement an air quality management plan that will include measures to adequately address the issue of odour management. The condition will include:

- an air quality improvement plan addressing priority areas including VOC emissions from the calciner;
- a field odour assessment study;
- an assessment of odour from the refinery catchment lake; and
- an emissions monitoring program with emphasis on odour emissions from significant point and area sources.

The EPA notes that the health risk assessment (HRA) has concluded that there is a good degree of confidence that emissions from the refinery are very unlikely to cause direct acute or chronic health effects on the surrounding population, and that the Department of Health concurs with this conclusion. The HRA did not consider the impact of fugitive particulate emissions from the BRDA's. However, as part of the proponent's response to submissions, acute hazard indices have been recalculated in order to take particulate emissions from the BRDA's into consideration. While the revised hazard indices exceed the target acute hazard index determined in the HRA at a number of receptors, the EPA notes that it is due to a number of conservative assumptions in the air dispersion modelling and related calculations, such as the inclusion of the proposed Collie B Power Station which is now unlikely to be built in the short to medium term, and emissions from the Muja A & B power stations which are scheduled to be decommissioned in 2007. Overall, the EPA considers that there still remains a good degree of confidence that the proposed expansion is unlikely to cause direct acute or chronic health effects on the surrounding population.

The energy efficiency of the proponent's operations following the expansion is estimated to be 10,832MJ/t of alumina, which is about 7% less than the world weighted average of 11,644MJ/t of alumina. The proposed expansion will include a coal-fired cogeneration facility that will generate about 700,000tpa more greenhouse gases than an alternative gas turbine cogeneration facility that was recently assessed by the EPA. While the EPA considers that a gas turbine cogeneration facility would represent the least greenhouse intensive means of meeting the required demand for additional process steam and electricity, and thus constitute best practice, the EPA is satisfied that the proposed coal-fired cogeneration facility is still more efficient than other alternative means of separately generating steam and electricity.

The EPA notes that noise modelling for the proposed refinery expansion predicts that noise levels at the nearest residences will comply with the assigned noise levels under the *Environmental Protection (Noise) Regulations, 1997*. Modelling also indicates that noise emissions from the existing conveyor will comply with the Agreement Act following the expansion, and that no noise sensitive premises are currently located within the predicted 35dB(A) noise contour of the proposed new conveyor system.

Mining activities may potentially impact on the noise amenity of a small number of premises that are located near the proposed new mining areas of Hotham North Extension, Central, and Brookton. However, the EPA considers that the proponent's proposed noise management measures are adequate in terms of ensuring that any impact on nearby residents will be minimised.

Cumulative noise levels are predicted to rise in the vicinity of the Worsley-Brunswick, Collie-Worsley, and Brunswick-Bunbury railway lines as a result of the increased number of rail movements that would be required for Worsley's proposed expansion. A review of the ERMP noise assessment found that the increase in noise during the day due to extra train movements for Worsley's expansion was unlikely to be significant. However, the increase during night-time may be significant between Worsley Siding to Brunswick Junction and Brunswick to Bunbury. The review determined that it would be useful to obtain additional information on maximum noise levels and how frequently they occur during night-time for the different sections as sleep disturbance may possibly become an issue with the proposed expansion. The review also determined that a more detailed analysis is required to examine the distance to residences along the length of the railway and to consider the impact of other projects and the changing conditions along the track, including topography and train operation (notch settings, length, and locomotive type etc).

The EPA recognises that there are other users of the existing railways which also contribute to cumulative noise levels. The EPA considers that it is beyond the proponent's ability to manage cumulative noise levels associated with rail movements along the Worsley-Brunswick, Collie-Worsley, and Brunswick-Bunbury railway lines. The EPA considers that an alternative approach to managing cumulative rail transportation noise levels is required. The EPA provides further advice on this matter in Section 5 of this report.

The EPA has therefore concluded that it is unlikely that the EPA's objectives would be compromised, provided there is satisfactory implementation by the proponent of their

commitments and the recommended conditions set out in Appendix 4, and summarized in Section 4.

## **7 Recommendations**

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

1. That the Minister notes that the proposal being assessed is the upgrade of the Worsley refinery in order to increase production to 4.4Mtpa;
2. That the Minister considers the report on the relevant environmental factors and principles as set out in Section 3;
3. That the Minister notes that the EPA has concluded that it is unlikely that the EPA's objectives would be compromised, provided there is satisfactory implementation by the proponent of the recommended conditions set out in Appendix 4, and summarised in Section 4, including the proponent's commitments; and
4. That the Minister imposes the conditions and procedures recommended in Appendix 4 of this report.

# **Appendix 1**

## **List of submitters**

**Organisations:**

1. All Dog Sledding and Carting Club of WA.
2. Conservation Commission of WA.
3. Conservation Council of WA.
4. Department of Conservation and Land Management.
5. Department of Environment (Air Quality Division).
6. Department of Environment (South West Region).
7. Department of Health.
8. Department of Indigenous Affairs.
9. Federation of Western Australian Bushwalkers Inc.
10. Fire & Emergency Services Authority of WA.
11. Lloyd Acoustics Pty Ltd (for the Department of Environment).
12. Radiological Council.
13. Rail Heritage Foundation of WA Inc.
14. Shire of Collie.
15. Shire of Harvey.
16. Water Corporation.
17. Western Australian Museum.

**Individuals:**

1. Catherine Dowdell.
2. David Osborne.
3. Dr Graham Thompson.
4. Jennifer Catalano.
5. S. Edwards.
6. Susan Lee.
7. Trish and Rob Bowden and Angela and Keith Davies.

# **Appendix 2**

## **References**

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## **Appendix 3**

**Summary of identification of relevant environmental factors and principles**

**Table 5: Identification of relevant environmental factors and principles**

Preliminary Environmental Factors	Proposal Characteristics	Government Agency and Public Comments	Identification of Relevant Environmental Factors
<b>BIOPHYSICAL</b>			
<p><b>Flora</b></p>	<p>The total area of the proposed mining extension is 74,000ha which includes 54,774ha of remnant vegetation. However, disturbance within this area will be in discrete pods over a 30-35 year life of project.</p> <p>A precise estimate of the mining pod areas requires higher intensity exploration. At this stage estimated area of clearing is 20,235ha.</p> <p>Based on preliminary estimates, the affected areas of poorly represented vegetation communities (i.e. those with less than 30% pre-European extent remaining) is anticipated to be less than:</p> <ul style="list-style-type: none"> <li>• 1.1%, 0.2%, and 4.6% of extant areas of Michibin, Dalmore 2 and Lukin 2 vegetation complexes; and</li> <li>• 0.004% and 0.2% of the extant area of vegetation association 946 and vegetation association 4.</li> </ul> <p>No Declared Flora (DRF) were located by Bennett (2004). However, 3 species are listed as possibly occurring in the mining envelope area.</p> <p>Eleven Priority species were recorded by Bennett (2004). Fourteen other species were recorded with significance due to restricted distribution or extent of distribution. Heath communities and granite rock communities, which are encouraged for conservation are scattered throughout the Brookton and Central mining envelopes.</p> <p>Dieback is widespread throughout the Brookton and Central mining envelopes. Four species of weeds were recorded by Bennett (2004). The proposal will increase the threat of dieback and weeds.</p> <p>Other threats are loss of productivity due to dust on leaves, water table rise due to clearing, alteration of water courses affecting dependent vegetation, and accidental wildfires.</p>	<p><b>Department of Conservation and Land Management</b></p> <ol style="list-style-type: none"> <li>1. Not enough information has been provided to adequately meet the requirements of EPA Guidance Statement No. 51;</li> <li>2. There have been errors in survey methodology application, analysis and interpretation;</li> <li>3. Not enough information has been provided to justify success of the proposed rehabilitation of disturbed areas; and</li> <li>4. The proposed bauxite conveyor alignments have not been adequately assessed in terms of impacts such as the potential to spread dieback.</li> </ol> <p><b>Conservation Commission of Western Australia</b></p> <ol style="list-style-type: none"> <li>1. The rate and overall change to landscape from increased mining needs to be properly addressed.</li> <li>2. The Conservation Commission of Western Australia supports a staged approach to address: progress in rehabilitation, uncertainty about detail of ecosystem values, and actual development program.</li> <li>3. A mid term audit of performance under the Forest Management Plan 2004-2013 is to be provided to the EPA by the end of 2008, with an end of term audit in December 2012.</li> </ol> <p><b>Public</b></p> <p>Private citizens and the Conservation Council of WA raise concerns regarding:</p> <ol style="list-style-type: none"> <li>1. Sustainability of continued clearing in Jarrah forests;</li> <li>2. Sustainability of continued mining in Jarrah forests;</li> <li>3. Destruction of forested areas;</li> <li>4. Success rate of rehabilitation in mined areas; and</li> <li>5. Potential for the spread of dieback and weeds from the proposed conveyor.</li> </ol>	<p>In view of the nature of the concerns that were raised in the comments that were received, the EPA considers that flora is a relevant environmental factor. Flora will be considered under the factor of conservation of biodiversity.</p>

**Table 5: Identification of relevant environmental factors and principles**

Preliminary Environmental Factors	Proposal Characteristics	Government Agency and Public Comments	Identification of Relevant Environmental Factors
<b>BIOPHYSICAL</b>			
<p><b>Fauna</b></p>	<p>Forest clearing may result in loss of habitat, direct fauna deaths, reduction in carrying capacity, fragmentation and isolation of habitat and habitat continuums. Project operations may result in disturbance of fauna due to noise, light and injury due to vehicle movements. Seven broad habitats identified:</p> <ul style="list-style-type: none"> <li>• Wandoo woodland - large hollows may be used by cockatoos;</li> <li>• Jarrah forest;</li> <li>• Dryandra thickets - food source for Carnaby’s Black Cockatoo, important for nectivorous birds and mammals, and for sheltering fauna such as kangaroos and wallabies;</li> <li>• Sheok woodland;</li> <li>• Heath - important for nectivorous birds and mammals, and for sheltering fauna such as kangaroos and wallabies;</li> <li>• Granite outcrops and lateritic breakaways - can support specialized fauna, including some reptile species, rocky pools can be important for breeding frogs and some invertebrates; and</li> <li>• Streams and dams - important source of drinking water for terrestrial fauna and as a breeding site for frogs.</li> </ul> <p>The following species, which are listed under the <i>WA Wildlife Conservation Act, 1950</i> and <i>Commonwealth Environment Protection and Biodiversity Conservation Act, 1999</i> may be present:</p> <ul style="list-style-type: none"> <li>• <i>Morelia spilota imbricata</i> (South West Carpet Python);</li> <li>• <i>Calyptorhynchus latirostris</i> (Carnaby’s Black-Cockatoo);</li> <li>• <i>Calyptorhynchus baudinii</i> (Baudin’s Black-Cockatoo);</li> <li>• <i>Leipoa ocellate</i> (Malleefowl);</li> <li>• <i>Falco peregrinus</i> (Peregrine Falcon);</li> </ul>	<p><b>Department of Conservation and Land Management</b></p> <ol style="list-style-type: none"> <li>1. Not enough information has been provided to adequately meet the requirements of EPA Guidance Statement No. 56; and</li> <li>2. The field investigation within the project area is inadequate to properly assess impact on fauna.</li> </ol> <p><b>Conservation Commission of Western Australia</b></p> <p>In accordance with Action 5.1 of the Forest Management Plan 2004-2013, protection of ‘indicative fauna habitat zones’ in and adjacent to mining envelopes should be ensured.</p> <p><b>WA Museum</b></p> <ol style="list-style-type: none"> <li>1. Faunal surveys should be undertaken prior to commencement of mining activities in all areas;</li> <li>2. Long-term faunal surveys should be undertaken to identify impacts of habitat disturbance/loss on faunal groups; and</li> <li>3. An independent assessment of biodiversity should be carried out in conjunction with monitoring of areas adjacent to mining activities.</li> </ol> <p><b>Public</b></p> <p>Private citizens and the Conservation Council of WA raise concerns regarding:</p> <ol style="list-style-type: none"> <li>1. Detailed fauna surveys as committed by Worsley in the Scoping document not being completed or undertaken;</li> <li>2. Fauna surveys carried out to date are not in compliance with EPA Guidance Statement No. 56 and EPA Position Statement No. 3;</li> <li>3. Adequacy of proponent commitments and compliance; and</li> <li>4. Implications of habitat destruction and fragmentation for native fauna species.</li> </ol>	<p>In view of the nature of the concerns that were raised in the comments that were received, the EPA considers that fauna is a relevant environmental factor. Fauna will be considered under the factor of conservation of biodiversity.</p>

**Table 5: Identification of relevant environmental factors and principles**

Preliminary Environmental Factors	Proposal Characteristics	Government Agency and Public Comments	Identification of Relevant Environmental Factors
<b>BIOPHYSICAL</b>			
<p><b>Fauna (Continued)</b></p>	<ul style="list-style-type: none"> <li>• <i>Merops ornatus</i> (Rainbow Bee-eater);</li> <li>• <i>Apus pacificus</i> (Fork tailed Swift);</li> <li>• <i>Phascogale calura</i> (Red-tailed Phascogale);</li> <li>• <i>Dasyurus geoffroi</i> (Chuditch);</li> <li>• <i>Pseudocheirus occidentalis</i> (Western Ringtail Possum);</li> <li>• <i>Myrmecobius fasciatus</i> (Numbat); and</li> <li>• <i>Setonix brachyurus</i> (Quokka).</li> </ul> <p>Species that are not listed under State or Commonwealth Acts but listed in publications as Threatened Fauna or as Priority species by CALM are:</p> <ul style="list-style-type: none"> <li>• <i>Ctenotus delli</i> (Darling Range Ctenotus);</li> <li>• <i>Calyptorhynchus banksii naso</i> (Forest Red-Tailed Black Cockatoo);</li> <li>• <i>Ninox connivens</i> (Barking Owl);</li> <li>• <i>Tyto novaehollandiae novaehollandiae</i> (Masked Owl);</li> <li>• <i>Burhinus grallarius</i> (Bush Stone-Curlew); and</li> <li>• <i>Falcunculus frontatus</i> (Crested Shrike-Tit).</li> </ul> <p>Species not listed under Acts or in publications but considered at least of local significance because of their pattern of distribution are:</p> <ul style="list-style-type: none"> <li>• 4 species of spiders;</li> <li>• <i>Lophoictinia isura</i> (Square-Tailed Kite);</li> <li>• <i>Stagonopleura oculata</i> (Red-Eared Firetail);</li> <li>• <i>Platycercus icterotis</i> (Western Rosella);</li> <li>• <i>Eopsaltria griseogularis</i> (Western Yellow Robin);</li> <li>• <i>Pachycephala pectoralis</i> (Golden Whistler);</li> <li>• <i>Phylidonoris melanops</i> (Tawny-Crowned Honeyeater);</li> <li>• <i>Petroica multicolour</i> (Scarlet Robin);</li> <li>• <i>Artamus cinereus</i> (Black-faced Woodswallow);</li> <li>• <i>Artamus cyanopterus</i> (Dusky Woodswallow);</li> <li>• <i>Myiagra inquieta</i> (Restless Flycatcher);</li> <li>• <i>Strepera versicolor</i> (Grey Currawong); and</li> <li>• <i>Cinclorhamphus mathewsi</i> (Rufous Songlark).</li> </ul>	<p>(Refer to previous page)</p>	<p>In view of the nature of the concerns that were raised in the comments that were received, the EPA considers that fauna is a relevant environmental factor. Fauna will be considered under the factor of conservation of biodiversity.</p>

**Table 5: Identification of relevant environmental factors and principles**

Preliminary Environmental Factors	Proposal Characteristics	Government Agency and Public Comments	Identification of Relevant Environmental Factors
<b>BIOPHYSICAL</b>			
<p><b>Surface water and groundwater</b></p>	<p>There is a potential for the water table to rise due to clearing. However, in recent years the water table rise in the existing mining envelope has been offset due to a decline in average annual rainfall.</p> <p>A rising water table increases the threat of salinity, water-logging and spread of dieback.</p> <p>The proposed mining extension areas lie across three major catchments: the Avon River, Swan Coast and Murray River.</p> <p>The main watercourses are the Dale, Murray, Williams and Hotham rivers and the upper tributaries of the Canning and Serpentine rivers as well as smaller watercourses draining into these systems. The smaller watercourses are typically ephemeral.</p> <p>The proposed transport corridor crosses watercourses and has the potential to result in sediment transport into natural waterways and disturbance to some in-stream and riparian vegetation.</p> <p>Construction may require disturbance to some CAR informal reserves.</p> <p>Public water supply catchments within the mining envelope and adjacent to it are currently at least 96% forested.</p> <p>Clearing of all available bauxite resource would disturb 5% or less of any catchment.</p>	<p><b>Water Corporation</b></p> <ol style="list-style-type: none"> <li>1. Degradation of water quality due to salinisation caused by clearing of forest;</li> <li>2. Reduction of water quantity due to mining requirements and over-dense rehabilitation; and</li> <li>3. Reduction of down-stream water quality as a result of mining activities.</li> </ol> <p><b>Department of Conservation and Land Management</b></p> <p>Raised concerns over Worsley’s planned use of potable water for industrial purposes, citing it places undue pressure on Catchment areas.</p> <p><b>Department of Health</b></p> <p>The Department of Health considers that water resource issues relating to impact on public health have been adequately investigated and the proposed management strategies are anticipated to be adequate.</p> <p><b>Public</b></p> <p>Private citizens and the Conservation Council of WA raised concerns regarding the:</p> <ol style="list-style-type: none"> <li>1. Quantity of water the project will consume;</li> <li>2. Potential for pollution of groundwater from waste products generated in the refinery;</li> <li>3. Potential negative impact to surface water systems as a result of mining in catchments; and</li> <li>4. Increased salinity in the general area as a result of clearing and excavation.</li> </ol> <p><b>Department of Environment (South West Region)</b></p> <p>Raised concerns in relation to the source of additional water if it is required and the need for information on alternative sources, as well as impacts of refinery emissions, mining, conveyors, and rehabilitation on water quality and quantity.</p> <p><b>Shire of Harvey</b></p> <p>Need to ensure that sufficient environmental flows are available for the Brunswick River and its tributaries.</p>	<p>In view of the nature of the concerns that were raised in the comments that were received, the EPA considers that surface water and groundwater is a relevant environmental factor.</p>
<p><b>Landforms and soil</b></p>	<p>Clearing for mining operations results in temporary disturbance of the landscape. The mining process will alter the soil profile.</p> <p>There is potential for soil erosion.</p>	<p><b>Public</b></p> <p>Private citizens and the Conservation Council of WA raised concerns regarding:</p> <ol style="list-style-type: none"> <li>1. Modification to the landscape, specifically removal of caprock and large quantities of earth; and</li> <li>2. Not enough information is known about the below ground biota, it’s interactions in ecosystems and the impact mining will have on it.</li> </ol>	<p>The EPA considers that the concerns that were raised have been adequately addressed by the responses provided by the proponent. In view of the above, the EPA considers that this environmental factor does not require further evaluation.</p>

**Table 5: Identification of relevant environmental factors and principles**

Preliminary Environmental Factors	Proposal Characteristics	Government Agency and Public Comments	Identification of Relevant Environmental Factors																																		
<b>POLLUTION</b>																																					
<p><b>Air quality</b></p>	<p>The increase in production rate from the approved 3.7Mtpa to 4.4Mtpa will result in the following changes in refinery emissions to the atmosphere:</p> <ul style="list-style-type: none"> <li>• 10,370tpa of SO<sub>2</sub> increases to 12,221tpa;</li> <li>• 6650tpa of NO<sub>x</sub> increases to 6892tpa; and</li> <li>• 512tpa of total particulates increases to 522tpa.</li> </ul> <p>The following percentage increases will apply:</p> <table border="0"> <tr><td>• arsenic</td><td>15.0%</td></tr> <tr><td>• benzene</td><td>15.8%</td></tr> <tr><td>• benzo(a)pyrene</td><td>19.9%</td></tr> <tr><td>• carbon monoxide</td><td>28.8%</td></tr> <tr><td>• fluoride</td><td>19.8%</td></tr> <tr><td>• formaldehyde</td><td>24.3%</td></tr> <tr><td>• mercury</td><td>23.2%</td></tr> <tr><td>• oxides of nitrogen</td><td>44.9%</td></tr> <tr><td>• odour</td><td>29.1%</td></tr> <tr><td>• PM<sub>10</sub></td><td>7.2%</td></tr> <tr><td>• PM<sub>2.5</sub></td><td>6.8%</td></tr> <tr><td>• sulphur dioxide</td><td>19.9%</td></tr> <tr><td>• toluene</td><td>16.9%</td></tr> <tr><td>• total dioxins &amp; furans</td><td>21.1%</td></tr> <tr><td>• total VOCs</td><td>33.2%</td></tr> <tr><td>• total PAHs</td><td>21.8%</td></tr> <tr><td>• total xylenes</td><td>42.8%</td></tr> </table> <p>The Bauxite Residue Disposal Area (BRDA) is the most significant dust source under dry windy conditions. However, the expansion will not require and increase in footprint for the BRDAs.</p> <p>Dust at the mine site is from earthworks, load and haul operations, blasting, crushing, materials handling, burning and wind erosion. The rate of mining will increase from approximately 13.5Mtpa to 16Mtpa due to the proposal.</p> <p>Annual clearing and rehabilitation will increase from 140 hectares per annum (ha/a) to 240 ha/a.</p>	• arsenic	15.0%	• benzene	15.8%	• benzo(a)pyrene	19.9%	• carbon monoxide	28.8%	• fluoride	19.8%	• formaldehyde	24.3%	• mercury	23.2%	• oxides of nitrogen	44.9%	• odour	29.1%	• PM <sub>10</sub>	7.2%	• PM <sub>2.5</sub>	6.8%	• sulphur dioxide	19.9%	• toluene	16.9%	• total dioxins & furans	21.1%	• total VOCs	33.2%	• total PAHs	21.8%	• total xylenes	42.8%	<p><b>Department of Environment (South West Region)</b></p> <ol style="list-style-type: none"> <li>1. The reliability and proposed operational configuration of the regenerative thermal oxidisers (RTOs) when operating at 4.4Mtpa was questioned;</li> <li>2. More detail should be given concerning the proposed “flue gas desulphurisation” technology and any associated waste streams;</li> <li>3. Is the baghouse for Calciner 6 best practice, and will it be sufficient to deal with acetaldehyde emissions?</li> <li>4. The inventory does not include chromium VI emissions;</li> <li>5. There is no commitment to upgrade emissions control on old calciners;</li> <li>6. A table of high emission rates does not necessarily include all substances of significance;</li> <li>7. The improved pollution control on the Liquor Burning Facility and the Digestion Facility have not been confirmed to date;</li> <li>8. The use of the other power stations emissions data is questioned;</li> <li>9. The BRDA and Refinery Catchment Lake represent potentially significant odour/VOC and particulate sources, but these fugitive emission sources have not been included in the emissions inventory and HRA;</li> <li>10. A specific commitment to establish a Continuous Emissions Monitoring System for the significant emission points is recommended;</li> </ol> <p><b>Department of Environment (Air Quality Division)</b></p> <ol style="list-style-type: none"> <li>1. The Liquor Burner odour criteria of 4.9OUs (3 minute average, 99.5 percentile) is not considered to be protective in relation to odours from liquor burners;</li> <li>2. Worsley should commit to proceed with odour emission quantification, field odour assessment and odour reduction to achieve and maintain acceptable odour levels;</li> <li>3. Monitoring of ozone should also be undertaken at the new site J monitoring station;</li> <li>4. The stacks and vents tend to be short and wake affected;</li> <li>5. The proponent should commit to refine/correct the emissions modelling in the DoE coordinated study of Collie air quality., and more work also needs to be undertaken to gather all the important emissions information; and</li> <li>6. Ministerial conditions/commitments should include the further work specified in Worsley’s Air Quality Management Plan.</li> </ol> <p><b>Department of Health</b></p> <ol style="list-style-type: none"> <li>1. The Department of Health concurs with the findings of the Health Risk Assessment report that predicted air emissions are unlikely to significantly contribute to adverse health effects in the Collie region.</li> <li>2. The Department of Health considers that dust issues relating to impact on public health have been adequately investigated and the proposed management strategies are anticipated to be adequate.</li> </ol> <p><b>Shire of Collie</b></p> <p>Will fallout of particulates contaminate the Harris Dam drinking water?</p>	<p>In view of the significant quantity of atmospheric emissions that will be emitted by the proposed development and the nature of the concerns raised in the comments that were received, the EPA considers that air quality is a relevant environmental factor.</p>
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**Table 5: Identification of relevant environmental factors and principles**

Preliminary Environmental Factors	Proposal Characteristics	Government Agency and Public Comments	Identification of Relevant Environmental Factors
<b>POLLUTION</b>			
Air quality (Continued)	(Refer to previous page)	<p><b>Shire of Harvey</b></p> <p>The Shire of Harvey expects adequate monitoring of air emissions and compliance with State emission limits, with penalties for breaches.</p> <p><b>Public</b></p> <p>Private citizens and the Conservation Council of WA raised concerns regarding:</p> <ol style="list-style-type: none"> <li>1. The ability of the liquor burner to control odours;</li> <li>2. The effect of odours produced by the refinery on public health;</li> <li>3. The impact of predicted concentrations of NO<sub>2</sub> and SO<sub>2</sub> on the health of nearby residents;</li> <li>4. Predicted concentrations of NO<sub>2</sub> and SO<sub>2</sub> impacting nearby 'organic farmers' produce; and</li> <li>5. Will particulate emissions contaminate the Harris Dam drinking water in the Shire of Collie?</li> </ol>	In view of the significant quantity of atmospheric emissions that will be emitted by the proposed development and the nature of the concerns raised in the comments that were received, the EPA considers that air quality is a relevant environmental factor.
Noise	<p>The sound power level for the refinery is expected to increase by 0.4dB(a).</p> <p>Blasting, mining, transport and crushing of ore will occur in new areas which are yet to be precisely defined.</p> <p>The capacity of the bauxite conveyor will be increased.</p> <p>The number of daily train movements will increase following the proposal:</p> <ul style="list-style-type: none"> <li>• Worsley - Brunswick Junction 12 increases to 20</li> <li>• Collie - Worsley 2 increases to 4</li> <li>• Brunswick Junction - Bunbury 20 increases to 28</li> </ul>	<p><b>Lloyd Acoustics Pty Ltd (for the Department of Environment)</b></p> <p>Refinery</p> <ol style="list-style-type: none"> <li>1. Report indicates tonality can exist in the direction of the most critical residence, but has no intrusive characteristics. Therefore, more evidence is required regarding tonal or non-tonal noise at the Ballingal property.</li> </ol> <p>Rail</p> <ol style="list-style-type: none"> <li>1. Noise may be an impact between Worsley Siding to Brunswick Junction and Brunswick to Bunbury during the nighttime. Further information is required to determine the extent of the impact; and</li> <li>2. Information indicating the maximum noise levels and number of events for both day and night times should be provided.</li> </ol> <p>Corridor</p> <ol style="list-style-type: none"> <li>1. Exceedance of night-time noise levels of the <i>Environmental Protection (Noise) Regulations, 1997</i> are noted for both existing and future conveyor systems. It is stated that compliance is only required with the State Agreement, therefore:</li> </ol>	In view of the nature of the concerns that were raised in the comments that were received, the EPA considers that noise is a relevant environmental factor.

**Table 5: Identification of relevant environmental factors and principles**

Preliminary Environmental Factors	Proposal Characteristics	Government Agency and Public Comments	Identification of Relevant Environmental Factors
<b>POLLUTION</b>			
Noise (Continued)	(Refer to previous page)	<ul style="list-style-type: none"> <li>• Does the State Agreement take precedence?</li> <li>• Does the State Agreement get periodically reviewed?</li> <li>• Does the State Agreement apply to future conveyors?</li> <li>• What are the actual noise levels at houses?</li> <li>• Are the existing or future conveyors tonal?</li> <li>• Is it practical to achieve 35dB(A) or what is the practical, achievable noise level?</li> </ul> <p>Mine</p> <ol style="list-style-type: none"> <li>1. There is conflict between Regulation daytime operating hours and mine daytime activities;</li> <li>2. It is assumed there are no tonal characteristics. Is there evidence to support this?</li> <li>3. All trucks have been placed in pits for the noise model. Some trucks will be on-route, which should be taken into consideration;</li> <li>4. Figure 3.16 of the Strategen report (Vol. 2) differs from those of SVT; and</li> <li>5. Are exceedances/noise complaints reported to the EMLG and/or public?</li> </ol> <p><b>Department of Conservation and Land Management</b></p> <p>Raised concerns over noise generated from the bauxite conveyor and transport routes.</p> <p><b>Department of Health</b></p> <p>The Department of Health considers that noise issues relating to impact on public health have been adequately investigated and the proposed management strategies are anticipated to be adequate.</p> <p><b>Shire of Collie</b></p> <p>The Shire of Collie raised concerns over increased noise levels caused by additional train movements.</p> <p><b>Public</b></p> <p>Private citizens and the Conservation Council of WA raised concerns regarding:</p> <ol style="list-style-type: none"> <li>1. Noise levels emanating from the refinery, mine, transport route and conveyor;</li> <li>2. Cumulative noise impact from increased rail traffic; and</li> <li>3. Effect noise produced by the operations will have on public health.</li> </ol>	In view of the nature of the concerns that were raised in the comments that were received, the EPA considers that noise is a relevant environmental factor.



**Table 5: Identification of relevant environmental factors and principles**

Preliminary Environmental Factors	Proposal Characteristics	Government Agency and Public Comments	Identification of Relevant Environmental Factors
<b>POLLUTION</b>			
<b>Greenhouse gas emissions</b>	Greenhouse gas emissions will increase 3.15Mtpa to 3.7Mtpa carbon dioxide equivalent.	<p><b>Public</b></p> <p>Members of the public and the Conservation Council of WA raised concerns regarding:</p> <ol style="list-style-type: none"> <li>1. The effect of additional greenhouse gases on public health and the environment; and</li> <li>2. The increase in greenhouse gas emissions from the liquor burning facility from 6,000tpa to 39,600tpa.</li> </ol>	In view of the significant quantity of greenhouse gas emissions that will be emitted by the proposed development, the EPA considers that greenhouse gas emissions is a relevant environmental factor.
<b>Liquid and solid waste disposal</b>	<p>The proposed upgrade will result in an increase in the rate of bauxite residue disposal from 12Mtpa (wet) to 16Mtpa (wet). However, there will be no increase in the footprint of the bauxite residue disposal areas. Mining activities will generate industrial and general wastes, mainly from machinery and equipment servicing and from the mine administration offices. Class 2 and 3 wastes are disposed of at the facility operated by the Shire of Boddington.</p> <p>Refinery operations will generate significant quantities of waste material from numerous processes, facilities and servicing activities, such as waste oil, grease, scrap metal, heavy vehicle tyres, recyclable office and domestic waste, batteries, electric motors, wire rope, solvents and chemicals, conveyor belt, flyash, bottom ash, and filter cloths etc. Flyash and bottom ash will be disposed of in the BRDA's. A Waste Minimisation Program run by a Waste Minimisation Team currently operates at the refinery.</p>	<p><b>Public</b></p> <p>The Conservation Council of WA raised the following concerns:</p> <ol style="list-style-type: none"> <li>1. Worsley has already produced about 55 million tonnes of residue. It doesn't know what to do with the waste that it is already producing at the rate of 5.5Mtpa, so what will it do with an extra 20%; and</li> <li>2. The expansion would mean an increase of 30ha for residue disposal (toxic waste). To date, toxic waste dumps cover some 350ha. Besides taking up land that would be better used for other purposes, the dumps may leak pollutants into ground and surface water, and the dust that blows off them spreads harmful chemicals onto people, animals, homes, and farmland. These problems must be corrected before any extension of their area is permitted.</li> </ol>	<p>The proponent's response to submissions document indicates that the bauxite residue facilities have been designed to contain all the residue from the mineable bauxite reserves, and that no additional residue disposal facilities area is required for the proposed expansion. The EPA notes that flyash and bottom ash from the refinery will be disposed of in the BRDA's. The EPA considers that the proponent's Waste Minimisation Program and commitment to prepare and implement a management plan for waste (other than bauxite residue) are adequate in terms of managing refinery waste.</p> <p>In view of the above, the EPA considers that this environmental factor does not require further evaluation.</p>
<b>SOCIAL SURROUNDINGS</b>			
<b>Aboriginal culture and heritage</b>	<p>Eight known registered Aboriginal archaeological sites and two known registered mythological sites (Canning and Serpentine Rivers) are possibly located within four of the five the mining envelopes. There is a high likelihood that additional archaeological sites are widely distributed throughout the proposed mining envelopes.</p> <p>Site preparation may disturb registered and/or undiscovered archaeological sites. Mining activities may interfere with or disturb areas of ethnographic significance.</p>	<p><b>Department of Indigenous Affairs</b></p> <p>The Department of Indigenous Affairs (DIA) has been involved in the conduct of heritage surveys and formulation of a predictive model for the location of archaeological sites. To date the DIA has determined the approach is adequate and is satisfied the issues have been appropriately dealt with provided Worsley continue to satisfy their commitments.</p>	The EPA considers that this environmental factor does not require further evaluation.
<b>European heritage</b>	No sites of European heritage are known to occur within the proposed mining areas.	<p><b>Public</b></p> <p>The proposed Peel Regional Tourist Railway (PRTR) dissects the northern section of the Marradong mining envelope. Part of this project includes the restoration of the historic Tullis Bridge and Hotham Branch Line. The Rail Heritage Foundation of WA in consultation with Worsley Alumina Pty Ltd have developed a draft Deed of Consent designed to support the PRTR project and protect the historic values of the area while allowing mining and related activities to also be carried out.</p>	The EPA considers that the concern that was raised has been adequately addressed by the response provided by the proponent. In view of the above, the EPA considers that this environmental factor does not require further evaluation.

Table 5: Identification of relevant environmental factors and principle

Preliminary Environmental Factors	Proposal Characteristics	Government Agency and Public Comments	Identification of Relevant Environmental Factors
<b>SOCIAL SURROUNDINGS</b>			
<b>Risk and hazards</b>	<p>The proposed development will involve the transport, storage, and handling of hazardous materials.</p>	<p><b>FESA</b></p> <p>The emergency response aspect does not appear to be addressed with the preparation of this ERMP. From a FESA perspective this aspect attracts the following questions:</p> <ol style="list-style-type: none"> <li>1. Can the proponent advise on the additional quantities of hazardous materials that will be required as a result of expansion of this project?</li> <li>2. Will the additional hazardous materials make up the total hazardous materials stored on-site require the facility to be reclassified as a Major Hazard Facility?</li> <li>3. How will these additional hazardous materials be transported on-site and what will be the additional risks conferred because of this?</li> <li>4. Will the proponent review its emergency response plan for the whole expanded operation including the additional hazardous materials?</li> <li>5. Is there an emergency response team on-site?</li> <li>6. If so, is the emergency response team equipped and able to apply procedures that are compatible with FESA Fire Services procedures.</li> </ol> <p><b>Radiological Council</b></p> <ol style="list-style-type: none"> <li>1. Should the proponent ascertain any use for the bauxite residue, a proposal is required by the Radiological Council for approval, along with the results of radionuclide analysis; and</li> <li>2. The closure plan is required by the Radiological Council, particularly with respect to rehabilitation of bauxite residue areas plus results of radionuclide analysis.</li> </ol> <p><b>Public</b></p> <p>The Conservation Council of WA raised concerns over the disposal of harmful bi-products produced at the refinery and the risks it poses to the environment and public health.</p>	<p>The EPA considers that the concerns that were raised have been adequately addressed by the responses provided by the proponent. In view of the above, the EPA considers that this environmental factor does not require further evaluation.</p>
<b>Traffic (road and rail)</b>	<p>Rail movements (daily) will increase as follows:</p> <ul style="list-style-type: none"> <li>• Bunbury to Brunswick - increased from 10 to 18 movements;</li> <li>• Brunswick to Worsley refinery spur line - 12 to 20 movements; and</li> <li>• Worsley refinery spur line - increased from 14 to 24 movements.</li> </ul> <p>The number of rail fleets will increase from 2 (comprised of 46 and 40 wagons) to 3 (comprised of 46, 46, and 15 wagons). Daily heavy vehicle movements (class 3 and above) will increase by 3% on Coalfields Highway and 1% on the Australind Bypass. The construction period will create a temporary increase in traffic due to delivery of construction materials and personal access of the construction work force (about 1000 at peak).</p>	<p><b>Shire of Harvey</b></p> <p>The Shire of Harvey ask what assistance Worsley will provide to improve/maintain road infrastructure, especially Coalfields Highway and Mornington Road?</p> <p><b>Shire of Collie</b></p> <p>The Shire of Collie ask what assistance Worsley will provide to improve/maintain roads to meet the needs of heavier road traffic?</p>	<p>The EPA considers that the concerns that were raised have been adequately addressed by the responses provided by the proponent. In view of the above, the EPA considers that this environmental factor does not require further evaluation.</p>

<b>Preliminary Environmental Factors</b>	<b>Proposal Characteristics</b>	<b>Government Agency and Public Comments</b>	<b>Identification of Relevant Environmental Factors</b>
<b>SOCIAL SURROUNDINGS</b>			
<b>Visual amenity</b>	<p>Operations may be visible from the following locations:</p> <ul style="list-style-type: none"> <li>• Brookton Highway;</li> <li>• Qualen Road Walk;</li> <li>• Bibbulmun Track at mount Dale;</li> <li>• Christmas Tree Well Walk;</li> <li>• Albany Highway;</li> <li>• North Bannister-Wandering Road;</li> <li>• Locality of North Bannister;</li> <li>• Bibbulmun Track at the Gringer Creek camp/picnic area, at Mt Cooke, Mt Vincent, and Mt Randall, White Horse Hills section of track, and Mt Wells;</li> <li>• Gibbs Rocks Walk;</li> <li>• Upper Dale River Walk;</li> <li>• Geddes Rocks Walk;</li> <li>• Pinjarra Williams Road;</li> <li>• Private property near the East Quindanning mining envelope;</li> <li>• Harvey Quindanning Road; and</li> <li>• Private property near the Morgans mining envelope.</li> </ul>	<p><b>Department of Conservation and Land Management</b></p> <p>Raised concerns regarding the impact of the bauxite conveyor on visual amenity.</p> <p><b>Shire of Harvey</b></p> <p>The Shire of Harvey would expect the project will not impact on the aesthetics of surface water systems, specifically aesthetic flows of the Brunswick River and it's tributaries.</p> <p><b>Public</b></p> <p>Concerns raised in regard to the impact on visual amenity from mining in bushland in the East Quindanning area.</p>	<p>The EPA considers that the concerns that were raised have been adequately addressed by the responses provided by the proponent. In view of the above, the EPA considers that this environmental factor does not require further evaluation.</p>
<b>Recreation</b>	<p>The Northern Jarrah Forest is a popular location for a variety of recreational activities such as bush walking, camping, trail and mountain bike riding, picnicking, and nature appreciation and study.</p> <p>There are a number of walk trails which may be directly disturbed, suffer temporary loss of access or be close enough to mining operations for them to be seen or heard. These include the Qualen Road, Gibbs Rocks, Christmas Tree Well, Upper Dale River, Geddes Rocks and Bibbulmun Track (Gringer Creek) Walks.</p>	<p><b>Public</b></p> <ol style="list-style-type: none"> <li>1. Loss of and degradation to walk trails used by various clubs;</li> <li>2. Permanent degradation of walk trails by inability to adequately rehabilitate mined sections;</li> <li>3. Some presently used recreation areas within the development area have not been identified and accounted for;</li> <li>4. Mining in bushland in the East Quindanning area, in terms of restriction of public access and reduction of social value of the area; and</li> <li>5. Worsley's commitment to 'establish new recreational sites where existing popular sites are severely affected by mining operations' and would like to meet with Worsley to discuss how the proposed operations will impact their sport.</li> </ol>	<p>The EPA considers that the concerns that were raised have been adequately addressed by the responses provided by the proponent and Commitment No.11 that was made by the proponent in relation to recreation. In view of the above, the EPA considers that this environmental factor does not require further evaluation.</p>

**Table 5: Identification of relevant environmental factors and principles (Continued)**

<b>PRINCIPLES</b>		
<b>Principle</b>	<b>Relevant Yes/No</b>	<b>If yes, Consideration</b>
<p>1. The precautionary principle  <i>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.</i>  <i>In application of this precautionary principle, decisions should be guided by –</i>                      (a) <i>careful evaluation to avoid, where practicable, serious or irreversible damage to the environment; and</i>                      (b) <i>an assessment of the risk-weighted consequences of various options.</i></p>		
	Yes	Principle 1 has been considered by the EPA as it has recommended a number of conditions relating to the conservation of biodiversity be imposed on the proponent.
<p>2. The principle of intergenerational equity  <i>The present generation should ensure that the health, diversity and productivity of the environment is maintained and enhanced for the benefit of future generations.</i></p>		
	Yes	Principle 2 was considered by the EPA as it noted that the proposal will incorporate a thermally efficient coal-fired cogeneration facility, and that it will employ best practicable technology to minimise the discharge of atmospheric pollution. Mined areas will be rehabilitated.
<p>3. The principle of the conservation of biological diversity and ecological integrity  <i>Conservation of biological diversity and ecological integrity should be a fundamental consideration.</i></p>		
	Yes	Principle 3 was considered by the EPA in assessing the conservation of biodiversity as a relevant environmental factor. The EPA has recommended that conditions be imposed on the proponent in relation to biodiversity investigations, the protection of biodiversity, transport corridor route plans, bauxite mining plans, and rehabilitation.
<p>4. Principles relating to improved valuation, pricing and incentive mechanisms                      (1) <i>Environmental factors should be included in the valuation of assets and services.</i>                      (2) <i>The polluter pays principle - those who generate pollution and waste should bear the cost of containment, avoidance and abatement.</i>                      (3) <i>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.</i>                      (4) <i>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.</i></p>		
	Yes	Principle 4(2) was considered by the EPA in assessing air quality and greenhouse gas emissions. The proponent will bear the costs of containment, avoidance and abatement for the pollution and waste generated by the proposal.
<p>5. The principle of waste minimisation  <i>All reasonable and practicable measures should be taken to minimize the generation of waste and its discharge into the environment.</i></p>		
	Yes	Principle 5 was considered by the EPA in assessing greenhouse gas emissions, atmospheric emissions, and liquid and solid waste disposal. A Waste Minimisation Program run by a Waste Minimisation Team currently operates at the refinery.

## **Appendix 4**

**Recommended environmental conditions and  
proponent's consolidated commitments**

## RECOMMENDED CONDITIONS AND PROCEDURES

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

WORSLEY ALUMINA - EFFICIENCY AND GROWTH INCREASE OF EXISTING  
OPERATIONS TO 4.4MTPA ALUMINA PRODUCTION

SHIRE OF BEVERLEY, SHIRE OF BODDINGTON, SHIRE OF BROOKTON,  
SHIRE OF COLLIE, SHIRE OF HARVEY, SHIRE OF WANDERING, AND SHIRE  
OF WILLIAMS

**Proposal:** To upgrade the Worsley refinery in order to increase production to 4.4 million tonnes per annum (Mtpa).

**Proponent:** Worsley Alumina Pty Ltd

**Proponent Address:** PO Box 344  
COLLIE WA 6225

**Assessment Number:** 1526

**Previous Assessment Number:** 984

**Previous Statement Number:** 423 (published on 2 July 1996)

**Report of the Environmental Protection Authority:** Bulletin 1209

**Previous report of the Environmental Protection Authority:** Bulletin 823

In accordance with Section 45B of the *Environmental Protection Act, 1986*, the following revised conditions and procedures apply to all:

- upgrades and modifications to the Worsley alumina refinery;
- operations at the Worsley alumina refinery;
- mining outside the Primary Bauxite Area as shown in Figure 2;
- construction of new bauxite transport corridors and new overland conveyors from mining areas to the existing overland conveyor; and

- operations of the overland conveyors.

Unless otherwise indicated, the conditions and procedures of Statement 423 continue to authorise and apply to all mining within the Primary Bauxite Area.

The revised proposal (other than any mining within the Primary Bauxite Area) to which the above reports of the Environmental protection Authority relate may be implemented by the proponent subject to the following conditions and procedures:

## **1 Implementation**

- 1-1 The proponent shall implement the proposal as documented in schedule 1 of this statement subject to the conditions and procedures of this statement.

## **2 Proponent Commitments**

- 2-1 The proponent shall implement the environmental management commitments documented 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 and provide a letter with a copy of this statement endorsed by the proposed replacement proponent that the proposal will be carried out in accordance with this statement. Contact details and appropriate documentation on the capability of the proposed replacement proponent to carry out the proposal shall also be provided.
- 3-3 The nominated proponent shall notify the Department of Environment of any change of contact name and address within 60 days of such change.

## **4 Commencement and Time Limit of Approval**

- 4-1 The proponent shall substantially commence the proposal within five years of the date of this statement or the approval granted in this statement shall lapse and be void.

Note: The Minister for the Environment will determine any dispute as to whether the proposal has been substantially commenced.

- 4-2 The proponent shall make application for any extension of approval for the substantial commencement of the proposal beyond five years from the date of this statement to the Minister for the Environment, prior to the expiration of the five-

year period referred to in condition 4-1.

The application shall demonstrate that:

1. the environmental factors of the proposal have not changed significantly;
2. new, significant, environmental issues have not arisen; and
3. all relevant government authorities have been consulted.

Note: The Minister for the Environment may consider the grant of an extension of the time limit of approval not exceeding five years for the substantial commencement of the proposal.

## **5 Compliance Audit and Performance Review**

5-1 The proponent shall prepare an audit program. The aim of this audit program is to ensure that there is on-going compliance with this Ministerial Statement. The audit program must include the following:

1. a copy of this Ministerial Statement;
2. an audit table, which lists the ministerial conditions and the proponent's commitments, and details how these will be met by listing the actions required, their objectives, details of how the actions/objectives will be achieved, and the relevant timeframes; and
3. details of any criteria and/or standards that will be used to measure compliance, and the rationale for their use.

5-2 The audit program shall be lodged with the Minister for the Environment for endorsement.

5-3 The proponent shall implement the endorsed audit program, and in doing so, shall submit annual compliance reports to the Department of Environment in accordance with a schedule approved by the Department of Environment.

5-4 The annual compliance reports shall be prepared in accordance with the Department of Environment's Compliance Monitoring Guidelines, and shall:

1. describe or update the state of implementation of the proposal as defined in schedule 1 of this statement;
2. provide verifiable evidence of compliance with the conditions, procedures, and commitments;
3. review the effectiveness of corrective and preventative actions contained in environmental management plans and programs;



4. provide verifiable evidence of compliance of the fulfillment of the requirements specified in 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.

Note: Under sections 48(1) and 47(2) of the *Environmental Protection Act, 1986*, the Chief Executive Officer of the Department of Environment is empowered to monitor the compliance of the proponent with the statement and should directly receive the compliance documentation, including environmental management plans, related to the conditions, procedures and commitments contained in this statement.

5-5 The proponent shall submit a performance review report every five years after the start of operations, to the requirements of the Minister for the Environment on advice of the Environmental Protection Authority, which addresses:

1. the major environmental issues associated with implementing the project; the environmental targets identified for those issues; the methodologies used to achieve the environmental targets; and the key indicators of environmental performance measured against those targets;
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 targets over the next five years, including improvements in technology and management processes.

## **6 Biodiversity Related Investigations**

- 6-1 The proponent shall prepare a draft Scope of Biodiversity Related Investigations.
- 6-2 The draft Scope of Biodiversity Related Investigations must cover those areas within the proposed new mining areas shown in Figure 2 of schedule 1 and sufficient surrounding lands to provide a regional context for the information obtained following the completion of the Biodiversity Related Investigations.
- 6-3 The draft Scope of Biodiversity Related Investigations must include investigation of the following matters:

1. the occurrence and spatial extent of floristic and vegetation communities at local and regional scale;
  2. the condition of floristic and vegetation communities identified in Item 1 above;
  3. the occurrence and spatial extent of Threatened Ecological Communities (TECs), including nominated TECs;
  4. the occurrence and extent of Declared Rare and Priority Flora as defined by the *Wildlife Conservation Act, 1950* and other significant flora;
  5. the role and significance of ecological linkages;
  6. the occurrence, severity and spatial extent of forest disease, and the potential for the spread of forest disease;
  7. characterisation of landform;
  8. the identification and spatial extent of fauna habitat, including specifically, habitat for Threatened, Priority listed and other significant Fauna, and significant Short Range Endemic fauna, and other significant invertebrate taxa;
  9. the occurrence and abundance of vertebrate fauna, including specifically, threatened fauna as defined in the *Wildlife Conservation Act, 1950* (WA) or the Commonwealth *Environmental Protection and Biodiversity Conservation Act, 1999*, Priority fauna as defined and listed by the Department of Conservation and Land Management (CALM), obligate tree hollow nesting or roosting species, and species requiring specialised habitats or resources, including Honey Possums;
  10. the occurrence and abundance of significant Short Range Endemic and other significant invertebrate taxa;
  11. groundwater systems and the occurrence and distribution of groundwater dependent ecosystems;
  12. stream flow and quality, and stream dependent ecosystems; and
  13. weed and pest severity status in State Forest.
- 6-4 Within one year of the issue date of this statement, the proponent shall submit the draft Scope of Biodiversity Related Investigations for comment to the:
1. Department of Conservation and Land Management;
  2. Environmental Management Liaison Group (Refer to Procedure 5); and

3. Stakeholder Consultation Group (Refer to Procedure 6).

- 6-5 Within 18 months of the issue date of this statement, the proponent shall forward a revised Scope of Biodiversity Related Investigations taking into account the comments (if any) received under condition 6-4, to the Minister for the Environment for endorsement on the advice of the Environmental Protection Authority and the Department of Conservation and Land Management.
- 6-6 The proponent shall make the Scope of Biodiversity Related Investigations, endorsed by the Minister for the Environment under condition 6-5 publicly available.
- 6-7 The proponent shall undertake investigations in accordance with the Endorsed Scope of Biodiversity Related Investigations.
- 6-8 Prior to the commencement of any proposed mining or transport corridor construction activities, and prior to the lodging the Bauxite Mining and Environmental Management Plans with the Department of Environment, the proponent shall provide a Biodiversity Investigations Report to the Minister for the Environment for endorsement on the advice of the Environmental Protection Authority and the Department of Conservation and Land Management in relation to the completion of the investigations undertaken in accordance with condition 6-7.
- 6-9 The Biodiversity Investigations Report must include the following:
- certification that the Endorsed Scope of Biodiversity Related Investigations was completed;
  - key biodiversity values to be protected;
  - indicators, parameters or criteria to be used in measuring maintenance of the key biodiversity values identified;
  - outcomes and findings for each of the matters investigated, including, but not limited to, those matters identified in condition 6-3;
  - surveyed plans detailing the ecological linkages and the proposed areas of zero disturbance;
  - the proposed areas of zero disturbance; and
  - defined buffer areas around ecological linkages and areas of zero disturbance.
- 6-10 The Biodiversity Investigations Report shall be made publicly available.

## **7 Protection of Biodiversity**

7-1 The proponent shall not, unless otherwise approved by the Minister for the Environment on advice of the Environmental Protection Authority, implement the proposal so as to cause or contribute to the direct or indirect disturbance of the following:

1. vegetation complexes (as mapped for the Reserve Forest Agreement) that have less than 30% of their pre-European extent remaining;
2. Threatened Ecological Communities (TECs) [including candidate TECs] as identified in the Biodiversity Investigations Report;
3. heathland as identified in the Biodiversity Investigations Report;
4. granite outcrops as identified in the Biodiversity Investigations Report;
5. other naturally rare or restricted floristic communities, vegetation or ecological communities and key ecological linkages identified in the Biodiversity Investigations Report;
6. Declared Rare Flora, unless the disturbance is approved under the *Wildlife Conservation Act, 1950* (WA);
7. Significant Priority Flora identified in the Biodiversity Investigations Report;
8. significant habitat for Threatened, Priority listed and other significant fauna, significant Short Range Endemic fauna, and other significant invertebrate taxa, identified in the Biodiversity Investigations Report;
9. stream zones in accordance with the Department of Environment Guidance for protection of sensitive water bodies, except for the construction and operation of stream crossings for haul roads, service roads, transport corridors, mine water supply, and other infrastructure;
10. other important conservation values and habitats identified through the Biodiversity Investigations Report.

7-2 Without limiting condition 7-1 the proponent shall ensure that mining and transport corridor construction and operational activities do not cause or contribute to the following:

1. any significant adverse impact on any groundwater dependent ecosystems identified by Biodiversity Related Investigations in condition 6-7 or lead to waterlogging of significant areas of dry land vegetation;
2. an increase in severity status of weeds or pests (as identified by the Biodiversity Related Investigations in condition 6-7) in State Forest;

3. the increased spread of forest disease outside areas identified by the Biodiversity Related Investigations in condition 6-7;
4. any species or ecological community moving to a higher category of threat, (consistent with the expectations of the Forest Management Plan); and
5. disturbance in defined buffer areas around ecological linkage and areas of zero disturbance.

## **8 Transport Corridor Route Plans**

- 8-1 Prior to the commencement of mining or transport corridor construction activities in any mining envelope (refer to Figure 2), the proponent shall prepare a Transport Corridor Route Plan showing the route and area of disturbance for each proposed transport corridor, for endorsement by the Minister for the Environment.
- 8-2 The Transport Corridor Route Plan shall outline how the selected transport corridor route complies with the requirements of the Biodiversity Investigations Report and condition 7, and ensures that transport corridor routes are selected to minimise the risk to biodiversity values from the introduction and spread of forest disease outside areas identified in the Biodiversity Investigations Report.
- 8-3 The proponent shall make the Transport Corridor Route Plan required by condition 8-1 publicly available.

## **9 Bauxite Mining Plans**

- 9-1 The proponent shall not carry out any mining or transport corridor construction activities unless it has prepared a Final Bauxite Mining Plan in respect of the area to be the subject of mining or construction.
- 9-2 Any draft or Final Bauxite Mining Plan prepared by the proponent shall:
  1. incorporate the findings contained in the Biodiversity Investigations Report;
  2. ensure that the areas of any proposed mining or transport corridor construction activities, including corridor and technology options considered during planning, are consistent with the areas of zero disturbance, ecological linkages, and buffers identified in the Biodiversity Investigations Report, and take into account the location of indicative fauna habitat zones as identified and in accordance with the requirements of the Forest Management Plan (2004);
  3. set out the management and mitigation measures that will be undertaken to ensure that the proposed mining or transport corridor construction activities comply with conditions 7-1 and 7-2;
  4. set out monitoring and auditing to be undertaken before, during, and following mining or transport corridor construction activities; and

5. demonstrate how the proponent's implementation of the proposal will protect the key biodiversity values identified in the Biodiversity Investigations Report.
- 9-3 The proponent shall submit a draft Bauxite Mining Plan to the Department of Environment, the Department of Conservation and Land Management, the Environmental Management Liaison Group and the Stakeholder Consultation Group for comment.
- 9-4 The proponent shall take the comments (if any) received under condition 9-3 into account in preparing a revised Bauxite Mining Plan. The proponent shall provide the revised Bauxite Mining Plan for review to an independent Environmental Auditor chosen by the proponent (refer to Procedure 7).
- 9-5 The proponent shall take the comments (if any) received from the Environmental Auditor into account in preparing a Final Bauxite Mining Plan.
- 9-6 If the proponent proceeds to carry out any mining or transport corridor construction activities as described in the Final Bauxite Mining Plan, the proponent shall implement the management, mitigation, monitoring and auditing measures set out in the Final Bauxite Mining Plan.
- 9-7 The proponent shall make the Final Bauxite Mining Plan required by condition 9-1 publicly available.
- 9-8 The proponent may amend the Final Bauxite Mining Plan subject to the approval of the Minister for the Environment.

## **10 Rehabilitation**

- 10-1 Within one year of the date of this statement the proponent shall prepare an initial draft proposed Rehabilitation Plan for presentation to the Environmental Management and Liaison Group as a basis for initiating a process of review and development of a comprehensive Rehabilitation Plan.

The objectives of the draft proposed Rehabilitation Plan are to ensure that:

- rehabilitation research and trials are targeted to the key issues facing the rehabilitation of the proposed bauxite mine areas;
- planning and implementation of rehabilitation is carried out in a manner consistent with industry best practice;
- rehabilitated native vegetation in State Forest areas will ultimately develop into sustainable ecological systems that are compatible with surrounding native vegetation and its land uses, and approximates as closely as possible the pre-mining biodiversity and functional values;
- rehabilitated private land areas return to a mix of productive agricultural land and native vegetation compatible with the original native vegetation, that at

least maintains the extent of the existing native vegetation and enhances ecological connectivity; and

- the matters identified in the report titled, 'A Review of the Rehabilitation at Worsley Alumina's Boddington Bauxite Mine' prepared by URS Australia Pty Ltd relating to the assessment of ecosystem sustainability are given due consideration.

The draft proposed Rehabilitation Plan shall address the following topics which are relevant to long term sustainable rehabilitation:

1. objectives for rehabilitation, including site specific variation;
2. an outline of proposed rehabilitation research priorities;
3. conduct and application of research;
4. topsoil management;
5. targets for nutrient cycling;
6. pest and disease control and management;
7. targets for flora and fauna recruitment, including specific targets for the:
  - return of recalcitrant species;
  - return of key fauna habitat;
  - translocation of mature specimens of long-lived species required for fauna habitat (eg. Xanthorrhoea and Macrozamia);
  - recolonisation of invertebrate fauna; and
  - recolonisation of mycorrhizal fungi;
8. hydrological function;
9. climate change consideration;
10. integration with State Forest management;
11. monitoring and adaptive management;
12. plant species composition (including reference to the species listed in the report titled, 'A Review of the Rehabilitation at Worsley Alumina's Boddington Bauxite Mine' prepared by URS Australia Pty Ltd), including species vulnerability to fire;

13. long term sustainability, including criteria for assessing ecosystem sustainability on natural and disturbed land;
14. completion criteria including an overall requirement that no extraordinary residual management liability (above the normal cost of managing undisturbed forest) shall accrue to the land management authority unless agreed by the State. Completion criteria should have an objective of achieving integration of the rehabilitation into large scale prescribed burning programs for the purpose of fire management prior to the hand back of responsibility to the State; and
15. peer review and reporting.

10-2 The proponent shall present a proposed Final Rehabilitation Plan to the Minister for the Environment for approval, on the advice of the Environmental Protection Authority and the Department of Conservation and Land Management, at least one year ahead of commissioning of the project.

10-3 The proponent shall implement the approved Final Rehabilitation Plan required by condition 10-2.

10-4 The proponent shall review the Final Rehabilitation Plan annually as part of annual environmental reporting.

The review shall include the following:

1. presentation of results of monitoring; and
2. plans for improvement in rehabilitation to meet objectives and targets where necessary.

10-5 The proponent shall make the Final Rehabilitation Plan required by condition 10-2 publicly available.

## **11 Water Supply Protection**

11-1 The proponent shall not carry out any ground disturbing activities in areas proclaimed as water reserves or catchment areas under the *Metropolitan Water Supply, Sewerage, and Drainage Act, 1909*, or the *Country Areas Water Supply Act, 1947*, prior to the preparation of a Water Resource Management Plan for mining (in accordance with Commitment No. 8), to the requirements of the Minister for the Environment, on advice of the Water and Rivers Commission, that demonstrates that the activities are likely to have negligible impact on the quality of water supplies from the catchment.

11-2 The proponent shall implement the Water Resource Management Plan required by condition 11-1.

11-3 The proponent shall make the Water Resource Management Plan required by condition 11-1 publicly available.



## 12 Greenhouse Gas Emissions

12-1 Prior to commencement of construction, the proponent shall prepare a Greenhouse Gas Emissions Management Plan to:

- ensure that through the use of best practice, the total net “greenhouse gas” emissions and/or “greenhouse gas” emissions per unit of product from the project are minimised; and
- manage “greenhouse gas” emissions in accordance with the *Framework Convention on Climate Change, 1992*, and consistent with the National Greenhouse Strategy;

to the requirements of the Minister for the Environment on advice of the Environmental Protection Authority.

This Plan shall include:

1. calculation of the “greenhouse gas” emissions associated with the proposal, as advised by the Environmental Protection Authority;

Note: The current requirements of the Environmental Protection Authority are set out in: *Minimising Greenhouse Gas Emissions, Guidance for the Assessment of Environmental Factors, No. 12* published by the Environmental Protection Authority (October 2002). This document may be updated or replaced from time to time.

2. specific measures to minimise the total net “greenhouse gas” emissions and/or the “greenhouse gas” emissions per unit of product associated with the proposal using a combination of “no regrets” and “beyond no regrets” measures;
3. estimation of the “greenhouse gas” efficiency of the project (per unit of product and/or other agreed performance indicators) and comparison with the efficiencies of other comparable projects producing a similar product, both within Australia and overseas;
4. actions for the monitoring and annual reporting of “greenhouse gas” emissions and emission reduction strategies;
5. a target set by the proponent for the reduction of total net “greenhouse gas” emissions and/or “greenhouse gas” emissions per unit of product and as a percentage of total emissions over time, and annual reporting of progress made in achieving this target. Consideration should be given to the use of renewable energy sources such as solar, wind or hydro power;
6. consideration by the proponent of entry (whether on a project-specific basis, company-wide arrangement or within an industrial grouping, as appropriate) into the Commonwealth Government’s “Greenhouse Challenge” voluntary

cooperative agreement program. Components of the agreement program include:

- an inventory of emissions;
- opportunities for abating “greenhouse gas” emissions in the organisation;
- a “greenhouse gas” mitigation action plan;
- regular monitoring and reporting of performance; and
- independent performance verification.

Note: In (2) above, the following definitions apply:

1. “no regrets” measures are those which can be implemented by a proponent and which are effectively cost-neutral.
2. “beyond no regrets” measures are those which can be implemented by a proponent and which involve additional costs that are not expected to be recovered.

12-2 The proponent shall implement the Greenhouse Gas Emissions Management Plan required by condition 12-1.

12-3 Prior to the commencement of construction, the proponent shall make the Greenhouse Gas Emissions Management Plan required by condition 12-1 publicly available.

### **13 Air Quality Management Plan**

13-1 Prior to commencement of construction, the proponent shall prepare an Air Quality Management Plan, to ensure that best available practicable and efficient technologies are used to minimise and monitor air emissions from the refinery and bauxite residue disposal areas, to the requirements of the Minister for the Environment on advice of the Environmental Protection Authority.

This Plan shall include:

1. an air quality improvement plan addressing priority areas. These will include mercury emissions from digestion and the coal-fired cogeneration facility, fugitive dust emissions from bauxite residue disposal areas, VOC emissions from calciners, a program for the Air Emissions Impact Assessment project, and community consultation;
2. a field odour assessment study;
3. an assessment of odour from the refinery catchment lake;

4. an ambient air monitoring program;
5. an emissions monitoring program, which includes, but is not limited to odour, mercury, particulate, and VOC emissions from significant point and area sources;
6. actions to control fugitive and point source particulate emissions;
7. incident and complaints response; and
8. a program for annual reporting on air quality.

13-2 The proponent shall implement the Air Quality Management Plan required by condition 13-1.

13-3 The proponent shall make the Air Quality Management Plan required by condition 13-1 publicly available.

#### **14 Decommissioning Plans**

14-1 Prior to commencement of construction, the proponent shall prepare a Preliminary Decommissioning Plan, which provides the framework to ensure that the site is left in an environmentally acceptable condition to the requirements of the Minister for the Environment on advice of the Environmental Protection Authority.

The Preliminary Decommissioning Plan shall address:

1. the rationale for the siting and design of plant and infrastructure as relevant to environmental protection, and conceptual plans for the removal or, if appropriate, retention of plant and infrastructure;
2. the long-term management of ground and surface water systems affected by the refinery, coal stockpiles, waste disposal areas, and associated infrastructure;
3. a conceptual rehabilitation plan for all disturbed areas and a description of a process to agree on the end land use(s) with all stakeholders;
4. a conceptual plan for a care and maintenance phase; and
5. management of potentially polluting materials to avoid the creation of contaminated areas.

14-2 At least 12 months prior to the anticipated date of decommissioning, or at a time agreed with the Environmental Protection Authority, the proponent shall prepare a Final Decommissioning Plan designed to ensure that the site is left in an environmentally acceptable condition to the requirements of the Minister for the Environment on advice of the Environmental Protection Authority.

The Final Decommissioning Plan shall address:

1. the removal or, if appropriate, retention of plant and infrastructure in consultation with relevant stakeholders;
2. the long-term management of ground and surface water systems affected by the refinery, coal stockpiles, waste disposal areas, and associated infrastructure;
3. rehabilitation of all disturbed areas to a standard suitable for the agreed new land use(s); and
4. identification of contaminated areas, including provision of evidence of notification and proposed management measures to relevant statutory authorities.

14-3 The proponent shall implement the Final Decommissioning Plan required by condition 14-2 until such time as the Minister for the Environment determines, on advice of the Environmental Protection Authority, that the proponent's decommissioning responsibilities have been fulfilled.

14-4 The proponent shall make the Final Decommissioning Plan required by condition 14-2 publicly available.

### **Procedures**

1. Where a condition states "to the requirements of the Minister for the Environment 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 advice to the proponent.
2. Where a condition states that a report, plan or program will be forwarded to the Minister for the Environment for endorsement, the Minister for the Environment may seek advice from the Environmental Protection Authority on the content of the document and the Environmental Protection Authority may provide advice to the Department of Environment in relation to the endorsement of the document. The endorsed document will form part of the implementation conditions.
3. 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.
4. Where a condition lists advisory bodies, it is expected that the proponent will obtain the advice of those listed as part of its compliance reporting to the Department of Environment.
5. The Environmental Management Liaison Group comprises representatives of state government agencies whose areas of responsibility are affected by the mining and refining operations of the proponent. The Environmental Management Liaison Group will comprise of the Department of Industry and Resources, the Department

of Environment, the Department of Conservation and Land Management, and the Department of Agriculture.

Note: other agencies that may have areas of responsibility from time to time affected by the mining and refinery operations of the proponent may be involved in providing advice or become members of the Environmental Management Liaison Group.

The Environmental Management Liaison Group shall have the following functions:

- provide comment on the draft Scope of Biodiversity Related Investigations;
  - review proposed rehabilitation research priorities and the draft Rehabilitation Plan;
  - provide comment on the draft Bauxite Mining and Environmental Management Plan(s);
  - review any 10 year rolling mine plans prepared by the proponent pursuant to clause 16 (10) of the *Alumina Refinery (Worsley) Agreement Act, 1973*, and provide reports on its findings to the Minister for State Development and the Minister for the Environment;
  - review the proponent's environmental performance annually against its Environmental Management Plan and Rehabilitation Plan; and
  - where appropriate, advise the Minister for Environment and the Minister for State Development on the proponent's environmental performance if it is of the opinion that the Bauxite Mining and Environmental Management Plans are inconsistent with the relevant environmental conditions.
6. The Stakeholder Consultation Group shall comprises members of the proponent's established community liaison committees or other consultative groups, non-government conservation organisation(s), relevant members of natural resource management groups within or adjoining proposed new mining areas, and relevant government agencies that have established research or related activities in or adjoining proposed new mining areas.

The Stakeholder Consultation Group shall have the following functions:

- provide comment on the draft Scope of Biodiversity Investigations;
  - provide comment on the draft Rehabilitation Plan; and
  - provide comment on any draft Bauxite Mining and Environmental Management Plan(s).
7. The revised draft Bauxite Mining and Environmental Management Plans are to be reviewed by an accredited Environmental Auditor as follows:

- (a) within one month of the proponent submitting a revised draft Bauxite Mining and Environmental Management Plan to it, the EPA shall provide the proponent with a list of names of five independent Environmental Auditors to whom the proponent may submit a revised draft Bauxite Mining and Environmental Management Plan;
- (b) within one month of receiving a revised draft Bauxite Mining and Environmental Management Plan, the independent Environmental Auditor shall prepare a draft report on whether, in its opinion, the Plan will comply with condition 7 (Protection of Biodiversity). The draft report shall be submitted to the proponent for the proponent's consideration; and
- (c) within one month of receiving a revised Bauxite Mining and Environmental Management Plan, the Environmental Auditor shall prepare a final report on whether, in its opinion, the Plan will comply with condition 7 (Protection of Biodiversity). The final report shall be submitted to the Minister for the Environment and shall be provided to the proponent.

#### **Notes**

1. 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.
2. 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*.
3. Within this statement, to "have in place" means to "prepare, document, implement and maintain for the duration of the proposal".

## Schedule 1

### The Proposal (Assessment No. 1526)

Worsley Alumina Pty Ltd proposes to upgrade the Worsley refinery in order to increase production to 4.4 million tonnes per annum (Mtpa). The proposed production rate will require an increase in the rate of mining from 13.2Mtpa (dry) to approximately 16.5Mtpa (dry). In the long term, mining is proposed to extend into additional areas to those currently approved. The proposal will result in an increase in annual ground disturbance and rehabilitation from about 140 hectares per annum (ha/a) to about 240ha/a, situated in cleared farmland, remnant vegetation on farmland, and within areas of State Forest.

The currently approved mining envelope is referred to as the Primary Bauxite Area (PBA). The PBA comprises the Saddleback, Marradong and Hotham North mining envelopes as shown in Figure 1. Currently mining only occurs within the Saddleback mining envelope. Mined bauxite is crushed in primary and secondary crushers at the Saddleback mine site and transported by the overland bauxite conveyor to the refinery (Figure 2). Existing environmental approval allows extension of the existing overland bauxite conveyor from the Saddleback mining envelope to the Marradong and Hotham North mining envelopes.

The proposal is to expand the mining area to include the East Quindanning, Morgans, Hotham North Extension, Central and Brookton envelopes as shown in Figure 2. The total area of the proposed new mining envelopes is 75,016 hectares of which approximately 21% (15,950 hectares) has been designated as bauxite resource. The area delineated as bauxite resource that is within the forested area is 12,803 hectares. Additional exploration and close-spaced drilling is required to determine the economic “proven” bauxite reserves in order to construct a detailed mine plan that will determine the actual areas and extent of clearing.

The proposed expansion of mining activities will require the installation of three additional primary crushers within the proposed mining envelopes and relocation within mining areas as bauxite mining is completed. The secondary crusher will remain at the Saddleback location but an additional crushed ore stockpile will be required to provide extra surge material to feed the overland bauxite conveyor.

The proposal includes the following additional conveyors (Figure 2):

- 34km conveyor extension from the Hotham North mining envelope which will cross both the Albany Highway and the Wandering-North Bannister Road;
- 16km spur from the south east of the Central mining envelope to the Luptons mining envelope; and
- 28km extension from the Central mining envelope to the Brookton mining envelope.

Indicative mine planning for the East Quindanning and Morgan mining envelopes to the south of the current mining operation has not been completed at this stage. However, bauxite transport options will include overland bauxite conveyor spurs in combination with haul truck transport.

The proposal includes the following upgrades to the refinery:

- an increase in bauxite feed and flow through the digestion;
- an expansion of separation and bauxite residue washing and filtration facilities;
- a new precipitation train and seed thickener;
- a new hydrate filtration building and an additional gas fired calciner; and
- a coal-fired cogeneration facility that will produce 350 tonnes of steam per hour (equivalent to 204 megawatts) and 35 megawatts of electrical power.

The proposal does not include any change to the footprint of the BRDA's. However, the deposition rate will increase from approximately 11.8Mtpa to 16Mtpa.

The main characteristics of the proposal are summarised in Table 1 below. A detailed description of the proposal is provided in Chapter 1 - Section 4 of the ERMP document (Strategen, 2005).



**Table 1: Summary of key proposal characteristics**

<b>Element</b>	<b>Description</b>
<b>Bauxite-Alumina Project</b>	
Alumina Production	4.4Mtpa.
Greenhouse gases	3.7Mtpa of CO <sub>2,e</sub> .
<b>Bauxite Mining</b>	
Mining areas	Refer to Figure 1.
Mining rate	Approximately 16.5Mtpa (dry).
Additional area of ground disturbance	Up to approximately 16,000ha.
Water supply sources	Groundwater and surface water in the vicinity of mining areas.
Water usage	Additional 170ML/a.
Crushing plant	3 additional primary crushers.
<b>Bauxite transport</b>	
Existing cable belt conveyor	
Capacity	Increase to 3,200tpa.
Operation	Up to 140 hours per week (unchanged).
New transport	Conventional idler-type conveyors and/or truck transport.
<b>Worsley Refinery</b>	
Refinery lease area	2,500ha (unchanged).
Operation	24 hours per day 365 days per year (unchanged).
Bauxite stockpiles	Increase by approximately 0.5Mt.
Milling and digestion plant	1 additional mill, 1 additional desilication tank and 8 new slurry heaters.
Separation	Extension of residue washing tanks and expansion of capacity of causticiser circuit.
Precipitation	1 additional precipitation train, 1 additional seed thickener.
Calcination	1 additional gas-fired calciner with baghouse and a new hydrate filtration building.
Liquor purification	Liquor burning and emission control system as for current production.
Power and steam raising	Addition of a coal-fired cogeneration facility with baghouse designed to produce 350 tonnes of steam per hour (equivalent to 204MW) and 35MW of electrical power.
Bauxite Residue Disposal Areas	Increase deposition rate from approximately 11.8Mtpa to 16Mtpa. No change to footprint of BRDA's.
Water supply source	Normally a freshwater lake located on the Augustus River (No change).
Raw water usage (average)	Additional 0.5GL/a.
<b>Air emissions</b>	
Sulphur dioxide (SO <sub>2</sub> )	Up to approximately 12,220tpa.
Nitrogen oxides (NO <sub>x</sub> )	Up to approximately 6,890tpa.
Particulates	Up to approximately 520tpa.
Carbon monoxide (CO)	Up to approximately 940tpa.
Total volatile organic compounds (VOCs)	Up to approximately 270tpa.

**Abbreviations**

BRDA's Bauxite residue disposal area  
 GL/a gigalitres per annum  
 ha hectares  
 ML/a megalitres per annum

MW megawatts  
 Mt megatonnes  
 Mtpa million tonnes per annum  
 tpa tones per annum

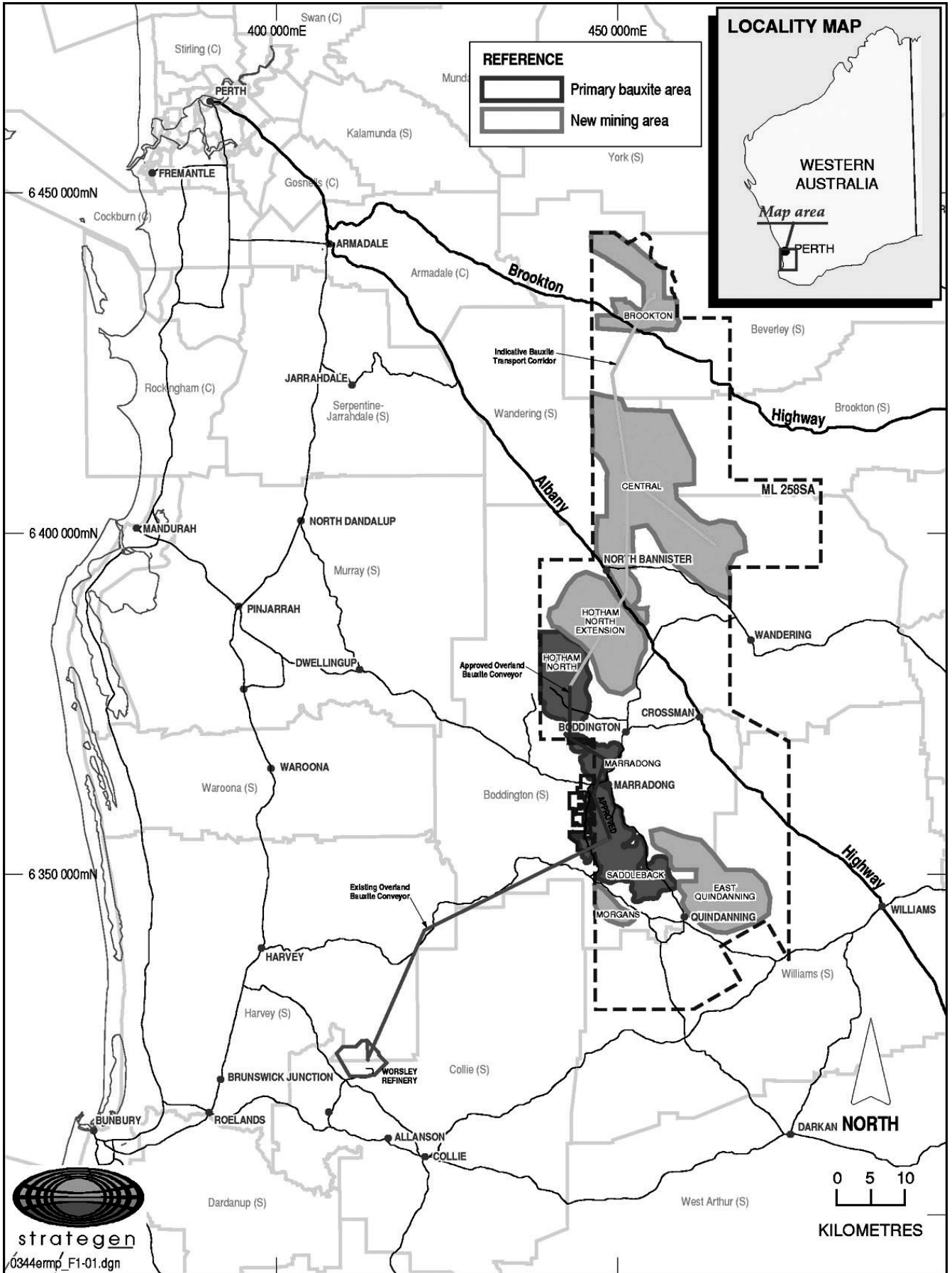


Figure 1: Regional location (Source: Figure 1.1 from Strategen, 2005)

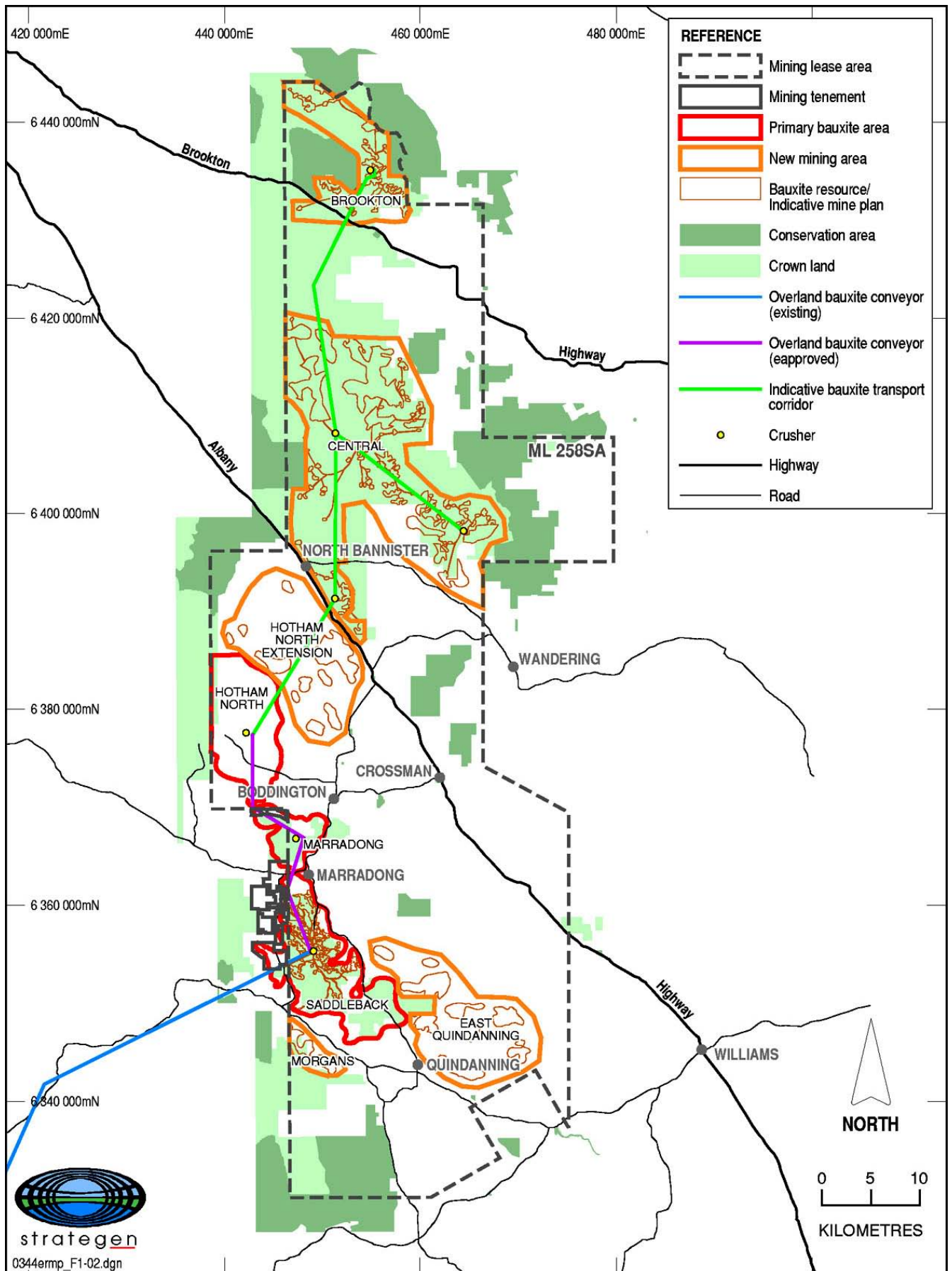


Figure 2: Existing and proposed mining envelopes (Source: Figure 1.3 from Straten, 2005)

## **Schedule 2**

### **Proponent's Environmental Management Commitments**

November 2005

#### **WORSLEY ALUMINA - EFFICIENCY AND GROWTH INCREASE OF EXISTING OPERATIONS TO 4.4MTPA ALUMINA PRODUCTION**

(Assessment No. 1526)

Worsley Alumina Pty Ltd

## Proponent's Environmental Management Commitments - November 2005

### WORSLEY ALUMINA - EFFICIENCY AND GROWTH INCREASE OF EXISTING OPERATIONS TO 4.4MTPA ALUMINA PRODUCTION (Assessment No. 1526)

**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.

#### Consolidated Management Commitments

Commitment Number	Topic	Objective	Action	Timing	Advice From
Project Wide					.
1	Environmental management	To meet all project environmental obligations and to provide a system for monitoring and review, consultation and environmental reporting programs.	Worsley will prepare and implement a management plan for general areas of project environmental management that: <ul style="list-style-type: none"> <li>• establishes environmental audit plans for the project;</li> <li>• identifies and maintains environmental management reporting requirements;</li> <li>• establishes consultation and liaison requirements and mechanisms with the Environmental Management Liaison Group, Community Liaison Committees and other stakeholders;</li> <li>• addresses spills management and response; and</li> <li>• addresses management of project construction activities.</li> </ul>	Prior to construction	EMLG <sup>a</sup>

<sup>a</sup> EMLG: Environmental Management Liaison Group

<b>Commitment Number</b>	<b>Topic</b>	<b>Objective</b>	<b>Action</b>	<b>Timing</b>	<b>Advice From</b>
2	Greenhouse gases	<p>To reduce as far as practicable net greenhouse emissions and project greenhouse intensity.</p> <p>To manage the sources and sinks of greenhouse gases associated with the Bauxite-Alumina project to minimise greenhouse gas emissions.</p>	<p>Worsley will prepare and implement a Greenhouse Gas and Energy Conservation Plan for the project that:</p> <ul style="list-style-type: none"> <li>• maintains an inventory and reports project greenhouse emissions and greenhouse intensity;</li> <li>• evaluates and adopts best practice technology to improve project greenhouse intensity;</li> <li>• identifies, evaluates and implements greenhouse reduction and offset measures; such measures may be 'no regrets' or beyond no regrets' measures; and</li> <li>• maintains Worsley's participation in the Australian Greenhouse Challenge Plus program.</li> </ul>	Prior to commissioning	EMLG
3	Closure	<p>To meet all legal requirements.</p> <p>To protect public health, safety and indigenous values.</p> <p>To ensure residual environmental and social impacts are acceptable.</p> <p>To ensure long term site maintenance is eliminated as far as practicable.</p> <p>To ensure end land uses have the agreement of government and other key stakeholders.</p> <p>To minimise long term liabilities.</p>	<p>Worsley will prepare a conceptual Decommissioning and Closure Management Plan that addresses:</p> <ul style="list-style-type: none"> <li>• development of suitable end land uses and objectives for decommissioning and closure in consultation with the Environmental Management Liaison Group and Community Liaison Committees;</li> <li>• establishment of completion criteria for rehabilitated areas;</li> <li>• closure concepts;</li> <li>• areas of research;</li> <li>• rehabilitation prescriptions suitable for all aspects of closure;</li> <li>• closure monitoring;</li> <li>• stakeholder consultation; and</li> <li>• updating the conceptual Decommissioning and Closure Management Plan.</li> </ul>	Operational	EMLG
4	Waste disposal (other than bauxite residue)	<p>To reduce as much as practicable the generation of solid and liquid waste resulting from refinery and mining operations.</p> <p>To dispose of waste in an environmentally acceptable manner.</p>	<p>Worsley will prepare and implement a management plan for waste (other than bauxite residue) that:</p> <ul style="list-style-type: none"> <li>• identifies and quantifies all project waste;</li> <li>• identifies all wastes that can be recycled/re-used;</li> <li>• details a program to reduce waste;</li> <li>• maximises the quantities of waste that are recycled; and</li> <li>• monitors waste volumes disposed to landfill.</li> </ul>	Prior to commissioning	EMLG/DoE

Commitment Number	Topic	Objective	Action	Timing	Advice From
Mining operations					
5	Vegetation, flora, fauna and rehabilitation	<p>To ensure biodiversity and sustainability of Eastern Darling Range forest ecosystems are maintained from adverse impacts of Worsley's bauxite mining activities.</p> <p>To ensure rare and endangered flora and fauna within the mining area are protected.</p>	<p>Worsley will prepare and implement a Flora, Fauna and Forest Protection Plan which will include the following:</p> <p><b>Vegetation and flora</b></p> <ul style="list-style-type: none"> <li>• a program for baseline surveys before mining;</li> <li>• a continued program to conduct seasonal vegetation surveys. These will contribute to existing knowledge of the distribution and extent of vegetation in the extension area;</li> <li>• the excision from mining of Lukin 2 and Dalmore 2 vegetation complexes that are not severely degraded;</li> <li>• the excision from mining of areas with a substantial proportion of the local population of Declared Rare Flora;</li> <li>• the excision from mining of Threatened Ecological Communities;</li> <li>• the excision from mining or clearing of all heaths and granite rock outcrops, including adequate buffers. This applies where they occur in the Michibin Complex which has less than 30% remaining and other complexes where practicable;</li> <li>• a program to monitor the distribution and abundance of flora and heath land communities adjacent to mined areas; and</li> <li>• a program for weed control.</li> </ul> <p><b>Fauna</b></p> <ul style="list-style-type: none"> <li>• a program to conduct seasonal fauna surveys. These will contribute to existing knowledge of the distribution and extent of fauna of significance and associated habitats in the extension area, in particular they will: <ul style="list-style-type: none"> <li>• determine habitat associations of fauna (especially short range endemic invertebrates, reptiles and birds) in order to determine the local significance and impact of the proposed mining operations. This will include determination of any effects on fauna as a result of fragmentation and isolation of habitat;</li> </ul> </li> </ul>	Prior to construction	EMLG/CALM

Commitment Number	Topic	Objective	Action	Timing	Advice From
			<ul style="list-style-type: none"> <li>• determine measures of abundance of significant species (especially critical weight range mammals);</li> <li>• identify rare habitats and old hollows. Disturbance of such habitats will then be avoided wherever practicable;</li> <li>• a collaborative feral animal program that integrates rabbit, feral cat and fox control measures;</li> <li>• creation of wildlife corridors wherever practicable; and</li> <li>• establishment of fauna habitat zones in consultation with the State.</li> </ul>		
6	Forest disease	To minimise the risk of bauxite mining activities introducing or spreading jarrah dieback or other forest diseases into area of State and private forest.	<p>Worsley will prepare and implement a Forest Disease Management Plan. The plan will include reasonable and practicable actions that Worsley will employ to minimise the risk of introducing or spreading forest disease. Specifically the plan will address:</p> <ul style="list-style-type: none"> <li>• dieback hygiene procedures;</li> <li>• research into forest disease management;</li> <li>• rehabilitation of forest project areas affected by Jarrah dieback; and</li> <li>• monitoring of the spread of forest disease infections in mining areas and any associated secondary impacts.</li> </ul>	Prior to construction	EMLG/CALM
7	Rehabilitation	<p>To ensure that rehabilitation of mined areas in State Forest is timely, sustainable and meets completion criteria agreed by the State. Specific goals include the maintenance of recreation, conservation, timber production, landscape and hydrology values, together with impact minimisation on undisturbed areas.</p> <p>To ensure that rehabilitation of mined areas on private property leaves the land in an environmentally stable and sustainable condition and meets the requirements of the private property owner.</p>	<p>Worsley will prepare and implement a Rehabilitation Plan which will address the following:</p> <ul style="list-style-type: none"> <li>• description of the rehabilitation process;</li> <li>• progressive rehabilitation of mining areas which minimises the time between mining and rehabilitation, particularly in areas of high visual amenity;</li> <li>• a program of research to improve rehabilitation outcomes;</li> <li>• consideration of climate change in rehabilitation planning;</li> <li>• monitoring of the establishment of flora species in rehabilitation;</li> </ul>	Prior to construction	EMLG/CALM



Commitment Number	Topic	Objective	Action	Timing	Advice From
			<ul style="list-style-type: none"> <li>• a process for progressive development of completion criteria;</li> <li>• establishment of recalcitrant species in rehabilitation;</li> <li>• the use of local provenance seed in rehabilitation;</li> <li>• re-creation of fauna habitat in rehabilitation areas to encourage fauna re-colonisation; and</li> <li>• monitoring of recruitment of fauna into rehabilitation areas.</li> </ul>		
8	Water Resources	To ensure that the environmental values of surface and groundwater resources are maintained from adverse impacts of bauxite mining activities.	<p>Worsley will prepare and implement a Water Resource Management Plan – Mining which takes into account changing rainfall patterns and which will address the following:</p> <ul style="list-style-type: none"> <li>• assessment of salinity hazard and salt storage in soils in proposed mining areas;</li> <li>• development of predictive tools to estimate the extent of watertable rise due to mining operations;</li> <li>• monitoring of salinity and level of groundwater in and near mining areas;</li> <li>• monitoring of regional water quality (salinity) of streams and groundwater;</li> <li>• contingency measures for salinity management;</li> <li>• assessment of water dependent ecosystems in new mining areas;</li> <li>• a process for selection of water supplies for the mine, including the evaluation of alternatives;</li> <li>• improvement in the efficiency of water use;</li> <li>• monitoring of water usage, groundwater level and any groundwater dependent ecosystems which may be affected by Worsley's groundwater abstraction;</li> <li>• working arrangements for exploration and mining in public drinking water supply areas;</li> <li>• establishment of appropriate stream buffer zones;</li> <li>• spills management; and</li> <li>• sediment control and drainage management in all areas where Worsley operates.</li> </ul>	Prior to construction	EMLG/DoE

<b>Commitment Number</b>	<b>Topic</b>	<b>Objective</b>	<b>Action</b>	<b>Timing</b>	<b>Advice From</b>
9	Dust	<p>To comply with statutory requirements so that the amenity of nearby residences is protected from dust impacts resulting from bauxite mining activities.</p> <p>To ensure that dust management techniques meets relevant best practice principles.</p>	<p>Worsley will prepare and implement a Dust Management Plan that addresses the following:</p> <ul style="list-style-type: none"> <li>• suppression of dust in all areas where Worsley operates, including the use of additives to reduce water consumption where appropriate;</li> <li>• monitoring of dust levels at locations upwind and downwind of operating areas; and</li> <li>• monitoring of the impact of dust on vegetation adjoining haulroads and the development of measures to address any identified significant adverse impacts.</li> </ul>	Prior to construction	EMLG/DoE
10	Noise and Vibration	<p>To comply with the statutory requirements so that the amenity of nearby residences is protected from noise impacts resulting from mining activities.</p>	<p>Worsley will prepare and implement a Noise and Vibration Management Plan – Mining, that will address the following:</p> <ul style="list-style-type: none"> <li>• forecasting of operational noise;</li> <li>• measures to ensure compliance with noise regulations. These will include mine planning and day to day noise forecasting;</li> <li>• measures to control noise emissions from mining equipment;</li> <li>• monitoring of operational and blast noise and vibration;</li> <li>• implementation of corrective and preventative actions where in-house targets are exceeded;</li> <li>• response to complaints; and</li> <li>• community consultation.</li> </ul>	Prior to construction	EMLG/DoE
11	European Heritage and Recreation	<p>To maintain the amenity of recreation activities within State forest and ensure public safety.</p>	<p>Worsley will prepare and implement a Public Safety and Recreation Facilities Management Plan, before mining in the extension area. The plan will address the following:</p> <ul style="list-style-type: none"> <li>• public safety measures;</li> <li>• road and walking track closure and re-establishment;</li> <li>• noise management measures where mining is close to popular recreational sites;</li> <li>• establishment of new recreational sites where existing popular sites are severely affected by mining operations; and</li> <li>• stakeholder consultation.</li> </ul>	Prior to construction	EMLG

<b>Commitment Number</b>	<b>Topic</b>	<b>Objective</b>	<b>Action</b>	<b>Timing</b>	<b>Advice From</b>
Bauxite transport corridor					
12	Relevant environmental factors - construction	To ensure that biodiversity, local water resources, heritage and recreation values are maintained from any adverse impacts associated with construction of bauxite transportation systems.	<p>Worsley will develop and implement a Construction Management Plan for bauxite transport systems which details measures to address the following as they relate to construction:</p> <ul style="list-style-type: none"> <li>• flora and fauna habitat surveys before and after construction;</li> <li>• avoidance of Dalmore 2 and Lukin 2 vegetation complexes and Threatened Ecological Communities;</li> <li>• where practicable, avoidance of all heaths and granite outcrops from the proposed corridor extensions where they occur in the Michibin complex and other complexes;</li> <li>• minimisation of disturbance to streams and associated riparian vegetation during construction of stream crossings;</li> <li>• control of access during construction;</li> <li>• forest disease management;</li> <li>• control of runoff and dust;</li> <li>• feral animal control;</li> <li>• workforce education regarding the protection of vegetation, flora, fauna, and watercourses;</li> <li>• protection of Aboriginal heritage and culture;</li> <li>• protection of European heritage;</li> <li>• management of impacts on recreation facilities;</li> <li>• management of recreation and social impacts;</li> <li>• management of waste; and</li> <li>• management of noise.</li> </ul>	Prior to construction	EMLG/CALM
13	Relevant environmental factors - operation	<p>To ensure operation of bauxite transportation systems has minimal impact on forest ecology.</p> <p>To minimise the risk of spreading jarrah dieback in forest areas adjacent to bauxite transportation systems.</p>	<p>Worsley will prepare and implement an Operation Management Plan prior to operation of any bauxite transport system that will address the following:</p> <ul style="list-style-type: none"> <li>• measures to control access specifically: <ul style="list-style-type: none"> <li>• public access;</li> <li>• road crossings;</li> </ul> </li> </ul>	Prior to construction	EMLG/CALM

Commitment Number	Topic	Objective	Action	Timing	Advice From
			<ul style="list-style-type: none"> <li>• emergency access;</li> <li>• application of the Forest Disease Management Plan;</li> <li>• inspection and monitoring of forest health within and adjacent to the proposed corridor extensions;</li> <li>• the CALM Interagency Agreement for Wildfire Suppression; and</li> <li>• maintenance of the transport corridor as a controlled drainage system.</li> </ul>		
14	Noise	Ensure noise emissions for the overland bauxite conveyor and proposed extension comply with statutory requirements (Agreement Act conditions)	<p>Worsley will prepare and implement a Noise Management Plan – Bauxite Transport, which will address:</p> <ul style="list-style-type: none"> <li>• the use of noise emissions modelling results in the siting of transport corridors;</li> <li>• monitoring of noise emissions from conveyor systems to demonstrate compliance with Agreement Act requirements;</li> <li>• corrective and preventative actions where in house targets are exceeded;</li> <li>• identification of potential noise sensitive premises;</li> <li>• community consultation; and</li> <li>• response to complaints.</li> </ul>	Prior to construction	EMLG/CALM
Refinery					
15	Air emissions	<p>To comply with statutory requirements so that the ecological values of off-site areas and the amenity and health of nearby residents are protected from adverse emissions to air from the refinery operations.</p> <p>To minimise all emissions from the refinery.</p>	<p>Worsley will prepare and implement an Air Quality Management Plan which will include the following:</p> <ul style="list-style-type: none"> <li>• air quality improvement plan addressing priority areas. These will include mercury emissions from digestion, fugitive dust emissions from residue areas, VOC emissions from calciners, a program for the Air Emissions Impact Assessment project and community consultation;</li> <li>• field odour assessment study;</li> <li>• assessment of odour from the refinery catchment lake;</li> <li>• ambient air monitoring program;</li> </ul>	Prior to construction	EMLG/DoE

Commitment Number	Topic	Objective	Action	Timing	Advice From
			<ul style="list-style-type: none"> <li>• emissions monitoring program, with emphasis on odour emissions from significant point and area sources;</li> <li>• actions to control fugitive and point source particulate emissions;</li> <li>• incident and complaints response; and</li> <li>• program for annual reporting on air quality.</li> </ul>		
16	Noise	To comply with the statutory requirements so that the amenity of nearby residents is protected from noise impacts resulting from refinery operations.	<p>Worsley will prepare and implement a Noise Management Plan – Refinery which will include the following:</p> <ul style="list-style-type: none"> <li>• noise monitoring program;</li> <li>• maintenance of refinery noise model;</li> <li>• actions to ensure compliance with noise regulations; and</li> <li>• establishment of noise standards for use in acquisition of new noise emitting equipment.</li> </ul>	Prior to construction	EMLG/DoE
17	Water resources	<p>To ensure that environmental values of water resources are maintained from adverse impacts of refinery operations and bauxite residue disposal.</p> <p>To design construct and operate the residue disposal areas in a manner that maintains the integrity of the containment system.</p>	<p>Worsley will prepare and implement a Water Resource Management Plan - Refinery that takes into account changing rainfall patterns and that addresses:</p> <ul style="list-style-type: none"> <li>• strategic water source planning;</li> <li>• improvement in the efficiency of water use at the refinery;</li> <li>• protection of water quality in the Augustus River, which is located downstream of the refinery;</li> <li>• maintenance of environmental water provisions which will be reviewed, as appropriate, during renewal of Worsley’s Surface Water Licence;</li> <li>• surface and groundwater quality monitoring; and</li> <li>• management and cleanup of spills and onsite contamination.</li> </ul>	Prior to construction	EMLG/DoE

## **Appendix 5**

**This Appendix is on the CD pasted to the back page of this bulletin.**

**The attached CD contains the following information:**

- 1) Summary of submissions and proponent's response to submissions; and**
- 2) Environmental Review and Management Programme.**