Gas Fired Co-generation Facility

Worsley Alumina Pty Ltd

Report and recommendations
of the Environmental Protection Authority

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Contents

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 relevant to the proposal by Worsley Alumina Pty Ltd (WAPL) to construct and operate two gas fired co-generation units each producing 120 megawatts (MW) of electrical power and 210 MW of steam at the alumina refinery at Worsley.

Based on the information provided in the referral document the EPA considered that, while the proposal has the potential to affect the environment, it could be readily managed to meet the EPA's environmental objectives. Consequently, the proposal was advertised in *The West Australian* newspaper on 8 August 2005 advising that the EPA was assessing the proposal at the level of Assessment on Referral Information (ARI).

The proponent has submitted a referral document setting out the details of the proposal, potential environmental impacts and appropriate commitments to manage those impacts. The EPA notes that the proponent has consulted with relevant stakeholders. The EPA considers that the proposal as described can be managed in an acceptable manner, subject to these commitments and the EPA's recommended conditions being made legally binding.

The EPA has therefore determined under Section 40(1) of the Environmental Protection Act that the level of assessment for the proposal is Assessment on Referral Information, and this report provides the EPA advice and recommendations in accordance with Section 44(1).

2. The Proposal

WAPL's alumina refinery has existing approval for the production of 3.7 million tonnes per anum (Mtpa) of alumina.

Note: There is currently a separate proposal for expansion of the project to increase production to 4.4 Mtpa which is being assessed by the EPA at the level of Environmental Review and Management Program (ERMP). This ERMP details an option of coal fired co-generation.

The proposal being assessed in this report represents an alternative gas fired option. WAPL proposes to construct and operate a natural gas-fired, co-generation facility. The proposal would be implemented in two stages, each consisting of a gas turbine with a nominal generation capacity of 120 MW electrical output and a heat recovery steam generator (HRSG) of nominally 210 MW steam output. The facility would be located at the Worsley alumina refinery (Figure 1). Each of the stages could provide approximately 994 gigawatt hours (GWhr) of electricity annually, much of which would be exported into the South West Interconnected System (SWIS).

The two stages are:

- Stage A: to decrease dependence on coal at the approved production rate;

- Stage B: to meet energy demand (steam and electricity) for the proposed expansion.

The main components for each stage of the co-generation facility would be:

- one natural gas-fired turbine of 120MW nominal generating capacity;
- one HRSG of nominally 210MW output;
- water production (de-aerator and polishing) plant; and
- one 55m HRSG stack.

The proposal would result in the existing coal fired co-generation being reduced by almost 30% for Stage A and about 20% for Stage B, resulting in a significant reduction in emissions of sulphur dioxide (SO_2), particulates and carbon monoxide (CO).

A detailed description of the proposal can be found in the proponent's referral document (Strategen, 2005). The main characteristics of each stage of the proposal are summarised in the table below.

Table 1: Summary of key proposal characteristics

Element	Description for each stage(i.e. x 2)
Project Purpose	To supply steam to the Worsley alumina refinery and electricity to the south west integrated system
Life of the Project	25 years (nominal)
Power Generating Capacity	120 megawatts (nominal)
Fuel Type Gas Transportation	 natural gas Dampier to Bunbury Natural Gas Pipeline
Plant Facilities Gas turbine specifications Heat recovery steam generator (HRSG) Number of stacks Height of HRSG stack	 1 × gas turbine of 120 megawatts nominal generating capacity fitted with dry low NO_x burners 1 × HRSG with a capacity of 210 megawatts one 55metres
Thermal Efficiency Thermal Efficiency based on net higher heating value	 approximately 77%
Operation Hours	24 hours a day, 365 days/year (with an availability of approximately 95%)
Inputs Natural Gas Process water	 approximately 12.8 petajoules per annum approximately 0.5 gigalitres per annum, integrated with refinery water supply
Outputs Waste water	 directed to existing to existing refinery catchment lake
Air Emissions Carbon dioxide equivalent (CO_{2e}) Oxides of nitrogen (NO_x) Carbon monoxide (CO)	 767 000 tonnes per annum 575 tonnes per annum 9.9 tonnes per annum

The potential impacts of the proposal are discussed by the proponent in the referral document (Strategen, 2005).

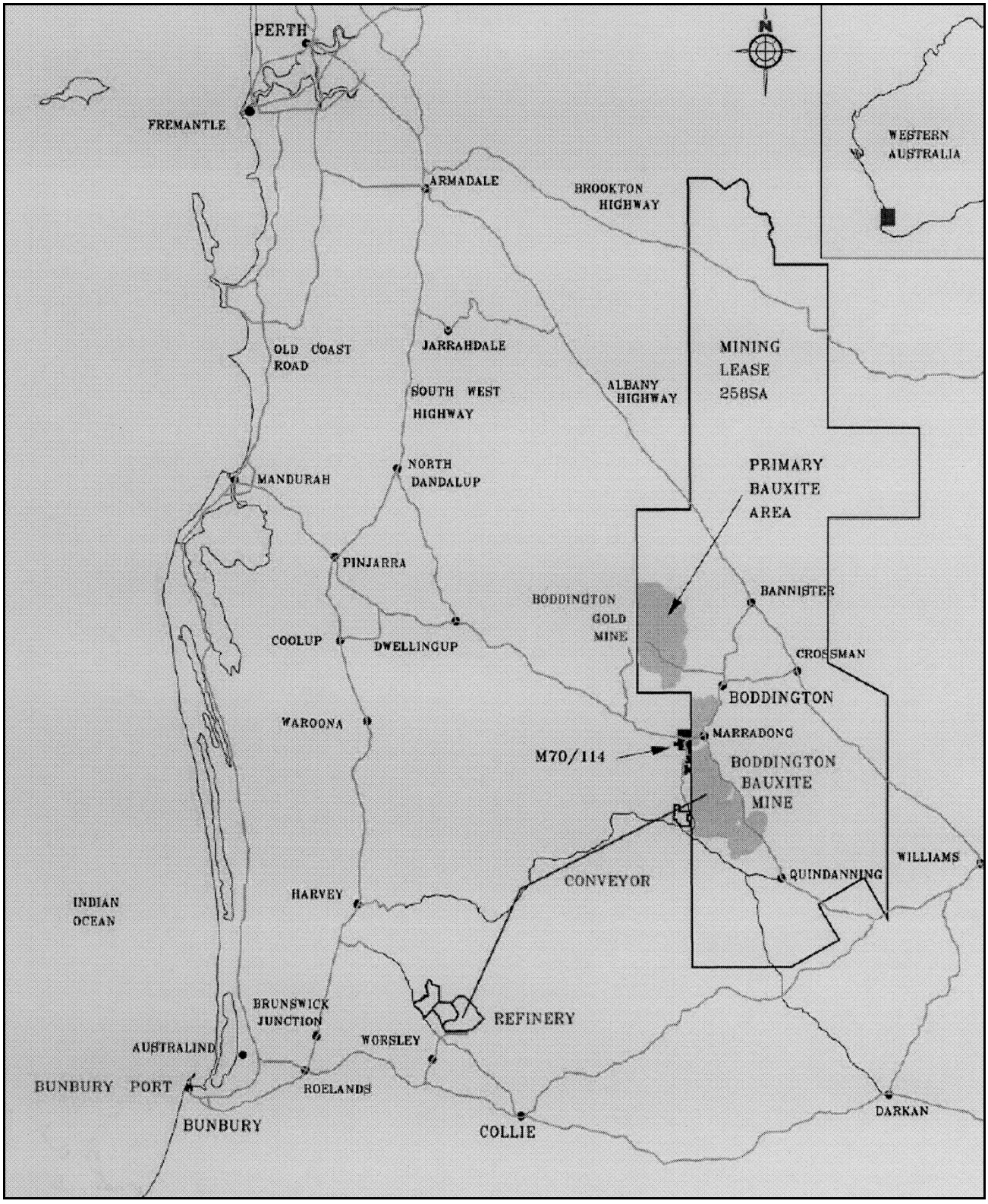

Figure 1: Regional Location (Strategen, 2005)

3. Consultation

Section 5 of WAPL's referral (Strategen, 2005) document details the consultation that has occurred with the following targeted group of stakeholders:

- workforce and contractors;
- near neighbours and neighbours of the refinery, conveyor and mine;
- South West Land and Sea Council and Aboriginal communities and organisations;
- local and Perth based environmental and land care groups;
- general community;
- Environmental Management Liaison Group;
- EPA, Department of Environment, Department of Industry and Resources, Department of Health, Department of Agriculture, Conservation and Land Management and the Conservation Commission;
- local Members of Parliament and relevant Ministers; and
- local business organisations.

A number of environmental issues were raised by the stakeholders during the consultation. Table 2 summarises the main issues raised and details the actions taken by WAPL to address the issues.

Table 2: Summary of issues raised during stakeholder consultation (Strategen, 2005)

Key stakeholders	Consultation	Issue raised	Response
Community Liaison Committees	Expansion project briefing including options for meeting project energy requirements	Management of traffic	Not a significant issue associated with co-generation proposal
Members of Parliament	Expansion project briefing including options for meeting project energy requirements	No issues raised in relation to proposed co-generation facility	n/a
Local Government	Expansion project briefing including options for meeting project energy requirements	Support for coal fired power station Modelling (air emissions) to include impacts on land owners in the Shire of Harvey	Feasibility of both coal and gas continuing to be assessed Modelling of dispersion and assessment of impact of emissions to air provided in section 3. Modelling of ozone extended to include Harvey. Insignificant impact of criteria pollutants beyond refinery lease boundary.
Business groups	Expansion project briefing including options for meeting project energy requirements	No issues raised in relation to proposed co-generation facility	n/a
Conservation groups	Expansion project briefing	Support for use of natural gas	Feasibility of both coal and gas continuing to be assessed
Environmental Management Liaison Committee	Expansion project briefing including options for meeting project energy requirements	No issues raised in relation to proposed co-generation facility	n/a

The EPA considers that the consultation process has been appropriate and that reasonable steps have been taken to inform the community and stakeholders on the proposed development.

4. Relevant Environmental Factors

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.

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

(a) Air quality; and

(b) Greenhouse gas emissions.

Details on the relevant environmental factors and their assessment are contained in Sections 4.1 - 4.2. 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.

4.1 Air quality

Description

The implementation of the gas fired co-generation facility would allow a reduction in the amount of coal burnt and this would reduce emissions of SO_2, CO and particulates. There would also be an increase in NO_X emissions of 12% (see Table 3 below).

Table 3: Emission levels

	Emission rate in grams per second (% change from existing)			
Scenario	**SO_2**	**NO_X (as NO_2)**	**CO**	**PM_{10}**
Existing production level (3.25 Mtpa) with coal fired power station and single gas turbine	315	129	11.0	2.9
Approved production level (3.7 Mtpa) with Stage A	223 (-29%)	116 (-10%)	8.5 (-25%)	2.1 (-28%)
Expansion (4.4 Mtpa) with Stage A and B	248 (-21%)	144 (+12%)	9.7 (-14%)	2.3 (-20%)

The impact of the proposed plant was evaluated by modelling NO_2 for a variety of scenarios including cumulative emissions from existing and approved (but not operational) industries.

For the Worsley alumina refinery emissions alone, the second highest predicted ground-level concentration of NO_2 was 28% of the 1 hour National Environment Protection Measure (NEPM) standard and 1% of annual average NEPM standard.

NO_2 emissions from the Worsley alumina refinery and other Collie regional sources do not overlap or cumulatively affect any receptors except those to the north west of the refinery. At these receptors the cumulative ground level concentration is predicted to be less than 30% of the NEPM 1 hour standard.

Assessment

EPA objective

The EPA's environmental objective for this factor is to ensure that emissions do not adversely affect environmental values or the health, welfare and amenity of the people and land uses by meeting statutory requirements and acceptable standards.

EPA guidance statement number 15 *Guidance Statement for Emissions of Oxides of Nitrogen from Gas Turbines* provides assessment guidance and criteria for the management of NO_x emissions. For this proposal the relevant maximum emission level is $0.07g/m^3$ or 34ppmv NO_x at 15% dry oxygen and STP reference level (EPA, 2000a). This is an upper limit and the EPA considers that proponents should use best practicable technology to better these limits. As such, the EPA expects the best practice of low-NO_x burners to be installed in all gas turbines (EPA, 2002a).

The EPA notes that the relevant criterion for ambient air quality is the NEPM standard of 0.12ppmv NO_2 (1 hour average) and 0.03ppmv NO_2 (annual average). The cumulative effect of NO_2 emissions from the co-generation facility and nearby sources should be less than this standard.

Relevant Proposal Characteristics

The proponent advises that the co-generation facility would be less than the EPA's guideline level of 34ppmv during normal operations.

The co-generation facility would utilise dry low-NO_x burners. The EPA considers that the use of low-NO_x burners demonstrates the implementation of best practicable technology. The EPA notes that the proposal would only use natural gas as a fuel and liquid fuel would not be used.

Air dispersion modelling results provided in the referral document predicts that the proposed co-generation facility would contribute a minor amount to existing ambient NO_2 levels in the Collie area and that the NEPM standard for cumulative NO_2 is not likely to be exceeded.

The EPA recommends that the proponent be required to design and implement a stack emissions monitoring strategy in accordance with recommended condition 7 attached in Appendix 2 of this bulletin.

The EPA notes that the environmental benefit from the significant reduction in emissions of SO_2, particulates and CO outweigh the disbenefit from the increase in NO_X emissions since SO_2 and particulates are of greater concern in the Collie area due to the existing and proposed use of coal for power generation.

Summary

Having particular regard to the:

- reduced emissions of SO_2, particulates and CO;
- results of the dispersion modelling, which indicates that it is unlikely that the NEPM ambient air quality standard would be exceeded by the proposed co-generation facility;
- installation of dry low-NO_x burners; and
- recommended condition 7, which requires the proponent to prepare and implement a monitoring strategy to gauge in-stack air emissions,

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

4.2 Greenhouse Gas Emissions

Description

Each of the proposed stages would emit approximately 767,000 tonnes of carbon dioxide equivalent (CO_{2e}) per year.

The proposed plant has a net total energy efficiency of 77% (based on net higher heating value, modelled at 15ºC). World's best practice total efficiency for a combined cycle gas turbine plant adjusted for Australian conditions is 46.7% for a plant of capacity less than 250MW (AGO, 2001). The reason for the much greater efficiency of the co-generation facility is that the recovered heat (steam) is used in the alumina refining process at about 86% thermal efficiency rather than in a steam turbine which has only about 36% thermal efficiency.

While the overall carbon intensity of the facility is only 0.28 tonnes carbon dioxide per megawatt hour (CO_{2e}/MWh), the proponent has apportioned the CO_{2e} emissions such that the average carbon intensity of the electrical output is 0.49 tonnes CO_{2e}/MWh. This can be compared with the average carbon intensity of Western Power's SWIS during the year 2002 which was 0.92 tonnes CO_{2e}/MWh.

By substituting natural gas for coal in the mixture of fuels used by WAPL to generate energy, the emissions of CO_{2e} per unit of alumina produced would decrease. The current figure is 0.80 tonne of CO_{2e} per tonne of alumina (tCO_{2e}/t) and this would reduce to 0.69 tCO_{2e} /t with implementation of the proposal

Assessment

EPA requirements

The EPA's objective for greenhouse gases is to ensure 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.

EPA guidance statement number 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, 2002b).

Relevant proposal characteristics
Each stage would comprise a 120 MW gas turbine with a HRSG to recover waste heat of 210 MW.

The EPA notes that the proponent has apportioned the CO_{2e} emissions to the electrical power generation such that the greenhouse intensity for the electricity produced is equivalent to a Combined Cycle Gas Turbine (CCGT) power station of 44% efficiency. This is equivalent to worlds best practice of 46.7% when adjusted for the altitude of the Worsley site. As such, the EPA notes that the proposed co-generation facility has a greenhouse gas intensity of 0.49 tonnes/MWhr which is 53% of the average greenhouse gas intensity of Western Power's operations and will result in a small net average reduction in the greenhouse gas intensity of the SWIS if constructed.

The EPA notes that the proponent is a signatory to the Greenhouse Challenge which requires the proponent to undertake annual emissions reporting to the Greenhouse Office and operational performance monitoring of combustion to ensure that power generation meets the design criteria.

The EPA notes that the proponent has not committed to offsetting any of its carbon emissions. The EPA considers that the proposed co-generation facility represents the most efficient means of meeting the required demand for process steam and electricity and the EPA is satisfied that it represents best practice for the expansion. Co-generation facilities are more efficient than open cycle gas turbines, steam turbines and CCGT plants and the EPA does not require offsets to recommend approval of this proposal. However the EPA would encourage the proponent to consider carbon sink projects during the life of the project.

The EPA recommends that the standard ministerial condition (i.e. Condition 6 in Appendix 2 of this report) applied to all proposals with large greenhouse gas inventories be imposed on the proposal. This condition requires a greenhouse gas emissions management plan to be prepared and implemented.

Summary
Having particular regard to the:
- high thermal efficiency of the co-generation configuration;
- significant reduction in greenhouse gas intensity (i.e. CO_{2e} per tonne of product);

- proponent's commitment to continue to participate in the Greenhouse Challenge; and
- 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.

5. Conditions and Commitments

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

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.

6. Conclusions

The EPA has considered the proposal by WAPL to construct and operate a co-generation facility at their Worsley alumina refinery.

Air emissions
Implementation of the proposal would allow a reduction of coal burning which would result in a significant reduction in emissions of SO_2, particulates and CO. Predicted ground level NO_2 concentrations from the cumulative air modelling for the co-generation facility are below the relevant NEPM standards.

Greenhouse gas emissions
The EPA is aware that demand for electricity in Western Australia will continue to grow, and believes that the greenhouse intensity of new generation should be reduced as much as possible. The EPA notes that implementation of this co-generation facility would reduce the greenhouse intensity of the SWIS. The EPA also notes that implementation would significantly decrease the greenhouse intensity of the alumina product.

The EPA considers that this natural gas fired co-generation option provides the best environmental outcome of the options being considered by WAPL for their expansion.

The EPA has concluded that the proposal is capable of being managed in an environmentally acceptable manner such that it is most unlikely that the EPA's objectives would be compromised, provided there is satisfactory implementation of the recommended conditions and proponent's commitments set out in Section 5.

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 for the construction and operation of a co-generation facility at the Worsley alumina refinery;
2. That the Minister considers the report on the relevant environmental factors as set out in Section 4;
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 2; and
4. That the Minister imposes the conditions and procedures recommended in Appendix 2 of this report.

Appendix 1

References

AGO, 2001. *Technical Guidelines- Generator Efficiency Standards.* Version 1.2, January 2001. Australian Greenhouse Office, Commonwealth Government of Australia, Canberra, ACT. Available: www.greenhouse.gov.au/pubs

EPA, 2000a. *Guidance for the Assessment of Environmental Factors: Guidance Statement for Emissions of Oxides of Nitrogen from Gas Turbines.* EPA Guidance Statement 15, May 2000. Environmental Protection Authority, Perth WA.

EPA, 2002a. *Strategic Planning for Future Power Generation: Pinjar Power Station Expansion; Kwinana/East Rockingham Power Station; Kemerton Power Station; New Bunbury Power Station; Collie Power Station Expansion.* EPA Bulletin 1067, September 2002. Environmental Protection Authority, Perth, Western Australia.

EPA, 2002b. *Guidance for the Assessment of Environmental Factors: Guidance Statement for Minimising Greenhouse Gas Emissions* . EPA Guidance Statement 12, October 2002. Environmental Protection Authority, Perth WA.

Strategen 2005. *Proposed New Gas Fired Co-generation Facility*. Worsley Alumina Pty Ltd, Strategen, April 2005

Appendix 2

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)

GAS-FIRED CO-GENERATION FACILITY, WORSLEY

Proposal: The construction, operation and maintenance of a co-generation facility of 120MW electrical output and 210 MW of steam output at Worsley, as documented in schedule 1 of this statement.

Proponent: Worsley Alumina Pty Ltd

Proponent Address: PO Box 344
Collie WA 6225

Assessment Number: 1584

Report of the Environmental Protection Authority: Bulletin 1189

The proposal referred to above may be implemented by the proponent subject to the following conditions:

1 Implementation

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

2 Proponent Commitments

2-1 The proponent shall implement the environmental management commitments documented in schedule 2 of this statement, to the requirements of the Minister for the Environment on advice of the Environmental Protection Authority.

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:

- the environmental factors of the proposal have not changed significantly;

- new, significant, environmental issues have not arisen; and

- 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 and submit compliance reports to the Department of Environment which address:

- the status of implementation of the proposal as defined in schedule 1 of this statement;

- evidence of compliance with the conditions and commitments; and

- the performance of the environmental management plans and programs.

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.

5-2 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:

- the major environmental issues associated with the project; the targets for those issues; the methodologies used to achieve these; and the key indicators of environmental performance measured against those targets;

- the level of progress in the achievement of sound environmental performance, including industry benchmarking, and the use of best available technology where practicable;

- significant improvements gained in environmental management, including the use of external peer reviews;

- stakeholder and community consultation about environmental performance and the outcomes of that consultation, including a report of any on-going concerns being expressed; and

- the proposed environmental targets over the next five years, including improvements in technology and management processes.

5-3 The proponent may submit a report prepared by an auditor approved by the Department of Environment under the "Compliance Auditor Accreditation Scheme" to the Chief Executive Officer of the Department of Environment on each condition/commitment of this statement which requires the preparation of a management plan, programme, strategy or system, stating that the requirements of each condition/commitment have been fulfilled within the timeframe stated within each condition/commitment.

6 Greenhouse Gas Emissions

6-1 Prior to commencement of construction of the co-generation facility, 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.

6-2 The proponent shall implement the Greenhouse Gas Emissions Management Plan required by condition 6-1.

6-3 Prior to the commencement of construction, the proponent shall make the Greenhouse Gas Emissions Management Plan required by condition 6-1 publicly available.

7 Stack Emissions

7-1 Prior to construction of the co-generation facility, the proponent shall prepare a Stack Emissions Management Plan, to:

- ensure that best available practicable and efficient technologies are used to minimise total air emissions from the co-generation facility;

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

This Plan shall address:

1 specific measures to minimise total air emissions from the co-generation facility to meet emission limits consistent with best practicable technology and current industry standards;

2 monitoring of air emissions including nitrogen oxides (NO_X) and volatile organic compounds (VOC's) and

3 public reporting of air emissions and any complaints about air emissions.

7-2 The proponent shall implement the Stack Emissions Management Plan required by condition 7-1.

7-3 The proponent shall make the Stack Emissions Management Plan, required by condition 7-1 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 Environmental Protection for the preparation of written advice to the proponent.

2 The Environmental Protection Authority may seek advice from other agencies or organisations, as required, in order to provide its advice to the Department of Environment.

3 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.

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, implement and maintain for the duration of the proposal".

Schedule 1

The Proposal (Assessment No. 1584)

Worsley Alumina Pty Ltd propose to construct and operate two natural gas-fired co-generation facilities, each with a nominal generation capacity of 120 megawatts electrical output and 210 megawatts of steam output on a site located at their Worsley alumina refinery (location shown in Figures 1 and 2).

Table 1 – Key Proposal Characteristics

Element	Description for each stage (i.e. x 2)
Project Purpose	To supply steam to the Worsley alumina refinery and electricity to the south west integrated system
Life of the Project	25 years (nominal)
Power Generating Capacity	120 megawatts (nominal)
Fuel Type Gas Transportation	 natural gas Dampier to Bunbury Natural Gas Pipeline
Plant Facilities Gas turbine specifications Heat recovery steam generator (HRSG) Number of stacks Height of HRSG stack	 1 × gas turbine of 120 megawatts nominal generating capacity fitted with dry low NO_x burners 1 × HRSG with a capacity of 210 megawatts one 55metres
Thermal Efficiency Thermal Efficiency based on net higher heating value	 approximately 77%
Operation Hours	24 hours a day, 365 days/year (with an availability of approximately 95%)
Inputs Natural Gas Process water	 approximately 12.8 petajoules per annum approximately 0.5 gigalitres per annum, integrated with refinery water supply
Outputs Waste water	 directed to existing to existing refinery catchment lake
Air Emissions Carbon dioxide equivalent (CO_{2e}) Oxides of nitrogen (NO_x) Carbon monoxide (CO)	 767 000 tonnes per annum 575 tonnes per annum 9.9 tonnes per annum

Figures (attached)

Figure 1 – Regional location
Figure 2 – Site layout

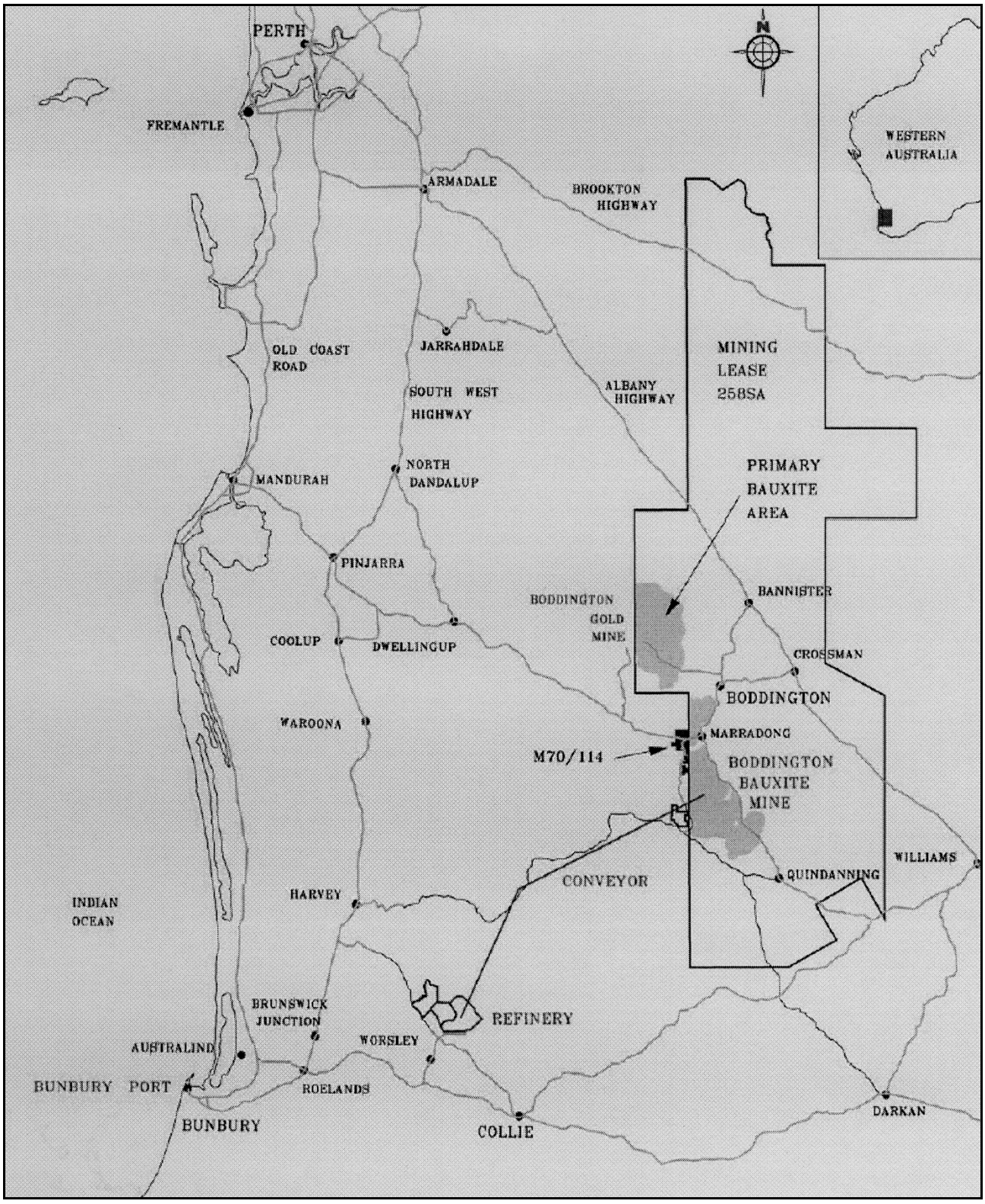

Figure 1: Regional location

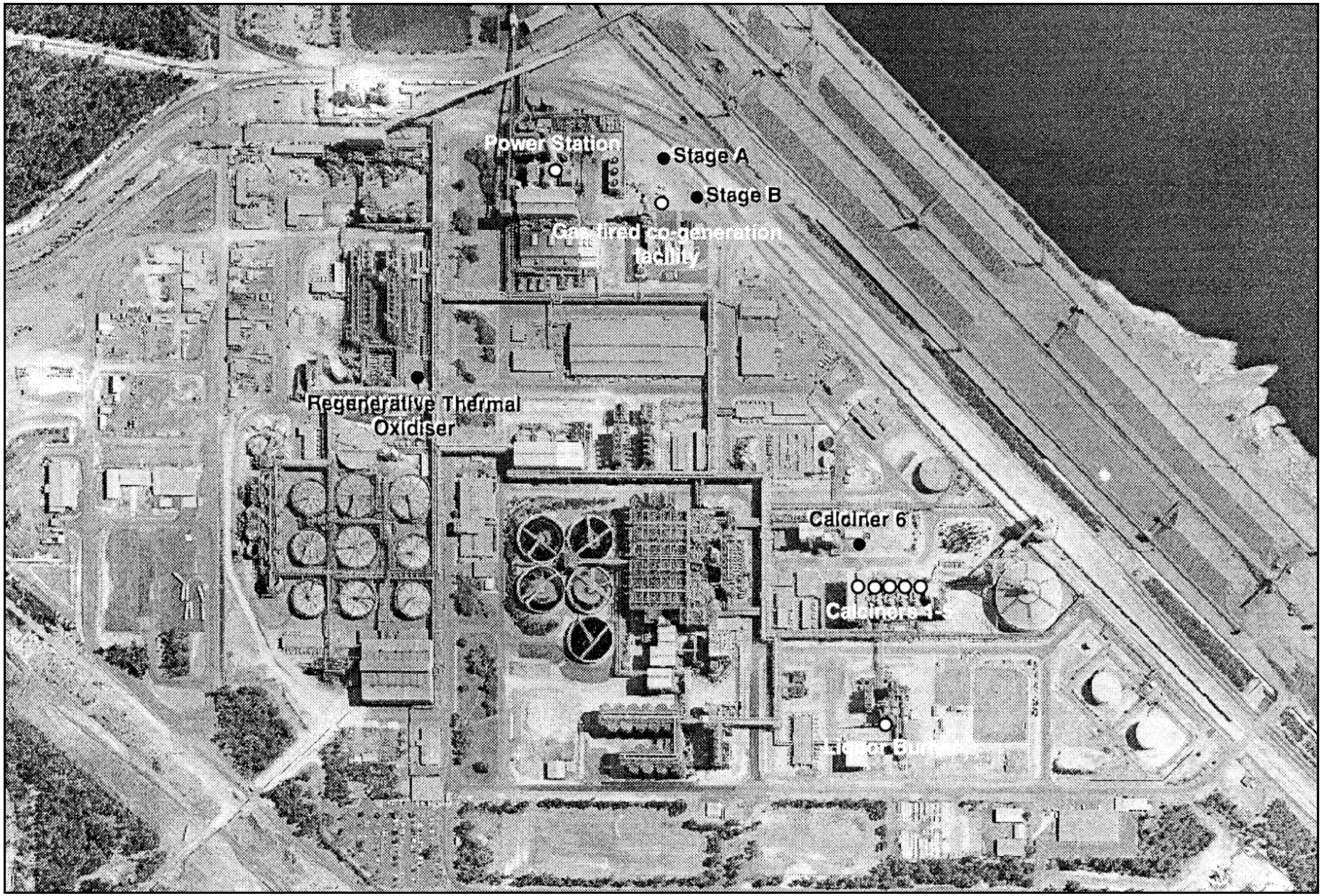

Figure 2: Site layout