

Biodiversity Investigations



Worsley Alumina



Ministerial Statement 000719 Public Information



Worsley Alumina Pty. Ltd.

Biodiversity Investigations



Prepared for Worsley Alumina Pty Ltd
by Strategen, 2008

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TABLE OF CONTENTS

1. INTRODUCTION	1
1.1 PURPOSE OF THIS DOCUMENT	1
1.2 BACKGROUND	2
1.2.1 Worsley Bauxite-Alumina Project	2
1.2.2 Location	3
1.2.3 Proponent/Ownership	4
1.2.4 Approval history	4
1.3 BIODIVERSITY INVESTIGATIONS AND WORSLEY'S MINE PLANNING AND DEVELOPMENT PROCESS	7
2. PROJECT MANAGEMENT FRAMEWORK FOR BIODIVERSITY-RELATED INVESTIGATIONS	10
2.1 THE BIODIVERSITY-RELATED INVESTIGATIONS	10
2.2 PROJECT MANAGEMENT, PEER REVIEW AND STAKEHOLDER CONSULTATION	11
2.2.1 Biodiversity Investigations Working Group	12
2.2.2 Peer Review Panel (PRP)	12
2.2.3 Biodiversity Investigations Government Working Group	12
2.2.4 Stakeholder consultation	13
2.2.5 Feedback and response to draft Scope	14
3. SCOPE OF INVESTIGATIONS - OVERVIEW	15
3.1 STUDY AREA	15
3.2 OBJECTIVES OF INVESTIGATIONS	16
3.3 INTEGRATED STUDY APPROACH	17
3.4 MANAGEMENT OF DATA	18
4. DEFINING THE REGIONAL BIODIVERSITY VALUES IN WORSLEY'S NEW MINING ENVELOPES	20
4.1 HYDROLOGICAL AND LANDFORM INVESTIGATIONS	20

4.1.1	Objectives	20
4.1.2	Proposed investigations	21
4.1.3	Timing of studies	22
4.2	FLORA AND VEGETATION INVESTIGATIONS	22
4.2.1	Previous investigations	23
4.2.2	Definitions	24
4.2.3	Objectives	25
4.2.4	Proposed botanical investigations	25
4.2.5	Timing of studies	28
4.3	FAUNA INVESTIGATIONS	29
4.3.1	Previous investigations	29
4.3.2	Definitions	30
4.3.3	Objectives	30
4.3.4	Proposed faunal investigations	31
4.3.5	Timing of studies	35
4.4	ROLE AND SIGNIFICANCE OF ECOLOGICAL LINKAGES	36
4.4.1	Objectives	36
4.4.2	Proposed investigations	37
4.4.3	Identification of regional ecological linkages	37
4.4.4	Management of regional ecological linkages	38
4.5	LANDSCAPE MODELLING	38
5.	THREATENING PROCESSES AND CLIMATE CHANGE	40
5.1.1	Objectives	40
5.1.2	Proposed investigations	40
5.1.3	Assessing the effects of threatening processes	41
6.	TARGETED FIELD WORK PROGRAMS	43
6.1.1	Key considerations in the targeted field work programs	43
6.1.2	Development of targeted field work programs	43
6.1.3	Identification of key biodiversity values to be protected	44
7.	MATTERS OF NATIONAL ENVIRONMENTAL SIGNIFICANCE	46

7.1	REQUIREMENT OF COMMONWEALTH APPROVAL	46
7.2	EPBC ACT LISTED THREATENED FLORA	46
7.2.1	Expected occurrence	46
7.2.2	Additional searches proposed	47
7.3	EPBC ACT LISTED THREATENED FAUNA	47
7.3.1	Expected occurrence	47
7.3.2	Additional searches proposed	47
8.	LONG TERM MONITORING PROGRAMS AND ESTABLISHMENT OF INDICATORS OF CHANGE IN BIODIVERSITY	49
8.1.1	Objectives of long-term monitoring	49
8.1.2	Key components of the monitoring programs	49
8.1.3	Evaluating the effects of climate change over time	50
9.	FRAMEWORK FOR GOVERNMENT REVIEW AND OTHER PARTNERSHIPS	51
9.1.1	Government agency review	51
9.1.2	Other partnerships	52
10.	REFERENCES	53

LIST OF TABLES

1.	Expert technical representation on Biodiversity Investigations Working Group	12
2.	Current Peer Reviewers	12
3.	Worsley's new mining areas	16
4.	Summary of timing of field studies for fauna	35

LIST OF FIGURES

1. Regional location of Worsley Bauxite Alumina Project	5
2. Simplified schematic of the key stages of consultations and approvals, required before mining or construction may commence in the expansion areas.	8
3. Detailed schematic showing the approvals process (in relation to Ministerial Statement 719)	9
4. Biodiversity-related Investigations project management structure	11

LIST OF APPENDICES

1. Ministerial Statement No 719
2. Approval Instrument EPBC 2004/1566
3. Table of Responses to Stakeholder and Peer Reviewer Feedback

1. INTRODUCTION

In April 2006, Worsley Alumina Pty Ltd (Worsley) was granted approval to increase its alumina production subject to a number of environmental conditions outlined in Ministerial Statement 719 (the *Ministerial Statement*) (Appendix 1). Likewise, in June 2007, the Commonwealth granted approval subject to Approval Instrument EPBC 2004/1566 (Appendix 2).

The expansion requires the extension of mining activities into new areas beyond those where mining had previously been approved. Under the terms of the Ministerial Statement and Commonwealth Approval, Worsley is required to investigate the local and regional biodiversity values of these areas prior to the commencement of mining activities.

1.1 PURPOSE OF THIS DOCUMENT

This document, the revised *Scope of Biodiversity-related Investigations* (the revised *Scope*), provides a framework for investigating and assessing biodiversity within the proposed new mining areas (described in Section 3.1 and see Figure 1) in accordance with the requirements of Conditions 8-1 and 8-3 of Ministerial Statement 719 and Clause 1 of the Commonwealth Approval (Appendix 2).

Condition 8-1 of the Ministerial Statement requires the investigation of the following matters:

1. the occurrence and spatial extent of floristic and vegetation communities at the 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 pursuant to the *Wildlife Conservation Act 1950* and other Priority Flora as identified in the database maintained by the [Department of Environment and Conservation (DEC)]
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* or the *Commonwealth Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act); Priority fauna as defined and listed by the Department of Environment and Conservation; 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
13. weed and pest severity status in State Forest
14. impacts of climate change.

As required by Condition 8-2 of Ministerial Statement 719, a *draft Scope of Biodiversity-related Investigations* was submitted in April 2007, for review to the Department of Conservation and Land Management (now DEC), Conservation Commission of Western Australia, the Environmental Management Liaison Group (EMLG), and the Stakeholder Consultation Group. This document (the 'revised Scope') incorporates Worsley's responses to the feedback and recommendations received from stakeholders during the review (Appendix 3). The revised document is required to be submitted to the State (WA) Minister for the Environment for endorsement, in accordance with Condition 8-3.

Under Clause 1 of the Commonwealth Approval, Worsley must submit for the Federal Minister's approval a Biodiversity Investigations Scope, detailing survey methodology for investigating the following matters in each mining 'pod' and transport corridor:

- a. the occurrence and extent of flora species listed under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act),
- b. the identification and spatial extent of habitat for EPBC Act listed fauna species.

The BIS must include investigations for but not necessarily be limited to the Cossack Spider Orchid (*Caladenia dorrienii*), Narrogin Pea (*Pultenaea pauciflora*), Shy Featherflower (*Verticordia fimbriilepis*), Slender Tailflower (*Anthocercis gracilis*), Carnaby's Black Cockatoo (*Calyptorhynchus litorostris*), Baudin's Black Cockatoo (*Calyptorhynchus baudinii*), the Chuditch (*Dasyurus geoffroyi*) and the Phascogale (*Phascogale calura*).

Under the Commonwealth Approval, the Scope must be approved prior to vegetation clearing (as defined in the approval instrument) and it must be implemented.

Following the completion of investigations, Worsley is required to report on these and other matters, (as described by Condition 8-6 of the Ministerial Statement and Clause 2 of the Commonwealth Approval Instrument), including key biodiversity values to be protected, in a *Biodiversity-related Investigations Report* (BIR).

1.2 BACKGROUND

1.2.1 Worsley Bauxite-Alumina Project

Worsley operates the Worsley Bauxite-Alumina Project, pursuant to the *Alumina Refinery (Worsley) Agreement Act 1973*. The project commenced in 1984 and involves mining bauxite ore from deposits on the Darling Plateau, with subsequent processing and refining of the crushed ore to produce alumina at its refinery near Collie. The alumina product is exported through the Bunbury Port.

Worsley's mining and bauxite transport operations are located primarily in State Forest and timber reserves, with some of the current mining and transportation and all of the alumina refining operations conducted on private property (forest and agricultural land).

Whilst Worsley operates under an Agreement Act, it is still bound by other legislation and new project proposals must undergo environmental, heritage and Native Title (where applicable) assessments and must address State initiatives. For example, for activities that are located on land vested with the

Conservation Commission of WA (CCWA), such as State Forest and timber reserves, Worsley is required to address the forest management plan¹ in conducting its environmental assessment, management and rehabilitation.

In April 2006 the Minister for the Environment granted Worsley approval under the *Environmental Protection Act (1986)* (EP Act) to increase overall production capacity of the operation to 4.4 million tonnes per annum (Mtpa) of alumina (Ministerial Statement 719). A component of the expansion is the extension of the approved mining area to ensure that the bauxite reserves and expected lifespan of the Worsley Project are sufficient for capital investment and market requirements. The preparation of the Scope of Biodiversity-related Investigations is a requirement of the Minister's approval issued under the EP Act.

Aspects of the expansion that relate to Aboriginal heritage and Native Title are dealt with under other State and Commonwealth legislation. These will be addressed by Worsley as separate processes and are therefore not discussed in this Scope.

1.2.2 Location

The Worsley Bauxite–Alumina Project is located in the south-west of Western Australia (Figure 1). Current mining operations are located south west of the town of Boddington. The Refinery Lease Area is located 15 km north-west of Collie.

The extension to the approved mining area consists of five new mining envelopes within the mining lease ML258SA which is managed by Worsley. These mining envelopes are identified as:

- Hotham North Extension
- Central
- Brookton
- East Quindanning
- Morgans.

The closest major towns to the new mining envelopes are Wandering, Williams, Brookton and Boddington (Figure 1), with populations of 333, 806, 1,054 and 1,391 respectively². Other smaller population centres near the mining envelopes include North Bannister, Bannister and Quindanning.

¹ Currently the Forest Management Plan 2004 – 2013, Conservation Commission of Western Australia (2004)

² Australian Bureau of Statistics, June 2006 (preliminary data)

1.2.3 Proponent/Ownership

Worsley Alumina Pty Ltd is the manager of the bauxite-alumina project for the Worsley Joint Venture (Worsley JV). The current membership of the Worsley JV is:

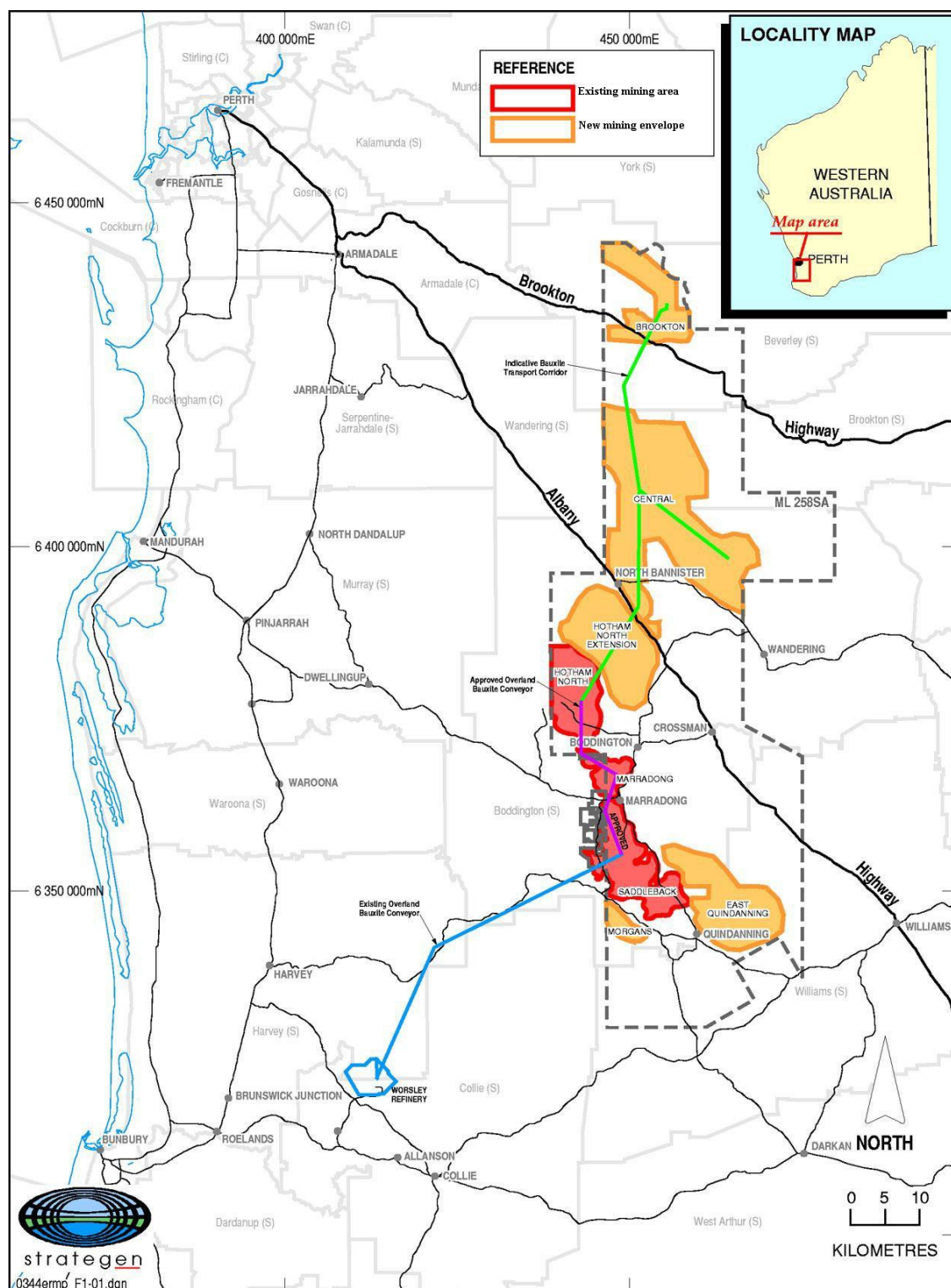
Billiton Aluminium (RAA) Pty Ltd	56 %
Billiton Aluminium (Worsley) Pty Ltd	30 %
Japan Alumina Associates (Australia) Pty Ltd	10 %
Sojitz Alumina	4 %

1.2.4 Approval history

Approval to commence the Worsley Bauxite-Alumina Project was granted in 1980 following acceptance of a project Environmental Review and Management Programme (ERMP) that was submitted pursuant to the *Alumina Refinery (Worsley) Agreement Act 1973*. The nominal start up capacity of the refinery in 1984 was 1.0 Mtpa of alumina, with the requirement that the project be subject to further environmental review when alumina production exceeded 2.0 Mtpa.

Expansion to 3.5 Mtpa

In 1996 approval to expand production from 2.0 Mtpa to 3.5 Mtpa was granted by the Minister for the Environment. The Environmental Protection Authority (EPA) assessed the expansion proposal under Part IV of the EP Act at the level of Consultative Environmental Review (CER). Following this assessment, the Minister for the Environment issued Ministerial Statement 423 that the proposal may be implemented subject to conditions described in the statement. In 2005, a change to the approved proposal was granted pursuant to section 45(c) of the EP Act to allow project production to increase to 3.7 Mtpa.



Schedule 1 of Ministerial Statement 719 defines the proposed “mining envelopes” (also referred to as “new mining areas” in the statement), as those areas identified by Worsley in the ERMP (Strategen 2005) as Brookton, Central, Hotham North Extension, East Quindanning and Morgans. For the purposes of the biodiversity-related investigations, ‘new mining areas’ and ‘new mining envelopes’ are deemed to have the same meaning.

Figure 1 Regional location of Worsley Bauxite Alumina Project

Environmental Management Liaison Group

Ministerial Statement 423 defined a mechanism for liaison and review of Worsley's environmental performance by Government agencies, through the establishment of the Environmental Management Liaison Group (EMLG) that comprises representatives³ of DEC, the Department of Industry and Resources (DOIR), the Water and Rivers Commission (now the Department of Water [DoW]) and the Department of Agriculture WA (now the Department of Agriculture and Food [DAFWA]). The key role of the EMLG was thus to review Worsley's annual rolling Ten Year Mine Plans and its environmental performance. The role of the EMLG has since expanded (Section 2.2.3).

Ministerial Statement 719 now ascribes the following functions to the EMLG, as defined in Procedure 6 of the Ministerial Statement:

- provide comment on the draft Scope of Biodiversity-related Investigations
- provide comment on the draft Rehabilitation Plan and revisions and amendments
- provide comment on the draft Bauxite Mining Plan(s) and revisions and amendments
- 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 Bauxite Mining Plan(s) and Rehabilitation Plan.

Expansion to 4.4 Mtpa

In 2005, Worsley sought environmental approval under Part IV of the EP Act to expand production to 4.4 Mtpa of alumina. The EPA decided to assess this proposal at the level of ERMP and following its assessment, the Minister for the Environment issued Ministerial Statement 719 (Appendix 1) that the proposal may be implemented subject to conditions described in the statement. This statement replaced the previous statement (Ministerial Statement 423) and rationalised a number of commitments in the previous statement.

The increase in production requires:

- an extension of mining operations into areas outside of the existing Primary Bauxite Area⁴ (PBA), and an increase in the rate of mining
- additions to ore transportation facilities and corridors to cater for the movement of bauxite from the new mining areas to the existing overland conveyor
- changes to the existing overland conveyor operations to cater for the increase in bauxite material being transported to the refinery
- refinery modifications and upgrades.

³ Agencies other than those listed, which may have areas of responsibility from time to time affected by the mining and refinery operations of Worsley may be involved in providing advice or become members of the EMLG.

⁴ Ministerial Statement 423 formalised a 220 km² area defined as the Primary Bauxite Area located within Mining Lease ML258SA granted to Worsley under the Agreement Act, and other Mining Leases on private land granted under the *Mining Act 1978* (WA). Worsley has approval to proceed with mining operations within the Primary Bauxite Area.

Existing mining operations are based on bauxite resources within an area delineated by the PBA and comprise areas of the Saddleback, Quindanning and Marradong timber reserves and privately owned land. As part of the expansion to 4.4 Mtpa, mining operations will be extended into areas outside of the PBA into the five additional mining envelopes (Hotham North Extension, Central, Brookton, East Quindanning and Morgans) (Figure 1). Worsley proposes to increase the annual rate of mining from 13.2 Mtpa (dry) to around 16.5 Mtpa (dry) as part of the approved expansion. The rate at which land will need to be cleared in order to facilitate this mining rate will be determined by bauxite grade and quantity; however it is expected to increase from around 140 hectares per annum to around 240 hectares per annum. Rehabilitation of mined areas will be conducted at a comparable rate.

The expansion project proposal was also referred and subsequently assessed and approved under the *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act). The Commonwealth Approval Instrument EPBC 2004/1566 (Appendix 2) also requires the proposal to be implemented subject to conditions.

More detailed background information on the Worsley expansion project is provided in the ERMP and associated appendices (Strategen 2005). This includes information on:

- the environmental setting of the project area
- key environmental studies completed during the preparation of the ERMP that are relevant to the Worsley project area
- an overview of the Worsley bauxite mining and rehabilitation process.

1.3 BIODIVERSITY INVESTIGATIONS AND WORSLEY'S MINE PLANNING AND DEVELOPMENT PROCESS

Worsley prepares an annual rolling Ten Year Mine Plan that provides a review of the operations during the preceding 12 months and details long term exploration and mining plans in accordance with existing statutory requirements. The plan also provides the framework for detailing the short-term plans for rehabilitation and proposed clearing areas (including cumulative clearing and rehabilitation data) for the coming 12 months. The Ten Year Mine Plan is reviewed by the EMLG.

Worsley also provides information on the environmental performance of its operations to the EMLG, through its Annual and Triennial Environmental Reports⁵. These reports summarise the status of the environmental management programs and research conducted by Worsley over a specific period; the latest reporting period includes July 2005 to June 2006 (Worsley, 2006).

The biodiversity-related investigations will provide a major input into Worsley's mine planning, mine development, rehabilitation and environmental reporting processes for the new mining envelopes (Figures 2 and 3). The *Biodiversity-related Investigations Report* will identify key biodiversity values to be protected during mining operations, with those prescribed by Condition 9 in the Ministerial Statement being protected as a minimum. Worsley is also required to prepare a Transport Corridor Route Plan and a Bauxite Mining Plan prior to any ground-disturbing activities in the new mining

⁵ Clause 5A(3) of the Alumina Refinery (Worsley) Agreement Act, 1973 (as amended), requires the Worsley Joint Venturers to report annually on progress in the implementation of the approved Worsley Alumina Project ERMP (Worsley Alumina 1979). Worsley also submits Triennial Reports to the EMLG which summarise the preceding three years' progress.

areas⁶. Each of these plans will incorporate the findings and requirements of the *Biodiversity-related Investigations Report* into the relevant planning, development and operating processes and procedures.

The findings of the *Biodiversity-related Investigations Report* will also be incorporated into the Ten Year Mine Plan. Areas where significant biodiversity values have been identified will be delineated and afforded protection or will be deferred from mining. Relevant information from the Transport Corridor Route Plan and Bauxite Mining Plan will also be addressed in the Ten Year Mine Plan.

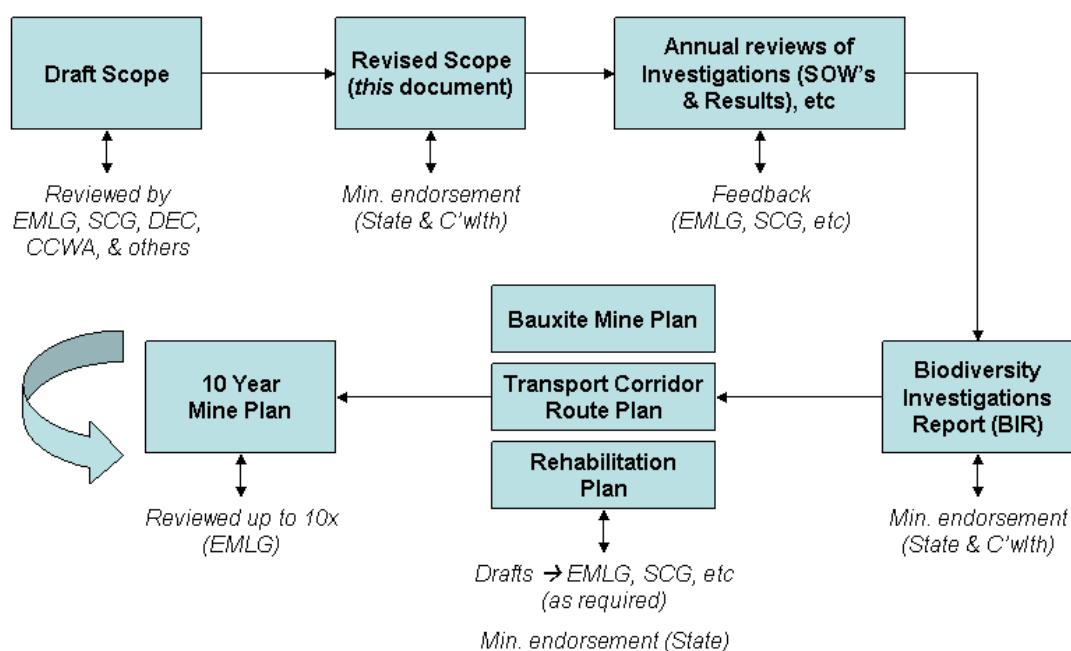


Figure 2 Simplified schematic of the key stages of consultations and approvals, required before mining or construction may commence in the expansion areas.

⁶ As required by Ministerial Statement 719 Conditions 10-1, 11-1.

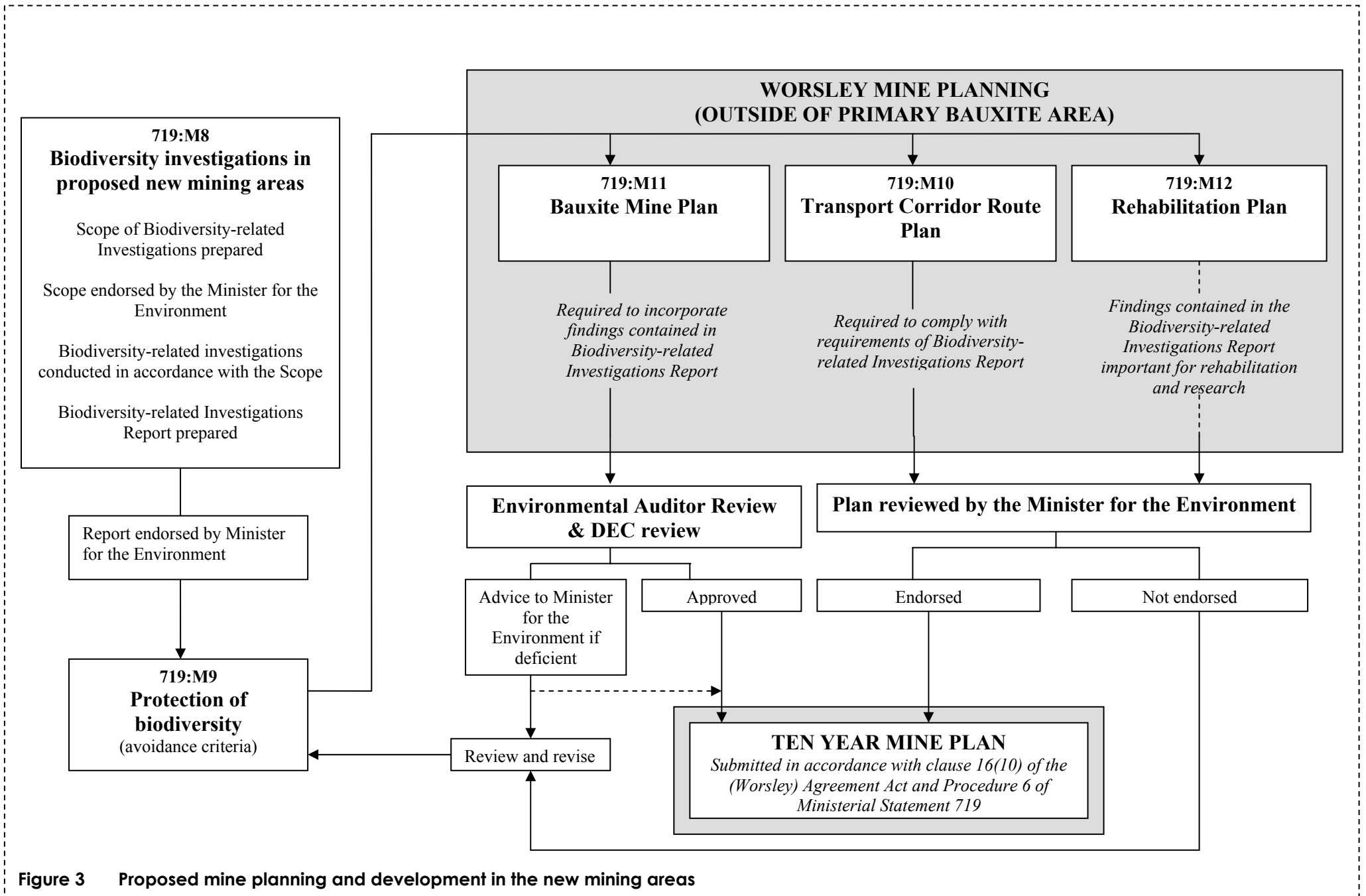


Figure 3 Proposed mine planning and development in the new mining areas

2. PROJECT MANAGEMENT FRAMEWORK FOR BIODIVERSITY-RELATED INVESTIGATIONS

2.1 THE BIODIVERSITY-RELATED INVESTIGATIONS

Ministerial Statement 719 sets out a process for development, review, endorsement and implementation of the *Scope*. Broadly, the biodiversity investigations will be conducted in three stages:

- 1) Stage 1: develop the *Scope of Biodiversity-related Investigations* and obtain Ministerial endorsement for this document
- 2) Stage 2: implement the endorsed *Scope of Biodiversity-related Investigations*
- 3) Stage 3: prepare a *Biodiversity-related Investigations Report* and obtain Ministerial endorsement for the document.

Stage 1

A draft *Scope of Biodiversity-related Investigations* was prepared within twelve months following the formal authority issued⁷ under the EP Act, and submitted for review to the relevant authorities (including the EMLG, DEC and the Conservation Commission of WA) and the Stakeholder Consultation Group (*Ministerial Condition 719:8-2*) (see Section 2.2.4)). Worsley has addressed all comments and recommendations during the preparation of this revised *Scope*, which has been submitted to the Minister for the Environment for endorsement (*Ministerial Condition 719:M8-3*).

During the review period, the Commonwealth Approval, which also required a Biodiversity Investigations Scope to be prepared, was received and consequently this Scope has also been revised to clearly address the requirements of the Commonwealth Approval (see Section 7). The endorsed *Scope of Biodiversity-related Investigations* will be made publicly available (*Ministerial Condition 719:M8-4*).

The current document is submitted as the revised *Scope of Biodiversity-related Investigations (Scope)* for the purposes of Condition 8-3 of Ministerial Statement 719, and is submitted as the *Biodiversity Investigations Scope (BIS)* for the purposes of Clause 1 of the Commonwealth Approval.

Stage 2

Worsley will implement the endorsed *Scope of Biodiversity-related Investigations (Ministerial Condition 719:M8-5, and Commonwealth Approval: Clause 1)*. Thorough detailed scopes of work will be prepared to guide specialist sub-consultant botanists, zoologists, hydrologists, and others as required, in the execution of the investigations. The fieldwork needed to meet the requirements of the *Scope* and associated detailed scopes of work is expected to be completed over a timeframe of three to four years. The results of investigations will be progressively analysed and reported to the EMLG in Worsley's Annual Environmental Report (Section 9). This annual review will ensure that the

⁷ The formal authority to proceed was issued by the Minister for the Environment in Ministerial Statement 719 on 13 April 2006.

outcomes of the investigations are continually evaluated and will provide an opportunity to adaptively manage the studies through the review of the individual scopes of work in light of the results obtained.

Stage 3

Worsley will prepare a *Biodiversity-related Investigations Report* on its findings on completion of the investigations (*Ministerial Condition 719:8-6, and Commonwealth Approval: Clause 2*). This report will be submitted to the Minister for the Environment for endorsement and will be used to form the basis for the development of Bauxite Mine Plans and Transport Corridor Route Plans for the new mining areas. The endorsed *Biodiversity-related Investigations Report* will be made available to the public (*Ministerial Condition 719:M8-7*).

2.2 PROJECT MANAGEMENT, PEER REVIEW AND STAKEHOLDER CONSULTATION

The Ministerial Statement specifies the memberships and functions of two stakeholder groups that will play key roles in the development and implementation of the *Scope*. Specifically, Worsley will consult with, and provide opportunities for review of key documents by, the existing EMLG and a new Stakeholder Consultation Group. To this end, Worsley has developed direct mechanisms for ensuring appropriate and relevant communications with both of these stakeholders (Sections 2.2.3 and 2.2.4).

Worsley has established two groups, a Biodiversity Investigations Working Group (BWG) and a Peer Review Panel (PRP), to facilitate the development of the draft *Scope* in addition to the groups required under the terms of the Ministerial Statement (Figure 4).

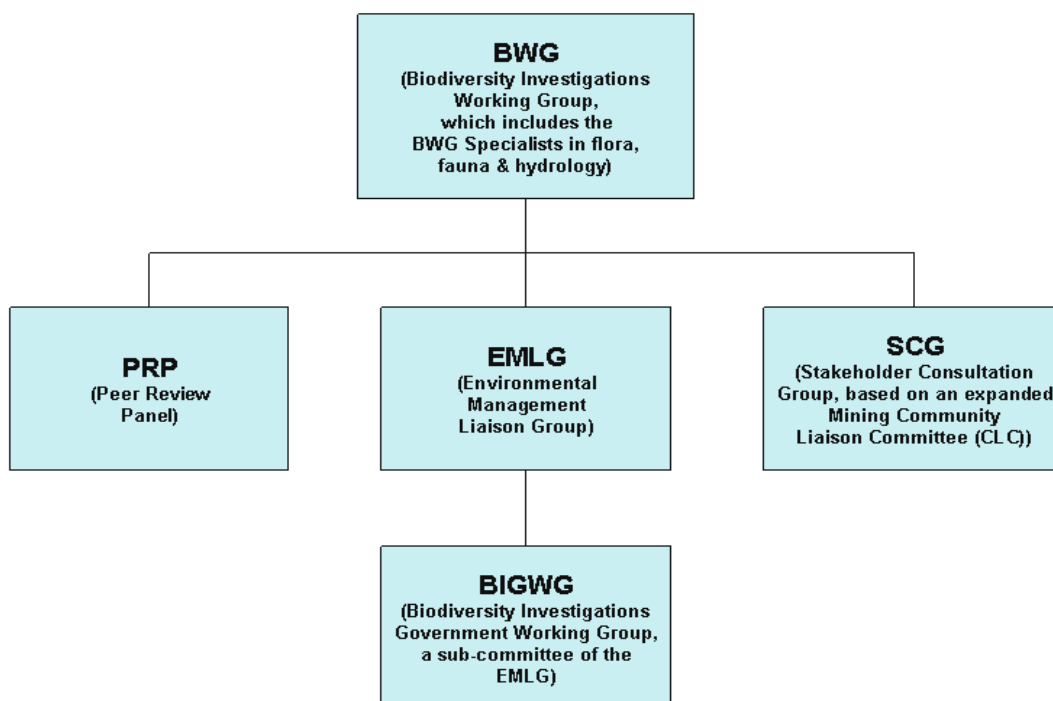


Figure 4 Biodiversity-related Investigations project management structure

The Biodiversity Investigations Working Group includes flora, fauna and hydrology experts and will develop the *Scope* in consultation with relevant government agencies and key stakeholders. This work will be reviewed by three Peer Reviewers, each of whom is an acknowledged expert in their field. Other experts may be engaged from time to time to assist in the development of the *Scope* (Stage 1), the implementation of the Investigations (Stage 2) and/or the preparation of the Report (Stage 3). For example, a landscape ecologist will be invited to be involved in the project during Stage 2 of the Investigations, to provide specific expertise in the integration and interpretation of data for landscape modelling purposes.

2.2.1 Biodiversity Investigations Working Group

The investigations will be co-ordinated by a specialist Biodiversity Investigations Working Group that has been appointed by Worsley. The group comprises representatives of Worsley's environmental department and recognised experts in the relevant fields of biodiversity (Table 1). Additional members may be appointed to the group by Worsley as appropriate.

Table 1 Expert technical representation on Biodiversity Investigations Working Group

Area of expertise/position	Name	Company
Flora and vegetation	Dr Libby Matiske	Matiske Consulting Pty Ltd
Fauna	Dr Mike Bamford	Bamford Consulting Ecologists
Hydrology (groundwater, surface water and salinity)	Mr James Croton	Water and Environmental Consultants
Environmental Specialist – Studies	Mr Stephen Vlahos	Worsley Alumina Pty Ltd
Environmental Coordinator (Expansion)	Mr Dirk Hirschberg	Worsley Alumina Pty Ltd

2.2.2 Peer Review Panel (PRP)

A Peer Review Panel (PRP) was established to assist with the development of the *Scope*. The role of each of the Peer Reviewers is to provide independent, expert opinion(s) on the methodologies and approaches for the proposed biodiversity-related investigations and to review this *Scope* during its development.

There are currently three Peer Reviewers although more may be appointed if required. Between them they have expertise in the areas of flora and vegetation, fauna and hydrology (Table 2).

Table 2 Current Peer Reviewers

Area of expertise	Peer Reviewer	Position
Flora and vegetation	Dr Bill Loneragan	Associate Professor & Honorary Research Fellow, Faculty of Natural and Agricultural Science, University of Western Australia
Fauna	Dr Andrew A Burbidge	Consultant, Conservation Biologist
Hydrology	Dr Don McFarlane	Regional Co-ordinator in South-west Western Australia for the Water for a Healthy Country Flagship, CSIRO

2.2.3 Biodiversity Investigations Government Working Group

As mentioned in Section 1.2.4, the role of the EMLG has expanded considerably under Procedure 6 of Ministerial Statement 719 (see also Section 1.2.4), and includes the review of a range of plans including the draft *Scope of Biodiversity-related Investigations*.

The Statement specifies that the responsibility for reviewing the draft *Scope* rests with the EMLG and all statutory reporting will be submitted through the EMLG where specified in the Minister's Conditions. However the EMLG has established a sub-committee to review the proposed biodiversity-related investigations process and to advise the EMLG accordingly. The Biodiversity Investigations Government Working Group (BIGWG) comprises expert representatives of the EMLG member agencies (DOIR, DEC, DAFWA, DoW) as well as the WA Museum. BIGWG provides specific advice and guidance on technical and policy aspects of the biodiversity-related investigations and it is expected that it will participate in the formal review of the draft *Scope of Biodiversity-related Investigations* document on behalf of the EMLG. The group reports directly to the EMLG on the development of the *Scope* and will continue to do so during its implementation.

Worsley will present the review and results of the biodiversity-related investigations to the EMLG (via the BIGWG if so directed) on an annual basis during implementation of the Investigations (Stage 2) and preparation of the final report (Stage 3) (Section 9). For the purposes of this Scope, reference will be made to the EMLG, however the EMLG is expected to defer to the BIGWG sub-committee on technical issues.

2.2.4 Stakeholder consultation

Worsley has established an ongoing stakeholder consultation program to ensure transparent and effective consultation with the community and other identified stakeholders. This was described in detail in the ERMP.

Under Condition 8-2 of Ministerial Statement 719, the following four key stakeholders were required to be consulted on the *draft Scope of Biodiversity-related Investigations*:

- Conservation Commission of Western Australia
- Department of Environment and Conservation (DEC)
- Worsley's Environmental Management Liaison Group (EMLG)
- Stakeholder Consultation Group.

The Stakeholder Consultation Group has been established (as required under Procedure 7 of Ministerial Statement 719) with one of the group's functions being to provide comment on the draft *Scope*. Worsley's existing Mining Community Liaison Committee (Mining CLC) has been expanded, to include additional members as listed in Procedure 7⁸ and to perform the functions of the Stakeholder Consultation Group. The existing Mining CLC comprises:

- Avon Catchment Council
- Boddington High School
- Department of Agriculture and Food, WA (DAFWA)
- Department of Environment & Conservation (DEC)

⁸ Procedure 7 of Ministerial Statement 719 requires the Stakeholder Consultation Group to comprise 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, including the Shire of Collie which have established research or related activities in or adjoining proposed new mining areas.

- Department of Water (DoW)
- Hotham Catchment Landcare group
- Shire of Boddington
- Shire of Brookton
- South West Aboriginal Land and Sea Council.

Other environmental bodies, organisations and local government authorities that were identified to potentially have an interest in the biodiversity-related investigations and that represent the wider environmental community have also been consulted, including the following:

- Birds Australia
- Conservation Council of Western Australia;
- Environmental Protection Authority (EPA)
- Peel Development Commission
- Peel-Harvey Catchment Council
- Shire of Beverley
- Shire of Collie
- Shire of Wandering
- Shire of Williams
- WA Museum
- WA Naturalists' Club
- Wildflower Society of Western Australia
- Worsley's Refinery Community Liaison Committee (Refinery CLC).

In addition, the Commonwealth Department of Environment and Water Resources has also been involved in consultations during the development of this Scope, including a site visit in 2006.

Other relevant groups to be engaged and consulted may be identified at a later stage in the process.

2.2.5 Feedback and response to draft Scope

Stakeholders and the PRP were provided with the Draft Scope for review and comment. Worsley has taken the comments received into account during the development of *this* revised Scope (Appendix 3).

3. SCOPE OF INVESTIGATIONS - OVERVIEW

3.1 STUDY AREA

Ministerial Condition 719:M8-1 requires that:

the Scope of Biodiversity-related Investigations encompasses those areas within the proposed new mining areas (as shown in Figure 2 of Schedule 1) and sufficient surrounding area to provide for information in regional context.

Figure 2 in Schedule 1 of Ministerial Statement 719 defines the proposed “**mining envelopes**” (also referred to as “**new mining areas**” in the statement⁹) as those areas identified by Worsley in the ERMP (Strategen, 2005) as Brookton, Central, Hotham North Extension, East Quindanning and Morgans (Figure 1).

The study area is delineated by these five mining areas and by additional areas for the purposes of the biodiversity-related investigations. These additional areas are defined as:

- those areas that will be disturbed for proposed bauxite transport corridors and other areas identified for activities related to mining¹⁰ and
- other natural areas (including areas outside of Worsley’s mining lease where necessary) where baseline information is needed to enable the assessment of biodiversity values in a regional context.

New mining envelopes

The northern mining envelopes, (Brookton and Central) lie mainly in State Forest and the three southern mining envelopes, (Hotham North Extension, East Quindanning and Morgans) are located mainly on private land.

Hotham North Extension incorporates areas of private forest and pine plantation, while East Quindanning and Morgans mining envelopes comprise cleared agricultural areas with some remnant vegetation (Figure 1).

The mining envelopes are areas within which bauxite resources are known or expected to occur. However, it is important to note that the actual extent of these resources and therefore the disturbance footprint required for mining and related activities will be restricted to a relatively small percentage of the total area of each mining envelope (see Table 3).

⁹ For the purposes of the biodiversity-related investigations, the terms ‘mining area’ as stated in Ministerial Condition 719:M8-1 and ‘mining envelope’ as stated in Ministerial Condition 719:M10 are deemed to have the same meaning.

¹⁰ From Ministerial Statement 719 Schedule 1: activities related to mining operations include “...exploration, development and operation of haul roads, crushers, material handling facilities, water supply, electricity supply and mining related infrastructure..”

Table 3 Worsley's new mining areas

New mining envelopes	Total area of mining envelope (ha)	Area of mining envelope delineated as bauxite resource* (ha)	Total area of native vegetation (ha) (% of total mining envelope area)
Brookton	9, 254	1, 528	8,917 (96%)
Central	36, 726	8, 005	33,123 (90%)
Hotham North Extension	14, 061	2, 595	8,307 (60%)
East Quindanning	13, 324	3, 169	3,356 (25%)
Morgans	1, 651	654	983 (60%)
TOTAL	75,016	15,951	54,688 (73%)

* Proposed mining envelopes are usually delineated according to identified bauxite resources in the categories of measured mineral resource, indicated mineral resource, inferred mineral resource and potential resource.

Additional study areas for regional context

The investigations may also be undertaken in additional areas outside of Worsley's new mining envelopes to ensure biodiversity values can be characterised in a regional context and to allow for the consideration of cumulative impacts (and threatening processes) on biodiversity values in the region. These additional areas will be determined as biodiversity values are identified and may include areas outside of Worsley's mining lease ML258SA.

Bauxite transport corridors

The investigations will also focus on those areas that will be disturbed for the proposed bauxite transport corridors and other areas that may be disturbed for activities relating to mining that are outside the defined mining envelopes. The majority of clearing required for the construction of the bauxite transport corridors will be for those corridors that are associated with the northern envelopes of Brookton and Central.

3.2 OBJECTIVES OF INVESTIGATIONS

The biodiversity-related investigations will be undertaken to satisfy the requirements of Conditions 8 and 9 of Ministerial Statement 719 and Clause 1 of the Commonwealth Approval Instrument. In particular Condition 8-1 requires the investigation of relevant information on the key biodiversity values in Worsley's expansion areas and Clause 1 of the Commonwealth Approval requires investigation of relevant EPBC Act listed flora and fauna species. This latter requirement is specifically addressed in Section 7.

The biodiversity-related information collected during the required investigations will be taken into account during the development and execution of Worsley's Bauxite Mining and Transport Corridor Route Plans (Conditions 10 and 11) and in the planning and implementation of rehabilitation (Condition 12).

Worsley considers that the overall objective of the above process of investigation, protection and re-establishment of biodiversity values, as prescribed by the Ministerial Conditions is to conserve biodiversity by ensuring that ecosystems remain productive and resilient to any disturbance resulting from Worsley's activities. This requires protection and maintenance of a diversity of habitats and ecological processes at various spatial scales from wider forested landscapes to specific localised habitats.

Worsley considers that this is consistent with the biodiversity objectives stated in the Forest Management Plan 2004 -2013. Whilst it cannot conserve biodiversity values in the wider “whole of forest” context described in the Forest Management Plan, Worsley recognises that it has a significant role to play in the conservation of biodiversity in the areas that may be affected by its operations. The Company’s ability to protect and conserve biodiversity will be realised primarily through the development and implementation of the Bauxite Mining and Transport Corridor Route Plans and through the implementation of the Rehabilitation Plan.

The biodiversity-related investigations represent the first stage in the biodiversity protection and conservation process prescribed by the Ministerial Conditions. The information gathered during the investigations will be used by Worsley to improve forest protection and forest management practices within the context of its operations. It will also be made available to State and Federal Government agencies with the expectation that this knowledge will contribute to government datasets and may be used to assist in the implementation of broader government initiatives such as the Forest Management Plan. The information gathered from the investigations will also be made available to local interest groups.

The primary environmental objective of the *investigations* is therefore to increase the knowledge base on the biodiversity of the forest region in which Worsley will operate; specifically:

1. to identify and record biodiversity values within the new mining envelopes and bauxite transport corridors in a local and regional context
2. to investigate and report on key biodiversity values to be protected in the new mining envelopes and bauxite transport corridors
3. to collect data on biodiversity values in the new mining envelopes and bauxite transport corridors in accordance with requirements for monitoring and rehabilitation and research
4. to determine the attributes of key biodiversity determinants in the new mining envelopes and bauxite transport corridors such as landform and hydrology.

The biodiversity-related investigations will be a comprehensive study that will collect a range of information on the natural values within Worsley’s new mining areas and relevant surrounding areas.

3.3 INTEGRATED STUDY APPROACH

A holistic approach to the biodiversity-related investigations will be employed to identify the significant biodiversity values within the study area. The actions outlined below summarise the integrated approach that is addressed in subsequent sections of this Scope:

1. Define the biodiversity values within the study area, by:
 - delineating the known biodiversity values within Worsley’s new mining envelopes and bauxite transport corridors and identifying information gaps by reviewing existing desktop information and local and regional datasets
 - characterising the extent and range of biodiversity values within Worsley’s new mining envelopes and bauxite transport corridors by undertaking baseline field surveys
 - undertaking a desktop review of available information in additional areas as required and conducting baseline surveys of additional areas to provide regional context.

2. Describe threatening processes and assess the impact of climate change, by:
 - describing how key threatening processes and the range of factors (such as weeds, feral animals, disease and fire, mining, type and extent of ecological linkages) affecting biodiversity within Worsley's new mining envelopes, bauxite transport areas and additional areas will be assessed and considered
 - investigating whether there are any long term trends in changes to flora and vegetation and fauna within the new mining envelopes and reviewing these trends against identified changes in climatic factors
3. Develop targeted field work programs, by:
 - describing the process that will identify those areas supporting significant biodiversity values within the new mining envelopes and bauxite transport corridors.
4. Develop monitoring programs, by:
 - establishing a process to assess potential changes in identified significant biodiversity values over time as a result of threatening processes and climate change
 - establishing a process to identify indicators that significant biodiversity values are being maintained.
5. Ensure timely reviews and audits, by:
 - establishing a process for annual review by Government agencies of study outcomes and any proposed modifications to the study approach. This will provide an integrated mechanism to ensure that relationships between biodiversity parameters are continually recognised and addressed in further investigations.

This approach aims to ensure the integration of localised baseline surveys into a broader regional context and to help define the relationships between biodiversity values and threatening processes.

3.4 MANAGEMENT OF DATA

Worsley will manage all data collected in the biodiversity investigations by inventory through an integrated Geographic Information System (GIS) and database management system. By integrating the datasets from the three principal survey streams (i.e. flora, fauna and hydrology), into a common GIS platform and associated relational database(s) (e.g. using ArcView), the three survey streams should inform each other on relevant aspects. For example, areas of possible groundwater-dependence identified from desktop hydrological investigations may be useful in the selection of target sites for surveys for frogs or Short Range Endemic (SRE) invertebrates, and the question of groundwater-dependence may subsequently be confirmed using the baseline flora and fauna survey information, and/or subsequent targeted investigations by the botanists or zoologists.

The integrated GIS and database management system will also facilitate a range of analyses (spatial and otherwise) and other operations, such as identifying the location of necessary buffer zones around certain key biodiversity values, identifying local and global outliers that may require further investigation, and so on.

The integrated GIS and database management system will be developed and managed by Worsley, in consultation with (where necessary) others with botanical, zoological, hydrological, ecological modelling, biometrics and/or GIS expertise. Some of the data analyses will specifically and

necessarily be undertaken by the botanical, zoological, or hydrological consultants (e.g. data classification and ordination), and then subsequently integrated into the GIS and database management system. See also Section 4.5, in relation to landscape modelling.

4. DEFINING THE REGIONAL BIODIVERSITY VALUES IN WORSLEY'S NEW MINING ENVELOPES

The first component of the investigations involves undertaking a regional assessment of the biodiversity values in Worsley's new mining areas. Much of the information needed for this regional assessment has already been collected by Worsley (Bennett 2004, and Bamford *et al.* 2004) as supporting information for the ERMP (Strategen 2005), or is currently being collected through on-going studies (see Sections 4.2.1 and 4.3.1). Information that is held by government agencies and is publicly available will be incorporated (such as locations of Formal and Informal Reserves, Forest Conservation Areas, Fauna Habitat Zones and Diverse Ecotype Zones).

The regional assessment for the purposes of these biodiversity-related investigations will build on the information already collected and will include a gap analysis to determine the level, type, relevance and reliability of existing biological and physical information for the region. Baseline field surveys will then be conducted to delineate further and describe the range of biodiversity values within the new mining envelopes. Sampling regimes will be developed that will be robust and consistent with datasets already collected in Worsley's operational areas, as well as within nearby northern forest areas and in the Wheatbelt.

The processes to be adopted to locate all monitoring and sampling sites (transects, quadrats, cage traps, pitfall traps, etc) to adequately collect data across a selected range of landforms, soil types and rainfall gradients will be developed and reviewed annually in consultation with the EMLG, as required.

Three key areas of investigation for the biodiversity-related investigations have been established based on the requirements of Conditions 8 and 9 in the Ministerial Statement. These are;

- hydrology and landform
- flora and vegetation
- fauna and fauna habitat.

In addition, this Scope investigates the role and significance of ecological linkages and key threatening processes and develops a framework for identifying them.

Desktop review, gap analysis and field programs, to ensure that the biodiversity values within the study area are fully characterised, are described in detail in Sections 4.1, 4.2 and 4.3. The investigations proposed for studying the role and significance of ecological linkages are described in Section 4.4.

4.1 HYDROLOGICAL AND LANDFORM INVESTIGATIONS

4.1.1 Objectives

The objectives of the hydrological investigations are:

1. To characterise the landform (*Condition 719:M8-1(7)*).
2. To determine groundwater systems and the occurrence and distribution of groundwater-dependent ecosystems (*Condition 719:M8-1(11)*).

3. To determine stream flow and quality, and stream-dependent ecosystems (*Condition 719:M8-1(12)*).

4.1.2 Proposed investigations

Characterising landform

A system of landform characterisation will be implemented which will be used to define the range of landform types and the existence of unusual areas, including areas of possible ecological significance, within the mining lease area. This desktop mapping exercise will use a combination of published and available data including:

- aerial photography
- vegetation complex mapping
- soil mapping
- LANDSAT images
- Vegetation Leaf Area Index (LAI)
- digital terrain (elevation) models
- airborne geophysics
- depth to groundwater from individual bores (where available) and from surface salinity expressions from Land Monitor mapping
- other map features such as streams and rock outcropping.

The resultant landform classification will be overlain with mining envelopes to help guide the fauna and flora surveys and to define areas of potential special interest.

This desktop study will produce a map (or series of maps) that illustrates the range of landform types existing within Worsley's mining lease area.

Identifying ground water dependent ecosystems

The studies into groundwater dependent ecosystems have been divided into three components:

1. Information gathered during the landform characterisation process will be used in a flux-density type analysis to identify areas where groundwater may be playing a role in the ecosystems of the valley floor areas. Aerial photographs and LANDSAT analysis will aid the process by highlighting where vegetation form and density also indicate possible groundwater dependence. Areas that are identified as potentially being of special interest will be ground-truthed to establish any groundwater dependency during the field investigations. These areas will also be assessed in combination with data collected through the vegetation and fauna investigations.
2. Streamflow and stream water quality monitoring programs will be developed for all streams of interest in the vicinity of new mining and bauxite transport areas. The intention is to define which streams actually flow under "normal" winter conditions and which, if any, have some persistence of baseflow into spring/summer. A number of monitoring points will be established within the study area and will be visited in late winter and again in late spring over the study period. If there is flow, then its rate will be estimated and a sample taken and tested initially for salinity (at each monitoring point).

3. If any groundwater-dependent ecosystems and/or streams are found then they will become sites of special study and a monitoring program will be developed based on their form and extent. This may include the establishment of piezometers to define groundwater fluctuations.

The flux-density analysis will be undertaken as a desktop study, following which any areas that require field assessment will be determined. The selection process to establish the number and location of permanent monitoring sites will be developed in consultation with the EMLG and reviewed on an annual basis or as required.

Identifying surface water dependent ecosystems

Surface water dependent ecosystems will largely be identified through the above-mentioned studies, established to characterise groundwater dependent ecosystems. The main additional point for characterising surface water dependent ecosystems is that any wetland or stream(ephemeral or permanent) found to have persistent or intermittent baseflow will require special consideration in flora and fauna investigations, particularly if the percentage area of mining within their catchments is high.

Review of historical climatic and hydrological information

Investigating the impacts of climate change will be based initially on reviewing existing hydrological information and historical climatic records. Emphasis will be placed on identifying changes in the hydrological regime on the Darling Plateau that are due to the below average rainfall since 1975. Any identified long term trends in climatic conditions will be reviewed against any changes identified in the flora and vegetation and fauna investigations. Further information relating to the assessment of climate change is presented in Section 5.

Stream condition monitoring

Worsley will develop and implement a stream water quality monitoring program for relevant chemical, physical and biological parameters. Baseline macro-invertebrate sampling and assessment (e.g. using the methodology outlined for the AusRivAS program) of suitable streams and/or wetlands supporting the relevant macro-invertebrate species, may also be undertaken, with the appropriate expertise, on an opportunistic basis (e.g. after a period of good rainfall), to obtain measures of stream water quality, for monitoring impacts from future mining-related activities, climate change, and other key threatening processes.

4.1.3 Timing of studies

Landscape analysis and landform characterisation will be undertaken as part of the desktop analysis prior to any field surveys. The collection of stream samples and estimates of streamflow rates will be targeted for the late winter to early summer period.

Field work is expected to commence in 2007.

4.2 FLORA AND VEGETATION INVESTIGATIONS

This section outlines the proposed investigations and associated objectives for assessing the flora and vegetation within the study area. The investigations will build on the botanical work undertaken to date in the northern new mining envelopes and will focus on collecting further information in these areas to allow botanical values to be assessed in a local and regional context.

Investigations in the southern mining envelopes, where no previous field investigations have been undertaken by Worsley, will set out to identify the key botanical values associated with the remaining natural areas in these mining envelopes. A detailed field program for all the new mining envelopes will be developed and subsequently reviewed on an annual basis (Section 6), in conjunction with government (EMLG) (Section 9). Fieldwork will be tailored annually to build on the results of the initial desktop review and the previous baseline field investigations that are proposed in this Scope.

4.2.1 Previous investigations

Detailed flora and vegetation surveys were commenced in the Brookton and Central mining envelopes by Bennett Environmental Consulting Pty Ltd (Bennett) in 2004 to support the preparation of the ERMP (Strategen 2005). These investigations have been expanded and continued in 2005 and 2006. The surveys followed an approved methodology (EPA's *Guidance for the Assessment of Environmental Factors – Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia*) (EPA 2004a) and used two methods:

1. Transects (approximately 200 – 300 m apart) were walked through with all changes in vegetation and any vegetation variations recorded. Aerial photographs were examined prior to walking transects to determine obvious variations in the vegetation. Sites were recorded at each change of vegetation, typically 200 m or less apart; and the number and health of trees was recorded in a 20 m radius from the site and understorey vegetation in a 5 m radius. A total of 1334 sites were surveyed in this way in 2004 (Bennett 2004), a further 989 sites were surveyed in 2005 (report in preparation) and 896 in 2006 (report in preparation).
2. Fifty-eight permanent quadrats were established and assessed by Bennett (2004) and subsequent investigations in 2005 and 2006 have established and assessed a further 31 quadrats (plus 1 revelee) and 31 quadrats respectively. All species were recorded in 10m x 10m quadrats, whilst 20m x 20m quadrats were used to record the number and cover of each tree species and to capture any additional understorey species opportunistically.

These investigations focused on the areas of proposed disturbance within the Brookton and Central envelopes, in particular on the likely bauxite mine pods, to record site vegetation types and to search for significant flora within these pods. Subsequent surveys have focussed on extending the mapping of vegetation types and searching for significant flora outside of the bauxite mine pods and throughout the entire northern mining envelopes¹¹.

No baseline field surveys have been conducted in the southern mining envelopes of Morgans, East Quindanning and Hotham North Extension. Except for a small portion of the Morgans envelope, the Hotham North Extension, East Quindanning and Morgans envelopes are located on private land that has been cleared extensively for agriculture or is under plantation timber. The remaining natural vegetation in these mining envelopes is small and fragmented and largely situated on private land that would require approval from landowners prior to entry to undertake biodiversity-related investigations. As a result field investigations to date have focused on the northern mining envelopes.

Extensive baseline flora surveys of existing mining areas within the PBA were undertaken prior to project construction (Worsley and Dames & Moore, 1981; Worsley Alumina Pty Ltd, 1985), with

¹¹ These surveys have already commenced in the Brookton mining envelope to make use of field seasons during the development of the draft Scope.

additional baseline flora studies conducted as project operations have extended into new areas within the PBA (Mattiske & Associates 1993, Mattiske Consulting Pty Ltd 1999a; 1999b).

Numerous studies have been undertaken in the Jarrah Forest including the proposed northern mining areas. Selected important studies include:

- Havel (1975): described twenty-six site vegetation types for the Jarrah forest
- Heddl *et al.* (1980): described the vegetation complexes of the Darling system (which comprises the Northern Jarrah Forest) at a scale of 1:250,000
- Beard (1981): mapped the original natural vegetation associations of the Swan area at a scale of 1:1,000,000
- Ecologia Environmental Consultants (1994): undertook a survey for the proposed Wandoo Reserve located to the east of the proposed northern Brookton mining envelope
- Mattiske and Havel (1998): as part of the Western Australian Regional Forest Agreement (RFA), mapped the vegetation complexes of the forest areas of WA including the Jarrah Forest

Information from these studies has been considered in the State Forest Management Planning process and relevant information has been incorporated into the databases maintained by State agencies. For example, species listed under the WA *Wildlife Conservation Act 1950* (Declared Rare and Priority Flora species) identified during these surveys are incorporated into databases maintained by DEC and the Western Australian Herbarium.

Investigations and review of botanical information, as presented in the ERMP (Strategen 2005), indicates that some areas supporting vegetation and flora of recognised regional significance have already been identified within the new mining envelopes (although these areas may not necessarily be affected by mining activities). For example, four vegetation complexes (after Mattiske and Havel 1998) that have less than 30 % of their pre-European distribution remaining have been mapped within the study area. Although no species listed as Declared Rare Flora under the *Wildlife Conservation Act 1950* have been recorded, over 20 flora species with restricted distributions or identified as 'Priority flora' by DEC have been identified as part of the previous investigations. Detailed information on the results of these investigations is presented in the ERMP (Strategen 2005).

4.2.2 Definitions

For the purposes of these investigations, minimum standards as described in the EPA's *Guidance Statement No. 51* (EPA 2004a) will apply to cover the issues below:

- geographically or spatially restricted floristic communities, vegetation or ecological communities
- listed TECs (as delineated by DEC and under the EPBC Act 1999)
- nominated TECS (as delineated by DEC)
- localised communities that occur on unusual or scarce landforms and soils (e.g. "heathland" and "granite outcrops")
- Rare Flora, Priority Flora species and Threatened Flora (as delineated by DEC and DEW¹²), including "significant populations of Priority Flora..."

¹² Department of Environment and Water Resources (DEW) formerly the Department of Environment and Heritage (DEH)

- significant flora and any other important flora and vegetation that occur as range extensions, are geographically restricted species or that are significant as fauna habitat.

The investigations will also apply standard techniques on assessing the condition of vegetation using condition ratings as developed by Keighery (1994) (refer to *Bush Forever*, Government of Western Australia 2000) or the equivalent; with due recognition to recent national developments in approaching condition rankings.

4.2.3 Objectives

The objectives of the flora and vegetation investigations are:

1. To determine the occurrence and spatial extent of floristic and vegetation communities at the local and regional scale (*Condition 719:M8-1(1)*).
2. To establish the condition of floristic and vegetation communities identified in 1 above (*Condition 719:M8-1(2)*).
3. To determine the occurrence and spatial extent of TECs including nominated TECs (*Condition 719:M8-1(3)*) within new mining envelopes and bauxite transport corridors and adjoining areas and as appropriate at the local and regional scale.
4. To determine the occurrence and extent of Declared Rare and Priority Flora pursuant to the *Wildlife Conservation Act 1950* and other Priority Flora as identified in the database maintained by the Department of Conservation and Land Management¹³ (*Condition 719:M8-1(4)*) within new mining envelopes and bauxite transport corridors and adjoining areas.
5. To determine the occurrence, severity and spatial extent of forest disease and the potential for the spread of forest disease (*Condition 719:M8-1(6)*) within new mining envelopes and bauxite transport corridors and adjoining areas.
6. To investigate the weed and pest severity status in State Forest (*Condition 719:M8-1(13)*) within new mining envelopes and bauxite transport corridors and adjoining areas.

4.2.4 Proposed botanical investigations

Desktop review and gap analysis

The desktop assessment will involve the review of existing datasets and methodologies used in local and regional investigations and will ensure they are considered in planning for flora and vegetation field survey programs. Key aspects of the desktop review will include:

1. Summarising the current literature on flora and vegetation in the area including reviewing data already collected by Worsley and its contractors, regional data on vegetation mapping (e.g. as described by Mattiske and Havel 1998 and Havel 1975) and other data collected in nearby areas (e.g. Wheatbelt Salinity Action Plan) to provide regional and local information on vegetation.
2. Producing a list of significant flora species likely to occur in the study area.

¹³ In 2006, the Department of Conservation and Land Management merged with the Department of Environment and is now known as the Department of Environment and Conservation (DEC).

3. Searching relevant databases for known occurrences of Rare, Priority or Threatened Flora or Significant Flora taxa (as listed under the *Wildlife Conservation Act 1950*, the EPBC Act and in databases maintained by the DEC).
4. Searching relevant databases for TECs, Ecologically Sensitive Areas (ESAs), wetlands, and other potentially significant vegetation that may occur within the study area.
5. Reviewing output from the hydrological and landform desktop review to identify areas that support potentially significant communities or vegetation, including groundwater dependent ecosystems, stream dependent species and ecosystems, heath communities on shallow soils and/or other spatially or geographically restricted species or communities that may occur within the study area.
6. Reviewing output from the fauna desktop review to identify areas that support potentially significant fauna species and/or vegetation that is important for fauna habitat.
7. Reviewing long term fire records and mapping assessments of forest disease (e.g. *Phytophthora cinnamomi*) for the study area to allow a basis for assessment of the influence of these factors on key ecosystem functions and processes and flora and vegetation.
8. Reviewing landform, soil, vegetation and floristic and fauna habitat mapping datasets, as well as land tenure and proposed mining disturbance area maps to identify indicative regional ecological linkages (see Section 4.4) within the northern mining envelopes. Within the southern mining envelopes, potential regional ecological linkages (that may need to be created within the already cleared and fragmented landscape) will be identified by reviewing the size, location and likely botanical values (from any known information such as vegetation complex mapping) of remnant natural areas existing in the study area.

The desktop analysis will identify gaps in the flora and vegetation information where baseline field investigations are required to determine biodiversity values and suitable monitoring parameters. For example, a number of significant flora species may require further investigations because they are in extreme sites and/or on the interface with the Wheatbelt.

Baseline botanical surveys – filling in the gaps

Further baseline field surveys will be undertaken in the northern mining envelopes, where current information is outdated or insufficient to describe the flora and vegetation values in the study area within a regional context. Initial baseline field surveys will also be undertaken in the southern mining envelopes to assess their regional and local floristic values (subject to agreement with the relevant landowners).

Surveys will be undertaken in accordance with requirements set out in *Guidance Statement No. 51* (EPA 2004a) and to ensure that flora and vegetation data collected is comparable with other local and regional studies wherever possible. The advice of Dr Libby Matiske, who co-authored the regional vegetation study (Matiske and Havel 1998) for the Regional Forest Agreement (RFA), has been sought during the preparation of the scope to ensure the flora surveys will be compatible with other regional surveys.

The survey method used for the baseline studies is descriptive in nature and suited to identifying patterns and understanding ecological sequences across the landscape. It is consistent with and builds on the data collected for the initial 2005 ERMP and, as described, compatible with other regional surveys. The baseline study survey method consists of a mixture of transects and quadrats to assist in defining values. A modified quadrat survey method, more suited to long-term monitoring, will be

used for the long term vegetation monitoring program, in line with the flora quadrat methodology currently used for forest and rehabilitation monitoring at Worsley's Saddleback operations (Section 8).

Key aspects of the baseline surveys are summarised below.

1. The vegetation of the mining envelopes, bauxite transport corridors, and sufficient other area to provide a regional context, will be described using the site vegetation type descriptions developed by Havel (2000) and the vegetation complex descriptions after Mattiske and Havel (1998). This will enable comparison with (and context to be gained from) these other regional studies. In the southern mining envelopes, and where additional information is required to describe the vegetation in the northern mining envelopes in a regional context, transects will be established to survey flora and vegetation from the valley floor to the ridge top. These transects will correspond to those used for the fauna fieldwork (see Section 4.3.4).

Transects will also be established in locations where it is considered important to measure changes in the vegetation or floristic pattern in response to other environmental factors such as soil and rainfall. The extent of site vegetation types will be mapped as well as those plant communities and flora taxa that may be significant across the local area or region. Other information affecting vegetation and flora values such as forest disease, the distribution or presence of weed species and obvious signs of fire and other disturbances in the study area will also be recorded during the transect surveys.

2. Permanent plots and quadrats will be established in the southern mining envelopes to provide baseline information on plant communities that are representative of the range of site vegetation types, changes in soil types and to reflect gradients in rainfall patterns in these areas. Additional permanent plots and quadrats will also be established in the northern mining envelopes, bauxite transport corridors and other areas where further baseline information is needed to provide a regional context on the range of plant communities.

Tree plots (20m x 20m in size) will be established to record the range of tree species, numbers and average heights of the mature and juvenile individuals for each tree species, as well as assessment of the vegetation condition (using methodology after Keighery 1994). The tree plots will be photographed and will be located with a hand-held GPS.

A 10m x 10m understorey quadrat will be located in the NW corner of each 20m x 20m tree plot. Measurements in the understorey quadrats will include recording species present and the percentage foliage cover of each species. This will be used to confirm the distinctions between site vegetation types using software-based vegetation classification analysis. All permanent plots and quadrats will be sampled at least twice prior to the commencement of mining.

3. The abundance and spatial extent of Threatened Flora (pursuant to the EPBC Act 1999, the *Wildlife Conservation Act 1950* and as identified in databases maintained by DEC) as well as significant flora as defined by Guidance Statement No. 51, (EPA 2004a) will be delineated through recording occurrences of these species during the transect and quadrat surveys. Recordings of occurrences of Threatened Flora and significant flora species will include a GPS reading, a photograph, recording the exact number of plants (where there are only a small number of plants) or an estimate of the number where there are many, together with the soil and vegetation type.
4. Where the desktop analysis and hydrological and fauna desktop assessments indicate potential areas of restricted and significant environments, communities and habitats, or vegetation important for fauna habitat (as described in *Ministerial Condition 719:M9-1, 9-2*), reconnaissance field surveys will be conducted to confirm the presence of these communities. If present, the

exact location of the community will be GPS recorded, mapped and described and monitoring sites will be established.

5. Monitoring sites will be established specifically to investigate long term trends in vegetation and flora that may occur (or have occurred) as a result of climatic change and threatening processes. These monitoring sites will be located in a range of different sites; for example, in areas that support common and widespread species, or in areas where the hydrological studies indicate key sites that reflect significant hydrological changes, most likely as a result of longer term changes in climatic conditions. Monitoring sites will also encompass a range of vegetation and floristic units across rainfall and soil gradients.
6. The ecological communities that occur in areas identified as potential ecological linkages within the northern mining envelopes will be investigated for their functionality as an ecological linkage in accordance with the guiding principles for identifying ecological linkages (Section 4.4.2).

Within the southern mining envelopes, fieldwork will be carried out to assess the regional floristic values of remnant natural areas. The potential to create or re-establish linkages between sites with the highest biodiversity values will be identified and investigated. Strategies to develop such linkages will be devised in consultation with, and with the agreement of, the relevant landowners.

Characterising the botanical values in the study area

Characterisation of the regional botanical values of the study area will be based on information gathered from the desktop analysis and the baseline field surveys. The southern mining envelopes, areas lying outside the new mining envelopes and other areas where further floristic information is required to provide the regional context, will be investigated as part of the baseline studies (for example where additional information is required to determine the representation or the range of a specific plant community).

Threatening processes that potentially affect the botanical values of the new mining envelopes will also be reviewed as part of the characterisation process (see Section 5).

Once the flora and vegetation values of the new mining envelopes are described and characterised, targeted field surveys will be established to further refine these values and to record potential locally significant biodiversity values. Targeted field surveys will be developed initially based on the findings of the previous studies.

Targeted surveys may also be required to further define and assess parameters such as:

- the occurrence of spatially or geographically restricted species or other species of local or regional significance within the new mining areas
- keystone species which may be critical to ecosystem functioning
- the occurrence, role and significance of ecological linkages.

The process for developing the targeted field surveys is described in more detail in Section 6.

4.2.5 Timing of studies

Vegetation mapping can be undertaken over a number of seasons as it relies on recording key structural species which are present at all times of the year. Areas where prescribed burning is scheduled to be undertaken will be surveyed prior to burning, assuming that sufficient time is available to do so.

Surveys for DRF, Priority Species and other significant flora will be timed to coincide with when expected species are likely to be present and/or flowering. Flora surveys may require numerous visits over different seasons to ensure that all species are recorded within economic and time constraints.

4.3 FAUNA INVESTIGATIONS

This section outlines the objectives and proposed investigations for assessing the fauna and fauna-related values within the study area. The investigations will build on the fauna work undertaken to date in the northern mining envelopes (Bamford *et al.* 2004, 2005 report in preparation) and will focus on collecting additional information to allow Worsley to assess the faunal values in a regional context. No previous field investigations have been undertaken by Worsley in the southern mining envelopes. The objective of the investigations in Hotham North Extension, East Quindanning and Morgans will therefore be to identify the key fauna and fauna habitat values associated with the remaining natural areas in these mining envelopes.

A detailed field program for all the new mining envelopes will be developed and subsequently revised on an annual basis (Section 6), in consultation with the EMLG (Section 9). Fieldwork will be tailored annually to build on the results of the initial desktop review and the previous baseline field investigations that are proposed in this Scope.

4.3.1 Previous investigations

Similar to the flora and vegetation surveys that were conducted to support the preparation of the ERMP (Strategen 2005), detailed fauna investigations were also carried out in the northern mining envelopes (Bamford *et al.* 2004). These investigations continued in 2005 and 2006, providing Worsley with further baseline knowledge of fauna habitat and species abundance in these areas.

The investigations included a desktop review, with the aim of producing an updated list of fauna species known to be present or expected to occur in Worsley's Mining Lease area. These include threatened and migratory fauna species listed under the EPBC Act, the *Wildlife Conservation Act 1950* or considered otherwise to be 'Conservation significant fauna' (see Section 4.3.2). Field investigations surveyed the range of fauna habitats present in the northern new mining envelopes and investigated the abundance and importance of the area for significant fauna species. Permanent transects that extend at least from valley to ridge have been established across a number of landforms within the new mining envelopes.

Fauna surveys have also been undertaken throughout Worsley's existing mining areas (i.e. within the PBA). Baseline surveys of the Saddleback Timber Reserve were undertaken between 1980-1983 as part of the Phase Two Flora and Fauna Studies (Worsley Alumina Pty Ltd, 1985) with several subsequent surveys, most recently between 1996-1998 (Ninox Wildlife Consulting, 1997 & 1998). Baseline surveys of the Quindanning Timber Reserve were undertaken between 2000-2001 (Ninox Wildlife Consulting, 2002).

The baseline vertebrate fauna surveys undertaken to date in the new mining areas and as reported on in the ERMP (Strategen 2005), indicated that the new mining envelopes are relatively rich in fauna and support a wide range of fauna habitat. A combination of this fieldwork and desktop studies have identified a total of 215 vertebrate species in the northern mining envelopes that includes 16 species of frogs, 54 species of reptiles, 31 species of mammals and 114 species of birds. Of these, two species of reptiles, 24 species of birds and 11 species of mammals are known to be conservation significant (see

Section 4.3.2). Detailed information on the results of the fauna investigations is presented in the ERMP (Strategen 2005).

No detailed fauna investigations have been conducted in the southern mining envelopes. With the exception of a small portion of the Morgans mining envelope, the southern envelopes are located on private land that has been cleared extensively for agriculture or are under plantation timber. As the remaining natural areas in these mining envelopes are small and fragmented, field investigations to date have focused on the northern mining envelopes.

4.3.2 Definitions

For the purposes of these investigations the following definitions relating to the fauna investigations apply:

- ‘Conservation significant fauna’ are defined as the following:

Conservation Significance (CS) 1: Species listed under State or Commonwealth Acts

Conservation Significance (CS) 2: Species not listed under State or Commonwealth Acts, but listed in publications on threatened fauna or as Priority species by DEC

Conservation Significance (CS) 3: Species not listed under Acts or in publications, but considered of at least local significance because of their pattern of distribution.

In these investigations, where the term ‘other significant fauna’ (*after Ministerial Condition 719:M9-1 (8)*) is given, the above definition(s) apply.

- ‘significant areas of habitat’ (*after Ministerial Condition 719:M9-1(8)*) is defined as habitat areas that are significant for sustaining the populations of significant species, or critical to the survival of significant species.

In addition, minimum standards as described in the EPA’s *Guidance Statement No. 56* (EPA 2004b) will apply to cover the issues below:

- fauna habitat
- Priority and significant fauna
- Short-range endemic fauna¹⁴.

4.3.3 Objectives

The objectives of the fauna investigations are:

1. To identify and define the 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 (*Condition 719:M8-1(8)*) within new mining envelopes and bauxite transport corridors and adjoining areas.

¹⁴ In these investigations, where the terms ‘significant Short Range Endemic fauna’ and ‘other significant invertebrate taxa’ (*after Ministerial Condition 719:M9-1(8)*) are used, these species will be determined in consultation with the WA Museum.

2. To determine the occurrence and abundance within the new mining envelopes and bauxite transport corridors and adjoining areas of:
 - vertebrate fauna, including specifically, threatened fauna as defined in the *Wildlife Conservation Act 1950* or the Commonwealth EPBC Act
 - Priority fauna as defined and listed by the Department of Environment and Conservation
 - obligate tree hollow nesting or roosting species
 - species requiring specialised habitats or resources, including Honey Possums (*Condition 719:M8-1(9)*).
3. To define the occurrence and abundance of significant Short Range Endemic and other significant invertebrate taxa (*Condition 719:M8-1(10)*) within new mining envelopes and bauxite transport corridors and adjoining areas.

4.3.4 Proposed faunal investigations

Desktop review and gap analysis

The desktop assessment will ensure that existing datasets and methodologies used in previous local and regional investigations are reviewed and considered in the planning for fauna field survey programs. Key aspects of the desktop review will include:

1. Reviewing other relevant publications that provide information on general patterns of distribution of the range of fauna taxa likely to occur within the new mining envelopes and bauxite transportation corridors and sufficient other area to establish a regional context.
2. Searching relevant databases for additional information and records on threatened and significant fauna species that are likely to occur within the study area (e.g. as listed under the *Wildlife Conservation Act 1950*, EPBC Act and in databases maintained by the DEC).
3. Producing a list of vertebrate fauna species, including significant fauna species likely to occur within the study area.
4. Producing a list of significant Short Range Endemic and other significant invertebrate taxa to be studied in the field investigations based on advice from the WA Museum.
5. Producing a list of obligate tree hollow nesting or roosting species and species requiring specialised habitats or resources to be determined in consultation with the EMLG.
6. Reviewing available information, methodologies, datasets and previous investigations for Black-Cockatoos to assist in understanding regional patterns of distribution and habitat requirements for these species.
7. Identifying the broad habitats that occur or are likely to occur within the new mining envelopes and reviewing the habitat requirements of significant fauna species likely to occur within the study area.
8. Reviewing the relevant hydrological and landform desktop information, and the flora and vegetation desktop information, to identify areas supporting potential significant habitat for fauna species such as groundwater dependent ecosystems, stream dependent species and ecosystems, heath communities on shallow soils and/or other spatially or geographically restricted communities that may occur within the study area.
9. Reviewing potential faunal requirements for consideration in regional ecological linkages (see Section 4.4), based on the variation in plant communities and habitat types, in conjunction with the flora and vegetation desktop review of ecological linkages.

10. Reviewing long term fire records and mapping of forest disease (e.g. *Phytophthora cinnamomi*) for the study area to help assess the influence of these factors in the patterns of distribution and abundance of key fauna species within the study area
11. Reviewing existing information to determine feral animal control and feral animal distribution.

Baseline faunal surveys - filling in the gaps

Additional baseline fauna surveys will be undertaken to characterise and define the fauna values in the northern mining envelopes, bauxite transport corridors and sufficient other area to establish a regional context. Field surveys will also be conducted in the southern mining envelopes to assess the fauna values at these sites. Surveys will be undertaken in accordance with requirements set out in *Guidance Statement No. 56* (EPA 2004b) and to ensure that data collected is comparable with other local and regional studies.

Key aspects of the baseline fauna surveys within the study area are summarised below:

1. The patterns of distribution and abundance of vertebrate fauna (including small mammals, reptiles, amphibians and birds) and selected invertebrate fauna in relation to changes in soil, vegetation and landform will be determined using a series of transects. In the northern mining envelopes, additional transects will be established to build on the information already collected (or being collected through current surveys) (see Section 4.3.1). No transects have been established in the southern mining envelopes to date.

The aim of the transect program is to progressively survey the entire new mining envelopes to identify conservation significant species and habitat that is significant to them. The transect methodology is proposed to pick up changes in populations across the landscape and will therefore run from the valley floor to the ridge top in locations that reflect a range of different vegetation units, rainfall gradients and soil types. Sample points will be set up at 50 m intervals along each transect. At each sampling point a pitfall trap, funnel trap and Elliott trap will be set up and birds will be counted within 25 m of each point (bird census). 50m x 50m quadrats containing 3 x 3 (i.e. 9) census points (including pitfall traps) will also be established at some sampling points (between two and four sites) along many of the transects, to provide more intensive quadrat-based data for relevant taxa and relevant soil and vegetation types. Larger quadrats (e.g. 200 m x 200 m) are not used as they may unavoidably include additional vegetation types (among other factors), thus potentially confounding the data analysis (correlations, etc). All census points will be repeat sampled (i.e. across multiple survey days), to increase the data collected from each site.

A number of species, that are not readily trapped or observed by conventional methods, are of conservation significance; e.g. the South West Carpet Python (*Morelia spilota imbricata*) and some Critical Weight Range mammals, such as the Tammar Wallaby (*Macropus eugenii*), Brush Wallaby (*Macropus irma*), and the Numbat (*Myrmecobius fasciatus*). These will be recorded opportunistically and separate transects and sampling programs will also be established to measure the abundance of most other Critical Weight Range mammals (see below).

Sampling over different parts of the year, when each respective fauna group is active, will provide a fuller picture of the range of fauna present and hence enable Worsley to accurately identify patterns of faunal diversity in the landscape and eventually across the wider study area (Section 4.3.5). It will also produce measures of abundance and habitat relationships that can be used to guide and assess the success of rehabilitation following mining. Identification of significant habitats will enable Worsley to map habitat distribution and important ecological

linkages¹⁵ to be identified. The sampling approach will identify locations and habitats that are important for some significant species and important in biodiversity values. Mapping of habitats for particular species may then be possible based on factors such as soils, slopes, aspect and vegetation floristics. Where the fire history is a factor, seasonal sampling will detect movements across the landscape.

Patterns of faunal diversity within a valley and eventually across the entire project area will be defined. Sampling will enable the production of species accumulation curves however documenting species' presence is not considered to be as important as documenting patterns of diversity.

2. The abundance of Critical Weight Range (CWR) mammals will be determined along separate transects (to those described above). Most CWR mammals are conservation significant species including the Chuditch (*Dasyurus geoffroii*), Quenda (*Isoodon obesulus*), Brush-tailed Possum (*Trichosurus vulpecula*), and both Phascogales (*Phascogale tapoatafa* spp. (WAM M434) and *P. calura*).

The CWR mammal sampling will aim to monitor abundance of these species and to identify their key habitats. Sampling will generally use a layout consisting of an Elliott and cage trap pair every 200 m along a 5km transect (i.e. 25 individual trapping points per 5km transect), to increase the coverage of the transects and traps, given that CWR mammals are generally more widely ranging than the fauna targeted by the regular 'pitfall transects'. These transects will be run progressively across all the new mining envelopes with specific focus on sampling across patterns of vegetation and flora and in areas identified through the hydrological and landform investigations as being of special interest.

Sampling for the two Phascogale species will involve the use of 50 to 100 nest boxes spread throughout suitable habitat. Several nest box designs will be trialled. In addition, specific transects of Elliott traps spaced at 50m intervals within and adjacent to suitable habitat (mainly she-oak woodland) will also be used to target the Red-tailed Phascogales. The Elliott traps will be positioned both on the ground and mounted above the ground within suitable trees.

Spot-lighting will also be undertaken along defined routes of known length for the Brush-tailed Possums, Western Ring-tailed Possums and Tammar Wallabies.

- The foraging areas and nesting sites of Carnaby's Cockatoo *Calyptorhynchus litirostris*, Baudin's Black Cockatoo (*Calyptorhynchus baudinii*) and Forest Red-Tail Black Cockatoo (*Calyptorhynchus banksii naso*) will be recorded through targeted surveying and through opportunistic observations of cockatoos made during fauna surveys in order to identify significant and otherwise important habitats. Foraging habitat based on sightings will be mapped along with floristic information and fire history. In each instance the location, type of food plant and habitat will be recorded where cockatoos are found to be foraging.

Nest sites must be individually located however searching for nest hollows is very labour intensive. Surveying for nest sites will be targeted to focus on areas likely to be disturbed by mining activities and in adjacent forested areas. Searches will be conducted to identify suitable breeding areas outside of the mining envelopes and transport corridors to provide regional and local context to any areas that may be affected by operations. Knowledge of the location(s) of nest hollows will enable Worsley to minimise disturbance to, and loss of, nest hollows through careful mine planning and development.

¹⁵ Description on identifying ecological linkages within Worsley's study area is provided in section 4.4

3. Individual Masked Owls and Barking Owls are thought to be very wide-ranging, but their numbers are possibly limited by the availability of suitable nest hollows. Therefore surveying will focus on identifying and locating nest hollows as significant habitat¹⁶ for these species.
4. Field surveys for targeted short range endemic invertebrate groups (as recommended by the WA Museum) will be undertaken to identify the distribution of these species as well as significant and otherwise important habitats (including areas that form a linkage between habitats). Targeted searching will focus on rare habitats such as sandy soils, granite outcrops and wetlands. Small, “wet” pitfall traps may be deployed and specimens may also be caught opportunistically in vertebrate pitfalls. Sampling will focus first on those areas likely to be disturbed by mining activities.

The targeted short range endemic invertebrate groups and the sampling methodology required to adequately survey these groups will be developed in consultation with the WA Museum during the desktop review stage. At this stage, the preliminary list of invertebrate groups to be targeted includes:

- Millipedes
 - Scorpions
 - Pseudo-scorpions
 - Trap-door spiders.
5. A range of frog species will be surveyed, however investigations will focus on identifying key breeding locations for a number of specific species. Surveys will be undertaken by listening for calling aggregations followed by targeted trapping at specified breeding sites to investigate population structure. Identifying key breeding locations is important as these areas are often sensitive to hydrological impacts and therefore data on frog population structure can provide valuable information on long-term hydrological changes. It may be possible to determine migration pathways once significant breeding habitats are identified.
The specific frog species to be investigated and criteria used to identify key breeding locations will be developed in consultation with the EMLG.
 6. The effect of climate change on fauna values within the study area will be assessed by establishing monitoring sites for specific fauna species in key locations where the review of the hydrological and climatic data indicates the potential a long-term trend or change. For example, changes in the distribution and extent or population structure of fauna species that typically utilise wet or moist environments (e.g. frogs) will be monitored over time in specific locations. Long-term sampling locations will be selected because they respond rapidly to climatic changes (e.g. by producing considerably less stream flow). It may then be possible to identify fauna species suitable for use as a bio-indicator species.

The selection process of identifying suitable sites to assess the potential effects of climate change will be developed in consultation with the EMLG on an annual basis.

In summary, the proposed methodologies (e.g. transect and plot locations, layout, timing of surveys, etc) will vary according to the fauna being targeted, on account of the variation in biology within and between the different fauna groups.

¹⁶ See Section 4.3.2 for definition of ‘significant habitat’.

Characterising the fauna and fauna habitat values in the study area

Information gathered from the desktop analysis and baseline fauna surveys will provide information required to characterise and define key fauna values within the new mining envelopes. Patterns of faunal diversity will be determined along fairly narrow transects as part of the baseline studies. However, transects will be sampled across several years and can be replicated where further detailed information is required (see Section 6 on targeted surveys). Initial mapping of key habitat areas for fauna species of conservation significance will be conducted during the baseline investigation but will be refined during more detailed follow up field investigations and as data becomes available from flora and hydrological studies.

The investigations also take into consideration the impact of key threatening processes (see Section 5). For example, key areas of fauna habitat (e.g. for conservation significant species) will be assessed for the presence of forest disease, weeds and other threatening processes and the impact these factors could have on the viability of fauna in these areas will be assessed.

4.3.5 Timing of studies

Fauna investigations will be undertaken throughout the year; the actual timing will depend on the fauna group being surveyed (Table 4).

Table 4 Summary of timing of field studies for fauna

Fauna Group	Timing	Reason
Short-range endemic Invertebrates	Winter / early Spring, or as otherwise determined in consultation with the WA Museum.	Likely to be more easily detected during the wetter months.
Amphibians	Late Autumn, early Winter. Annual (early Spring)..	For surveys of distribution of calling adult frogs, especially in the genus <i>Heleioporus</i> . For emergence of metamorphs to monitor breeding success.
Reptiles	Biennial (late Spring and Summer).	Reptiles are most active at this time.
Birds	Quarterly. Spring survey for breeding Black Cockatoos.	Quarterly survey required as birds vary seasonally in abundance.
Mammals	Autumn (~April/May) mainly. Main spotlighting surveys also in Autumn, but may also include other seasons. For some mammals, like phascogales, nest-boxes will be used and checked quarterly.	Main trapping in Autumn to coincide with independent young and avoid stressing females while carrying pouch young.

4.4 ROLE AND SIGNIFICANCE OF ECOLOGICAL LINKAGES

The identification and management of ecological linkages is critical to the protection of biodiversity and provides a framework for rehabilitation strategies.

Worsley proposes the following *preliminary* definitions for ‘ecological linkages’, ‘regionally significant ecological linkages’ and ‘key ecological linkages’, for the purposes of these biodiversity-related investigations:

Ecological linkages:

‘are sequences of ecological communities and other important corridors for the movement of flora and fauna within and between the major landform elements within Worsley’s mining lease area.’

This definition draws on the EPA’s findings from the identification of ecological linkages within the Greater Bunbury Region (GBR) as part of its Natural Areas Strategy for the GBR¹⁷ (EPA 2003).

Regionally significant ecological linkages:

‘are ecological linkages of which the retention is important for the preservation of threatened flora or fauna, and/or for the preservation of one or more adjoining areas of significant biodiversity value (e.g. a small conservation reserve), within the region.’

Key ecological linkages:

‘are all or part of a regionally significant ecological linkage of which the retention is essential for the preservation of threatened flora or fauna, and/or for the preservation of one or more adjoining areas of significant biodiversity value (e.g. a small conservation reserve).’

This third definition is proposed to satisfy the intent of the use of the term ‘key ecological linkages’ in Condition 9-1(5) of Ministerial Statement 719. The above three definitions are preliminary, and will require input from key regulatory agencies. As such, Worsley proposes to finalise these definitions in consultation with the EMLG.

Investigations into the role and significance of ecological linkages and developing an approach to their identification will aim to maintain the regional biodiversity values within the study area.

4.4.1 Objectives

The objectives of the investigations into defining ecological linkages are:

1. To identify the role and significance of ecological linkages (*Condition 719:M8-1(5)*).
2. To identify the ecological linkages on surveyed plans (as required in the Biodiversity-related Investigations Report by *Condition 719:M8-6(5)*).
3. To identify the key ecological linkages, in consultation with the EMLG.

¹⁷ The Natural Areas Strategy for the Swan Coastal Plain of the GBR describes seven distinctive natural features that were identified through a series of regional scale studies and information sets. Ecological linkages within and between the major landform elements were broadly identified (EPA 2003).

4.4.2 Proposed investigations

Baseline surveys and desktop reviews (hydrological, flora and vegetation and fauna studies) will help determine the values of particular areas as well as identify patterns and changes in vegetation and flora and habitat types across the landscape. In identifying these patterns, the type and extent of ecological linkages that connect areas supporting key biodiversity values will be determined.

The following principles will be used to guide the process of defining ecological linkages in the new mining envelopes:

1. Ecological linkages should be contiguous or near contiguous (see the *Ecological linkages in the southern mining envelopes* sub-section, below) linkages of vegetation (and/or other desired natural values) linking known areas of high conservation value.
2. Ecological linkages should seek to incorporate the major variation in plant communities and fauna habitat typical of the region so that the widest range of flora and fauna possible can use the links (including linking “like to like” areas and “like to different” areas).
3. Ecological linkages within the study area should link to other identified ecological linkages outside of the study area.

The hydrological, flora and vegetation and fauna investigations will contribute towards identifying and mapping natural areas that support significant biodiversity values. Areas to be surveyed for the purposes of identifying key ecological linkages will be determined through the targeted field survey programs (Section 6).

4.4.3 Identification of regional ecological linkages

The field investigations required to adequately assess the suitability of selected natural areas identified within potential ecological linkages will be developed and reviewed annually in consultation with the EMLG. The determination of such linkages will rely on information from the baseline flora and fauna investigations, and the EMLG will also be consulted on an annual basis (e.g. through the annual workshops, see Section 9.1.1).

Indicative areas for potential regional ecological linkages will be identified at the regional scale. The purpose of these directional links is to join the areas of significant biodiversity values within the study area and to be broadly reflective of the intended direction of the ecological link at a regional scale. They will be targeted to connect high priority conservation areas via links containing the best condition vegetation.

The biodiversity-related investigations will determine these regional ecological linkages (determined in consultation with DEC and other management authorities, such as natural resource management catchment councils as required) and will consolidate those regional ecological linkage patterns already existing or proposed within the wider landscape or region.

Ecological linkages in the southern mining envelopes

Determining ecological linkages in the southern mining envelopes (Morgans, East Quindanning and Hotham North Extension), where much of the vegetation has been historically cleared and some of the remnant vegetation exists in isolated pockets, may be problematic. The remnant vegetation within these mining envelopes is for the most part located on privately owned, agricultural properties, or are otherwise fragmented due to other existing land uses. Nevertheless, wherever possible, the above-

mentioned approach to identifying and defining ecological linkages will be utilised for the southern mining envelopes as well.

Strategic links between natural areas supporting high conservation values may no longer exist, but there may be opportunities for such linkages to be created as part of the rehabilitation process, once mining activities are completed. As these linkage areas are also likely to be on private land, landowner agreement (to establish any such linkages) will be necessary. Opportunities may also exist to enhance existing 'remnant' ecological linkages, that may consist of remnant vegetation intersected by cleared land, through specific revegetation and conservation projects.

Strategic ecological linkages, linking natural areas of identified high biodiversity value will be mapped as described. These strategic ecological linkages may or may not currently include areas of remnant vegetation (but will link important areas of remnant vegetation). Information from this process will provide important input in the development of Worsley's long term rehabilitation program which will consider opportunities to re-create linking corridors between areas of high conservation value previously destroyed.

4.4.4 Management of regional ecological linkages

The potential impact of proposed bauxite mining activities and related operations on ecological linkages will be assessed prior to detailed final mine planning, once the indicative regional ecological linkages have been identified. The regional ecological linkages (or parts thereof) will be described as follows:

- RED – ecological linking corridor (or part thereof) coincides with bauxite resource
- BLUE – ecological linking corridor is located within a new mining envelope but does not coincide with bauxite resource ('buffer area')
- GREEN – ecological linking corridor is located within the mining lease but outside of areas where disturbance is likely and outside of buffer areas.

Worsley proposes to consult with the EMLG during the process of identifying the ecological linkages during the investigations.

Any additional field assessments required of natural areas within ecological linkages will be prioritised according to the categories outlined above (with the 'RED' areas given the highest priority). A more detailed examination of the vegetation communities within 'RED' and 'BLUE' areas (that have not previously been surveyed) will be undertaken and will include an assessment of the specific purpose or need for the linkage.

The development of measures for the management of 'RED' or 'BLUE' ecological linkages are beyond the scope of this document. Such issues will be addressed in the future *Bauxite Mine Plan*, *Transport Corridor Route Plan*, and/or *Rehabilitation Plan*, to be developed in consultation with stakeholders,, as required by Ministerial Statement 719.

4.5 LANDSCAPE MODELLING

A fundamental requirement of the regional and targeted field investigations over the next 3 – 4 years will be the ongoing integration and analysis of the survey data within a dedicated GIS and database management system. Adaptive management of the biodiversity-related investigations over time will depend on a well-maintained GIS management system.

An integrated GIS and database management system will be employed for detailed analysis of spatial information and for impact assessment, on a local or regional level (Section 3.4). Where more specialised modelling is required (for example, the hydrological flux density analyses), additional expertise may be needed to generate the required analytical data, and all relevant spatial information will be integrated back into the GIS management system. If needed, additional landscape modelling may also be used during and after the biodiversity-related investigations, as an extension to the GIS management system.

Some of the key geospatial information which will be used to inform the identification of the key biodiversity values to be protected, the key ecological linkages (to be preserved and additional linkages that may be created), the proposed areas of zero disturbance, and their respective buffer zones, will include the following (where available):

- vegetation mapping, including remnant vegetation, RFA vegetation complexes, detailed site vegetation types, poorly represented vegetation communities and other diverse ecotype zones
- threatened species and ecological communities (registered and nominated)
- key habitat required for the maintenance of the identified threatened species
- topographical and drainage information
- ground-water and surface-water dependent ecosystems, as well as areas potentially sensitive to 'upstream' hydrological changes
- survey sites, transects, etc, used during the biodiversity investigations
- key threatening processes (where geospatial information can be generated)
- environmentally sensitive areas (ESA's)
- formal and informal reserves, old growth forest and fauna habitat zones (FHZ's).

Opportunities may exist to share datasets between Worsley and the State, to establish a clearer understanding of the conservation value of the forest in the wider area.

5. THREATENING PROCESSES AND CLIMATE CHANGE

The biodiversity-related investigations will identify and assess key threatening processes within the Worsley study area. A number of key threatening processes that have the potential to affect biodiversity within the new mining areas have been identified as follows:

- the spread of forest disease (specifically by pathogens such as *Phytophthora cinnamomi* and *Armillaria luteobubalina*)
- the spread of weeds and introduced flora
- feral animals
- habitat fragmentation (particularly in the southern mining envelopes of East Quindanning and Morgans)
- inappropriate fire regimes
- mining activities
- other human impacts (including bee-keeping, logging etc.).

5.1.1 Objectives

The objectives of the investigations into key threatening processes that potentially affect biodiversity within Worsley's new mining envelopes are:

1. To assess the relative and cumulative impacts on biodiversity values of the following:
 - 1.1 forest disease (after *Condition 719:M8-1(6)*)
 - 1.2 weed and pest severity status (including feral animals) (after *Condition 719:M8-1(13)*)
 - 1.3 habitat fragmentation
 - 1.4 fire
 - 1.5 mining activities, and other human impacts (including bee-keeping, logging etc.).
2. To assess the impacts on biodiversity values of:
 - 2.1 climate change (after *Condition 719:M8-1(14)*).

5.1.2 Proposed investigations

Desktop analysis and baseline field surveys

Information for each of the identified threatening processes will be reviewed and collected as part of the individual investigations (hydrology, landform, flora and vegetation, fauna investigations). Relevant information will be reviewed during the desktop component of the investigations and detailed field programs will be established as part of the targeted field work.

5.1.3 Assessing the effects of threatening processes

Consideration of the relative and cumulative impacts of threatening processes on biodiversity values within the study area is important to provide some context for assessing the impacts and mitigation of Worsley's mining operations. Identifying and understanding the above threatening processes will facilitate the development of measures to assist management or adaptation of mining activities to counter their influence.

Assessing the impacts of threatening processes and climate change will include the following:

1. The extent of forest disease and weeds will be mapped within the State Forest and the relationship between these factors and the range of species, vegetation communities, landforms, soils and site conditions will be investigated. An assessment will be made regarding the potential for the spread of diseases and weeds, with and without Worsley's mining activities. The conservation status for each of the vegetation units mapped in relation to identified threats of forest disease and weeds (e.g. how many of the units of vegetation identified are infected or susceptible to forest disease such as dieback etc.) will be determined. Similarly, the distribution of significant taxa in those areas mapped as infected or susceptible to forest disease and/or weeds will be identified.

Modelling packages (such as BIOCLIM and CLIMEX) may be utilised to examine the potential for the spread and/or contraction of relevant exotic and native plant species.

The areas to be assessed to map the effect of forest disease (specifically by pathogens such as *Phytophthora cinnamomi* and *Armillaria luteobubalina*) and weeds within the State Forest will be developed and reviewed annually in consultation with the EMLG.

2. The effect of introduced fauna species (pests) will be qualitatively assessed as part of the fauna investigations by defining the patterns of distribution of introduced species and determining which fauna taxa are at most risk from the introduced species (through predation, competition for habitat). This may include some dietary sampling of introduced carnivores, on an opportunistic basis. The investigations into the introduced fauna species will also consider whether relationships exist between the introduced fauna species and the range of habitat type(s), as well as whether other threatening processes (such as clearing) and climate change increases or decreases this risk.

A list that identifies which introduced species (pests) are to be studied as part of the fauna investigations, and the methodology used to investigate them will be developed and reviewed annually in consultation with the EMLG.

3. The effect of the existing fire regime on the identified flora and vegetation values, and fauna values within the new mining envelopes will be investigated. This investigation will aim to increase the overall awareness of the impacts fire may have on biodiversity values in these areas. The effect of Worsley's proposed mining activities on the fire regime will also be assessed.

The investigations into the effect of fire on the flora and vegetation values, and the fauna values within the new mining envelopes will be undertaken in consultation with officers from DEC.

4. The potential for fragmentation of habitat (particularly in relation to the relevant threatened species identified within the study area) as a result of the proposed mining and bauxite transport activities, and as a result of the other key threatening processes mentioned herein, will also be assessed.
5. The review of the potential impact of the proposed mining activities (including bauxite transport and other mining-related activities) will be a central issue for discussion in the future *Biodiversity-related Investigations Report*, *Bauxite Mining Plan* and *Transport Corridor Route Plan* (see Section 1.3), and is one of the main contextual issues for the study of all of these

biodiversity-related investigations. Nevertheless, for the purposes of this section, mining-related activities will also be assessed as a potential key threatening process *per se*, in the local and regional context.

6. Other human impacts (including bee-keeping, logging, recreational activities, etc.) will also be assessed for their potential as threatening processes on the biodiversity values within the study area (particularly in relation to the key biodiversity values identified).

These assessments will also take into consideration how the key threatening processes may be operating in concert (e.g. the spread of dieback by feral pigs), or otherwise occurring simultaneously.

The effect of climate change will also be investigated by determining whether there are any long term trends in changes to flora and vegetation values and fauna values within the new mining envelopes. Predictive modelling may be undertaken to identify potential effects, with confirmation through the long-term monitoring program (see Section 8).

6. TARGETED FIELD WORK PROGRAMS

The results of the characterisation studies will be used to design a program of complimentary targeted field investigations to further define significant biodiversity values and key biodiversity areas within the new mining envelopes. Annual work programs will be developed based on the outcomes of the previous biodiversity investigations and will be subject to review by the EMLG (Section 9).

Field methodologies will be compatible with previous and ongoing local and/or regional studies to ensure that information can be analysed in the regional context and that it will be relevant and applicable for use by other interested stakeholders.

6.1.1 Key considerations in the targeted field work programs

The targeted field work programs will be designed to build on the information obtained from the characterisation studies. The programs will focus on refining the biodiversity values within the new mining envelopes and bauxite transport corridors and will include:

- more detailed characterisation of the areas within the new mining envelopes that support identified significant flora or fauna species, or are areas of specific biodiversity interest (e.g. identified as potentially important for ecological linkage purposes or important for fauna habitat purposes). This may include special studies, such as the evaluation of the fungal component of the ecosystem
- further targeted studies to locate the occurrence of, and identify patterns of distribution of significant flora and fauna species, Priority and threatened species (including the EPBC Act listed threatened species that are required to be studied under the Commonwealth Approval; see Section 7.1), keystone species and species at their range extensions
- further assessment of the impact that threatening processes may have on key biodiversity values (both within and outside new mining envelopes) as well as assessing the impact of climate change.

Field surveys will be undertaken through the three work streams (flora and vegetation, fauna and fauna habitat, and landform and hydrology) at appropriate times throughout the year¹⁸. Relevant information collected will be assimilated and used to guide continuing investigations.

6.1.2 Development of targeted field work programs

The targeted field work programs will be developed on an annual basis incorporating feedback received from the EMLG and other stakeholders (as necessary) on the previous year's work program and survey results (as described in Section 9). The following information will be taken into consideration in developing the annual targeted field work programs:

- the findings from desktop and baseline field surveys (both as part of these biodiversity-related investigations and other relevant investigations in adjacent or similar areas) and the results of the previous year(s) targeted field surveys

¹⁸ Worsley will establish a liaison contact with DEC Perth Hills District to ensure information regarding relevant DEC operational activities (e.g. such as prescribed burning) is available and provided to individuals conducting field surveys as necessary.

- advice from key Government agencies regarding field methodologies, changes in Government policy and/or policy interpretation and key areas of interest.

The targeted field work programs will be developed to define and assess significant biodiversity values in the study area in relation to the factors that influence them and also to determine key ecosystem functions and drivers.

The following principles will be used to guide the process of planning for targeted field work programs in the study area:

1. Determining the key drivers of ecosystem function and processes to enable suitable monitoring parameters and criteria to be developed.
2. Identifying and understanding patterns of biodiversity across environmental gradients to help identify functional ecological linkages.
3. Identifying key threatening processes to help determine the cumulative impacts affecting biodiversity values.
4. Determining the key biodiversity values to be protected within the study area will be a priority.

6.1.3 Identification of key biodiversity values to be protected

The results of the targeted field work programs will enable Worsley to identify key biodiversity values (as defined by *Ministerial Condition 719:M9-1* and *Condition 719:M9-2*) within the new mining envelopes and/or in areas that may be disturbed for the proposed bauxite transport corridors. These key biodiversity values may include:

1. vegetation complexes which have less than 30 % of their pre-European extent remaining
2. Threatened Ecological Communities
3. heathland or granite outcrops
4. other naturally rare or restricted floristic communities, vegetation or ecological communities¹⁹
5. key ecological linkages²⁰
6. Declared Rare or Priority Flora
7. significant areas of habitat for Threatened, Priority listed or other significant fauna including significant Short Range Endemic fauna and other significant invertebrate taxa
8. stream zones or groundwater-dependent ecosystems.

The targeted field work programs will also focus on investigating further any key threatening processes that may be affecting the identified significant biodiversity values. This will enable

¹⁹ As defined by *EPA Guidance Statement No. 51* (EPA 2004a).

²⁰ As defined in Section 4.4 of this document.

Worsley to gain a greater understanding of the factors affecting the ecology and function of the natural areas within the study area. It will also assist in selecting appropriate long term monitoring parameters and systems across the study area to determine the potential impacts that mining activities may have on key biodiversity factors within the study area.

7. MATTERS OF NATIONAL ENVIRONMENTAL SIGNIFICANCE

7.1 REQUIREMENT OF COMMONWEALTH APPROVAL

Clause 1 of Worsley's Commonwealth Approval requires that the Scope details the survey methodology for investigating the following matters in each mining 'pod' and transport corridor:

- (a) the occurrence and extent of flora species listed under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act),
- (b) the identification and spatial extent of habitat for EPBC Act listed fauna species.

This must include investigations for but not necessarily be limited to the following:

- EPBC Act listed Flora:
 - Cossack Spider Orchid (*Caladenia dorrienii*)
 - Narrogin Pea (*Pultenaea pauciflora*)
 - Shy Featherflower (*Verticordia fimbriilepis*)
 - Slender Tailflower (*Anthocercis gracilis*)
- EPBC Act listed Fauna:
 - Carnaby's Black Cockatoo (*Calyptorhynchus litoralis*)
 - Baudin's Black Cockatoo (*Calyptorhynchus baudinii*)
 - Chuditch (*Dasyurus geoffroii*)
 - Red-tailed Phascogale (*Phascogale calura*).

Significant impacts to such species are considered Matters of National Environmental Significance.

7.2 EPBC ACT LISTED THREATENED FLORA

7.2.1 Expected occurrence

Two of the EPBC Act listed Threatened Flora species, *Verticordia fimbriilepis* subsp. *fimbriilepis* and *Anthocercis gracilis*, have been recorded in the past within the Central mining envelope. *Verticordia fimbriilepis* subsp. *fimbriilepis* has also been recorded in the general area between the Central and Brookton mine envelopes. The other two EPBC Act listed Threatened Flora species, *Caladenia dorrienii* and *Pultenaea pauciflora*, have not been recorded in the past within the Brookton or Central mining envelopes, or within the vicinity of the proposed adjoining bauxite transport corridors. However, both *C. dorrienii* and *P. pauciflora* have been recorded elsewhere within the Mining Lease (within 1.5 – 4.0 km of the Brookton and East Quindanning mine envelopes, respectively) and, as such, have the potential to occur within the proposed mine envelopes as well.

None of these species are considered likely to occur in the southern mining envelopes (Hotham North Extension, Morgans and East Quindanning). The DEW Protected Matters Search Tool, and State Department of Environment and Conservation (DEC) and Western Australian Herbarium (WAH)

databases also indicated no known occurrences of EPBC Act listed Threatened Flora species in the three southern mining envelopes.

7.2.2 Additional searches proposed

Notwithstanding the above, it is possible that some new occurrences of EPBC Act listed Threatened Flora may be recorded within areas proposed to be disturbed and/or within the wider study areas for the baseline flora investigations (Section 4.2.4). Identifying additional populations of all of these (and other) rare species within the mining envelopes (and the proposed adjoining transport corridors) will be a component of the baseline flora / vegetation investigations.

The flora and vegetation investigations proposed in Section 4.2 are considered sufficiently comprehensive and of such design as to identify significant populations of such rare flora, if additional populations exist. In addition, the identification of key ecological linkages (e.g. those required for the preservation of any threatened species), as proposed in Section 4.4, will also draw on the baseline flora investigations, particularly in relation to threatened species. Refer to Sections 4.2 and 4.4 for more detailed information.

7.3 EPBC ACT LISTED THREATENED FAUNA

7.3.1 Expected occurrence

Carnaby's Black Cockatoo (*Calyptorhynchus litoralis*), Baudin's Black Cockatoo (*Calyptorhynchus baudinii*), and Chuditch (*Dasyurus geoffroyi*) have all been recorded in the past within the forested Brookton and Central mining envelopes. Although not recorded to date, the Red-tailed Phascogale (*Phascogale calura*) is also very likely to occur.

7.3.2 Additional searches proposed

The fauna investigations proposed in Section 4.3 are considered sufficiently comprehensive and of such design as to establish the presence and range of these species and their required breeding, roosting and/or foraging habitats.

The quarterly bird surveys, one of which will coincide with the Cockatoo breeding season, will be sufficient for the Baudin's Black Cockatoo and Carnaby's Black Cockatoo studies (Section 4.3.4).

The mammal studies proposed, including those proposed specifically for CWR mammals (which includes the Red-tailed Phascogale and Chuditch), will examine presence, range and patterns in populations of the Chuditch and Red-tailed Phascogale (Section 4.3.4).

In addition, the identification of key ecological linkages (e.g. including those required for the preservation of any threatened species), as proposed in Section 4.4, will also draw on the baseline fauna investigations, particularly in relation to threatened species. Refer to Sections 4.3 and 4.4 for more detailed information.

8. LONG TERM MONITORING PROGRAMS AND ESTABLISHMENT OF INDICATORS OF CHANGE IN BIODIVERSITY

Monitoring programs will be developed to evaluate the long-term retention of key biodiversity values within the study area and to confirm their protection from Worsley's operations. The *Biodiversity-related Investigations Report* will describe any indicators, parameters or criteria to be used in measuring retention of identified values and in ongoing monitoring (Condition 8-6(3) of Ministerial Statement 719). Monitoring programs will also address climate change within the study area.

This Scope outlines the framework that will be used to establish these monitoring programs and determine indicators of change in selected biodiversity-related parameters.

8.1.1 Objectives of long-term monitoring

The main objectives are to identify suitable indicators, parameters or criteria to be used in measuring maintenance of the key biodiversity values identified, and ongoing monitoring requirements. Long-term monitoring will also assess the effects of climate change.

The ongoing review and analysis of the results from the monitoring programs will be used to inform the ongoing review of biodiversity management, including rehabilitation prescriptions, thus providing the basis for adaptive management.

8.1.2 Key components of the monitoring programs

Design of monitoring programs

The design of the long-term monitoring programs will be developed in consultation with the EMLG, and will be fundamentally based on a field program, but may also include some additional information derived from remote-sensing techniques (e.g. digital aerial photography), if costs and logistics are not too prohibitive.

Long-term monitoring sites

The selection of suitable locations for the long-term monitoring sites (including controls) will be undertaken in consultation with the EMLG. Permanent control sites will be established in areas that will not be disturbed by mining-related activities (e.g. possibly outside of the mining envelopes themselves).

Key monitoring parameters

Various parameters (and methodologies) of the long-term monitoring programs are likely to differ from those used during the baseline biodiversity-related investigations, by virtue of differences in the respective timeframes and parameters of interest. For example, the flora monitoring quadrats proposed to be used (and re-used) are more likely to be similar in design to the current forest and rehabilitation monitoring plots at Worsley's existing Saddleback operations, for greater detail and comparative purposes.

The number and location of the monitoring sites and the specific botanical, zoological and hydrological monitoring parameters will be developed and presented in the *Biodiversity-related Investigations Report*. However, the monitoring program will focus on the following parameters:

1. Relevant parameters for the key biodiversity values
2. Changes in the distribution of forest disease and weeds
3. Changes in the occurrence of pest species
4. Groundwater²¹ standing water levels and quality, and stream levels/flows and quality
5. Vegetation health and condition, which may include the use of remote sensing techniques (e.g. LANDSAT, digital aerial photography, etc) and/or modern leaf reflectance techniques)
6. Relevant bio-indicators, which will be developed specifically for both faunal and botanical values, covering species with a range of attributes, such as life histories and habitat specificity. In identifying the bio-indicators, their suitability for assessing the following factors will be considered:
 - direct and indirect impacts of mining
 - impacts of key threatening processes
 - effects of climate change
 - rehabilitation success.

Worsley will consult with the EMLG during the process of identifying relevant monitoring parameters.

8.1.3 Evaluating the effects of climate change over time

Potential effects of climate change will be specifically investigated through the identification of relevant long-term trends in the meteorological and hydrological data, primarily in conjunction with the identification of long-term trends in the relevant flora and fauna indicator species (e.g. within surface- and groundwater-dependent ecosystems), and/or other key flora and fauna monitoring parameters.

Particular focus will be given to whether range extensions or contractions of particular species and communities (including changes in distribution and representation) are potentially resulting from changes in climatic conditions. It may be possible to access historical vegetation survey records for the Jarrah Forest, to assess changes over the longer-term. If use of such data is possible, and historical plots are able to be re-established as permanent monitoring plots, this could significantly increase the period over which the analyses of changes in the local vegetation could be undertaken. This may be a useful tool for predicting longer term changes in relation to climate change.

The selection process of identifying suitable sites to assess the potential effects of climate change will be developed and reviewed annually in consultation with the EMLG.

²¹ Groundwater monitoring program to be established if any groundwater dependent ecosystems are found during hydrological and landform investigations (Section 4.1.2)

9. FRAMEWORK FOR GOVERNMENT REVIEW AND OTHER PARTNERSHIPS

This draft *Scope of Biodiversity-related Investigations* sets out the framework to describe the overall approach to the biodiversity-related investigations. It lists those parameters that will be investigated as part of these studies (as required by *Ministerial Condition 719:M8-1*) and it describes the framework for developing the annual targeted field programs and monitoring programs so that the *Biodiversity-related Investigations Report* can address the following (from *Ministerial Condition 719:M8-6*):

- key biodiversity values to be protected
- indicators, parameters or criteria to be used in measuring retention of the key biodiversity values identified, and long term monitoring requirements
- the outcomes and findings for each of the matters investigated (including those matters identified in *Ministerial Condition 719:M8-1*)
- surveyed plans detailing the ecological linkages and the proposed areas of zero disturbance
- the proposed areas of zero disturbance
- defined buffer areas around ecological linkages and areas of zero disturbance.

Detailed field methodologies for the first year of investigations will be developed and described in Scopes of Works as part of the desktop review stage.

The results of the investigations will be reviewed and interpreted after each field season and the findings will be included in Worsley's Annual Environmental Report which is submitted to the EMLG in September.

9.1.1 Government agency review

The *Biodiversity-related Investigations Report* will be submitted to the Minister for the Environment for endorsement following completion of the investigations and prior to the lodgement of the draft Bauxite Mine Plan and the commencement of ground-disturbing activities relating to construction or mining (*Ministerial Condition 719:M8-6*). However, Worsley considers that it would be of value to involve key government agencies (as represented on the EMLG) in the technical review of the results during the biodiversity-related studies rather than being limited to just reviewing the final report.

Therefore, Worsley will present the findings to the EMLG and other stakeholders (as necessary) at an annual workshop. The workshop will provide the opportunity for stakeholders to discuss the results of the studies to-date, and for the group to review the Scopes of Work that have been used for that year. It is expected that this annual forum will provide sufficient feedback to Worsley to inform the development of scopes for the following year's work and thereby ensure that the fieldwork remains focussed on meeting the objectives of this Scope.

This government agency review mechanism will commence after the revised *Scope of Biodiversity-related Investigations* has been submitted to the Minister for endorsement. The first review is therefore expected to be held in 2008, prior to the commencement of the biodiversity-related investigations that are scheduled for the 2008/09 period.

It will enable key government agencies, as represented on the EMLG, to provide technical advice and feedback into the biodiversity-related investigations process on a continual basis and will provide a mechanism for addressing any proposed changes in the biodiversity-related investigations that are considered necessary as a result of the findings obtained in previous investigations.

9.1.2 Other partnerships

As part of these biodiversity-related investigations, opportunities may arise for Worsley to develop working partnerships to undertake collaborative studies with other organisations, companies, environmental groups, research institutions or government agencies.

Whilst outside the requirements of Ministerial Statement 719, establishing partnerships with key bodies or organisations may facilitate the collection and interpretation of regional environmental information that could be beneficial to the wider community or other stakeholders.

Through the implementation of these biodiversity-related investigations, Worsley will identify key partnership opportunities and establish collaborative study programs where appropriate to investigate further matters of regional significance.

10. REFERENCES

- Australian Bureau of Statistics, (June 2006) (preliminary data)
<http://www.abs.gov.au/ausstats/abs@.nsf/7d12b0f6763c78caca257061001cc588/797f86dbd192b8f8ca2568a9001393cd!OpenDocument> Webpage accessed 19 March 2007
- Bamford M.J., Wilcox J.A. and Davis R.A. (2004) *Worsley Alumina Extension area: northern mining envelopes. Preliminary fauna assessment*. Unpublished report prepared for Worsley Alumina Pty Ltd. December 2004.
- Beard J. S. (1981) *Swan – The Vegetation of the Swan Area*. University of Western Australia Press. Crawley, Perth.
- Bennett Environmental Consulting Pty Ltd (2004) *Vegetation and Flora Survey of Mining Lease ML258SA*. Unpublished report prepared for Worsley Alumina Pty Ltd. December 2004.
- Conservation Commission of Western Australia (2004) *Forest Management Plan 2004 – 2013*. Published report.
- Ecologia Environmental Consultants (1994) *Central wandoo woodlands: botanical survey*. Unpublished report for the Australian Heritage Commission; Heritage Council of Western Australia.
- Environmental Protection Authority (EPA) (2004a) *Guidance Statement No. 51: Guidance for the assessment of environmental factors – Terrestrial flora and vegetation surveys for environmental impact assessment in Western Australia*. Perth, Western Australia.
- Environmental Protection Authority (EPA) (2004b) *Guidance Statement No. 56: Guidance for the assessment of environmental factors: Terrestrial fauna surveys for environmental impact assessment in Western Australia*. Environmental Protection Authority, Perth, Western Australia.
- Environmental Protection Authority (EPA) (2003) *EPA Bulletin 1108 Greater Bunbury Region Scheme Appendix 4: Greater Bunbury Region – Ecological Linkages Plan*. A report and recommendations of the Environmental Protection Authority. September 2003
- Government of Western Australia (2000) *Bush Forever Volume 2: Directory of Bush Forever Sites*. Department of Environmental Protection. December 2000.
- Havel (2000) *Ecology of the forests of south western Australia in relation to climate and landforms*. Ph.D Thesis, Murdoch University, Western Australia.
- Havel, J.J. (1975), *Site-vegetation Mapping in the Northern Jarrah Forest (Darling Range)*. I. Definition of Site-vegetation Types, Bulletin **86** Forests Department Perth.
- Hedde E.M., Loneragan O.W. and Havel J.J. (1980) *Vegetation of the Darling System*. In: *Atlas of Natural Resources, Darling System, Western Australia*. Department of Conservation and Environment. Perth Western Australia.
- Keighery, B.J. (1994) *Bushland Plant Survey: a Guide to Plant Community Surveys for the Community*. Wildflower Society of Western Australia (Inc.), Nedlands, Western Australia

- Mattiske Consulting Pty Ltd. (1999a) *Flora and Vegetation of the Quindanning Timber Reserve*. Unpublished report for Worsley Alumina Pty Ltd.
- Mattiske Consulting Pty Ltd (1999b) *Flora and Vegetation Survey of the Collie Refinery Lease Area*, Unpublished report prepared for Worsley Alumina Pty Ltd, July 1999.
- Mattiske, E.M. & Associates (1993) *Monitoring the Effects of Ground-water Extraction on Native Vegetation on the Jandakot Mound*, Perth 1992, Report prepared for the Water Authority of Western Australia.
- Mattiske E.M. and Havel J.J. (1998) *Regional Forest Agreement Vegetation Complexes Pinjarra Western Australia*. Department of Conservation and Land Management.
- Ninox Wildlife Consulting (1997) *A Vertebrate Fauna Survey of the Proposed Northern Saddleback Mining Area 1996-1997*, Unpublished report prepared for Worsley Alumina Pty Ltd.
- Ninox Wildlife Consulting (1998) *A Vertebrate Fauna Survey of the Proposed Southern Saddleback Mining Area 1997-1998*, Unpublished report prepared for Worsley Alumina Pty Ltd.
- Ninox Wildlife Consulting (2002) *Baseline Studies of the Quindanning Timber Reserve*, Unpublished report prepared for Worsley Alumina Pty Ltd.
- Strategen (2005) *Environmental Review and Management Programme*. Worsley Alumina Pty Ltd. Bauxite-Alumina Project Expansion. June 2005. Leederville, Western Australia.
- Thackway R. and Cresswell I. D. (1995) *An interim biogeographic regionalisation for Australia: a framework for setting priorities in the National Reserves System Cooperative Program, Version 4.0*. Australian Nature Conservation Agency, Canberra.
- Worsley (2006) *Environmental Management of the Worsley Alumina Project. Bauxite/Alumina Operation*. Annual Environmental Report. July 2005 – June 2006. Western Australia
- Worsley Alumina Pty Ltd (1985) *Worsley Alumina Project Flora and Fauna Studies, Phase Two*, Worsley Alumina Pty Ltd, Perth.
- Worsley Alumina Pty Ltd & Dames and Moore (1981) *Worsley Alumina Project Flora and Fauna Studies, Phase One*, Worsley Alumina Pty Ltd, Perth.

Appendix 1
Ministerial Statement No 719



Hon Mark McGowan MLA
Minister for the Environment;
Racing and Gaming

Statement No.

000713

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

**WORSLEY ALUMINA – PRODUCTION TO MAXIMUM CAPACITY OF 4.4MTPA
ALUMINA AND ASSOCIATED MINING**

**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 alumina 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 Numbers: 984, 1526

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

Reports of the Environmental Protection Authority: Bulletins 823, 1209

The conditions and procedures of this statement supersede those conditions and procedures of statement 423 in accordance with section 45B of the *Environmental Protection Act 1986*.

**A. REVISED PROPOSAL: REPORTS OF THE ENVIRONMENTAL
PROTECTION AUTHORITY - BULLETINS 823 AND 1209.**

The revised proposal to which the Reports of the Environmental Protection Authority – Bulletins 823 and 1209 relate may be implemented by the proponent subject to the following conditions and procedures that apply to all mining, construction and operation within and outside the Primary Bauxite Area:

Published on:

13 APR 2006

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 within 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 shall include the following:

1. an audit table, which lists the implementation 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
2. details of any criteria and/or standards that will be used to measure compliance, and the rationale for their use.

5-2 The proponent shall submit compliance reports in accordance with the audit program approved by the Department of Environment and the compliance monitoring guidelines, and shall:

1. describe, or update, the status of implementation of the proposal;
2. provide verifiable evidence of compliance with the conditions, procedures and commitments;
3. review the effectiveness of corrective and preventative actions contained in the environmental management plans and programs;
4. provide verifiable evidence of the fulfilment of requirements specified in the environmental management plans and programs;
5. identify all confirmed non-conformities and non-compliances and describe the related corrective and preventative actions taken; and
6. identify potential non-conformities and non-compliances and provide evidence of how these are being assessed for corrective action

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.

5-3 The proponent shall submit a performance review report every five years following the formal authority issued to the decision-making authorities under section 45(7) of the *Environmental Protection Act 1986*, 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 objectives for those issues; the methodologies used to achieve these; and the key indicators of environmental performance measured against those objectives;
 2. the level of progress in the achievement of sound environmental performance, including industry benchmarking, and the use of best practicable measures available;
 3. significant improvements gained in environmental management, including the use of external peer reviews;
 4. stakeholder and community consultation about environmental performance and the outcomes of that consultation, including a report of any on-going concerns being expressed; and
 5. the proposed environmental objectives over the next five years, including improvements in technology and management processes.
- 5-4 The proponent may submit a report prepared by an independent auditor to the Chief Executive Officer of the Department of Environment on each condition or commitment of this statement which requires the preparation of a management plan, programme, strategy or system, stating whether the requirements of each condition or commitment have been fulfilled within the timeframe stated within each condition or commitment.

6 Greenhouse Gas Abatement

- 6-1 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;

Note: 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.
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.
- 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 Decommissioning

- 7-1 Within twelve months following the commencement of construction, the proponent shall prepare a Preliminary Decommissioning Plan to the requirements of the Minister for the Environment on advice of the Environmental Protection Authority.

The Preliminary Decommissioning Plan shall provide the framework to ensure that the site is left in an environmentally acceptable condition.

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.
- 7-2 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 to the requirements of the Minister for the Environment on advice of the Environmental Protection Authority.

The objective of the Final Decommissioning Plan is to ensure that the site is left in an environmentally acceptable condition.

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.

- 7-3 The proponent shall implement the Final Decommissioning Plan required by condition 7-2 until such time as the Minister for the Environment determines, on advice of the Environmental Protection Authority, that the proponent's decommissioning responsibilities are complete.
- 7-4 The proponent shall make the Final Decommissioning Plan required by condition 7-2 publicly available.

B. REVISED PROPOSAL: REPORT OF THE ENVIRONMENTAL PROTECTION AUTHORITY - BULLETIN 1209.

The revised proposal that relates to the Report of the Environmental Protection Authority - Bulletin 1209 may be implemented by the proponent subject to the following further conditions and procedures that apply to:

- 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; and
- construction of additional bauxite transport corridors outside of the Primary Bauxite Area.

8 Biodiversity-Related Investigations

- 8-1 The proponent shall prepare a draft Scope of Biodiversity-related Investigations document which encompasses those areas within the proposed new mining areas, shown in Figure 2 of schedule 1, and sufficient surrounding area to provide for information on regional context.

The draft Scope of Biodiversity-related Investigations shall 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 pursuant to the *Wildlife Conservation Act 1950* and other Priority Flora as identified in the database maintained by the Department of Conservation and Land Management;
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* 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;
 13. weed and pest severity status in State Forest; and
 14. impacts of climate change.
- 8-2 The proponent shall, within twelve months following the formal authority issued to the decision-making authorities under section 45(7) of the *Environmental Protection Act 1986*, submit the draft Scope of Biodiversity-related Investigations document required by condition 8-1 for review to:
1. the Department of Conservation and Land Management;
 2. the Conservation Commission of Western Australia;
 3. the Environmental Management Liaison Group (refer Procedure 5); and
 4. the Stakeholder Consultation Group (refer Procedure 6).
- 8-3 The proponent shall, within eighteen months following the formal authority issued to the decision-making authorities under section 45(7) of the *Environmental Protection Act 1986*, submit a revised Scope of Biodiversity-related Investigations document, taking into account all comments and recommendations (if any) received under condition 8-2, to the Minister for the Environment for endorsement on the advice of the Environmental Protection Authority, the Department of Conservation and Land Management and the Conservation Commission of Western Australia.
- 8-4 The proponent shall make the endorsed Scope of Biodiversity-related Investigations document referred to in condition 8-3 publicly available.
- 8-5 The proponent shall conduct biodiversity-related investigations in accordance with the endorsed Scope of Biodiversity-related Investigations document referred to in condition 8-3.

- 8-6 Prior to the lodgement of Bauxite Mining Plans (refer condition 11-1) and the commencement of ground-disturbing activities (including mining and transport corridor construction activities), the proponent shall prepare and submit a Biodiversity-related Investigations Report to the Minister for the Environment for endorsement on the advice of the Environmental Protection Authority, the Department of Conservation and Land Management and the Conservation Commission of Western Australia which details the results of biodiversity-related investigations conducted as required by condition 8-5.

The Biodiversity-related Investigations Report shall include the following:

1. written certification that the endorsed Scope of Biodiversity-related Investigations document is complete;
 2. key biodiversity values to be protected;
 3. indicators, parameters or criteria to be used in measuring maintenance of the key biodiversity values identified, and ongoing monitoring requirements;
 4. outcomes and findings for each of the matters investigated, including those matters identified in condition 6-3;
 5. surveyed plans detailing the ecological linkages and the proposed areas of zero disturbance;
 6. the proposed areas of zero disturbance; and
 7. defined buffer areas around ecological linkages and areas of zero disturbance.
- 8-7 The proponent shall make the Biodiversity-related Investigations Report required by condition 8-6 publicly available.

9 Protection of Biodiversity

- 9-1 The proponent shall not, unless otherwise approved by the Minister for the Environment on advice of the Environmental Protection Authority and the Department of Conservation and Land Management, 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 Regional Forest Agreement) which have less than 30% of their pre-European extent remaining;
 2. Threatened Ecological Communities (TECs) as identified in the Biodiversity-related Investigations Report;
 3. heathland as identified in the Biodiversity-related Investigations Report;
 4. granite outcrops as identified in the Biodiversity-related Investigations Report;
 5. other naturally rare or restricted floristic communities, vegetation or ecological communities and key ecological linkages identified in the Biodiversity-related Investigations Report;

6. Declared Rare Flora, unless the disturbance is approved under the *Wildlife Conservation Act 1950*;
 7. Significant populations of Priority Flora identified in the Biodiversity-related Investigations Report;
 8. significant areas of habitat for Threatened, Priority listed and other significant fauna, significant Short Range Endemic fauna, and other significant invertebrate taxa identified in the Biodiversity-related 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; and
 10. other important conservation values and habitats identified in the Biodiversity-related Investigations Report.
- 9-2 Without limiting condition 9-1, the proponent shall ensure that mining, transport corridor construction or 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 Report or lead to waterlogging of significant areas of dry land vegetation;
 2. any increase in severity status of weeds or pests (as identified in the Biodiversity-related Investigations Report) in State Forest;
 3. increased spread of forest disease outside areas identified as infected by the Biodiversity-related Investigations Report;
 4. placing any species or ecological community into a higher category of threat (consistent with the expectations of the Forest Management Plan 2004 - 2013); and
 5. causing disturbance in defined buffer areas around ecological linkage and areas of zero disturbance identified in the Biodiversity-related Investigations Report.

10 Transport Corridor Route Plans

- 10-1 Prior to the commencement of ground-disturbing activities (including mining and transport corridor construction activities) in any mining envelope (refer to Figure 2), the proponent shall prepare and submit a Transport Corridor Route Plan to the Minister for the Environment for endorsement on the advice of the Environmental Protection Authority and the Department of Conservation and Land Management.

The Transport Corridor Route Plan shall:

- 1 describe the route, area of disturbance and evaluation of alternative routes considered for each proposed transport corridor; and

- 2 describe how the selected transport corridor route complies with the requirements of the Biodiversity-related Investigations Report and is in accordance with condition 9.
- 10-2 The proponent shall implement and comply with the Transport Corridor Route Plan required by condition 10-1.
- 10-3 The proponent shall make the Transport Corridor Route Plan required by condition 10-1 publicly available.
- 10-4 The Minister for the Environment may initiate a review and/or amendment of the endorsed Rehabilitation Plan referred to in condition 10-1.

11 Bauxite Mining Plans

- 11-1 At least 12 months prior to ground disturbing activities, the proponent shall prepare and submit a draft Bauxite Mining Plan to the Department of Environment, the Department of Conservation and Land Management, the Conservation Commission of Western Australia, the Environmental Management Liaison Group and the Stakeholder Consultation Group for review.

The draft Bauxite Mining Plan shall:

1. incorporate the findings contained in the Biodiversity-Related Investigations Report;
 2. ensure that the areas for mining are consistent with the areas of zero disturbance, ecological linkages, and buffers identified in the Biodiversity-related 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 - 2013;
 3. set out the management and mitigation measures which will be undertaken to ensure that mining activities comply with conditions 9-1 and 9-2;
 4. set out monitoring and auditing to be conducted prior to, during and following mining activities;
 5. demonstrate how the proponent's implementation of the proposal protects the key biodiversity values identified in the Biodiversity-related Investigations Report and is in accordance with condition 9; and
 6. address the objectives of the Forest Management Plan 2004 - 2013.
- 11-2 The proponent shall revise and submit the draft Bauxite Mining Plan, taking into account all comments and recommendations (if any) received under condition 11-1, to an independent Environmental Auditor chosen by the proponent (refer to Procedure 7) for review.

- 11-3 The proponent shall submit its response to review comments received under 11-1 together with the revised draft Bauxite Mining Plan and the report prepared by the Environmental Auditor (refer procedure 7) to the Department of Conservation and Land Management and the Department of Environment for review.
- 11-4 The proponent shall prepare a Final Bauxite Mining Plan, taking into account all comments and recommendations (if any) received from the independent Environmental Auditor referred in condition 11-2 and additional comments received under condition 11-3.
- 11-5 Prior to the commencement of ground-disturbing activities, the proponent shall submit the Final Bauxite Mining Plan and the report prepared by the independent Environmental Auditor (refer Procedure 7) to the Department of Environment and the Department of Conservation and Land Management who may advise the Minister for the Environment of any remaining deficiencies within the Bauxite Mine Plan in which case ground disturbing activities shall not commence until the Minister has made a determination.
- 11-6 The proponent shall implement and comply with the Final Bauxite Mining Plan.
- 11-7 The proponent shall make the Final Bauxite Mining Plan publicly available.
- 11-8 The proponent may revise and amend the Final Bauxite Mining Plan subject to the amended Final Bauxite Mining Plan undergoing review and revision as specified in conditions 11-1, 11-2, 11-3, 11-4 and 11-5.
- 11-9 The Minister for the Environment may initiate a review and/or amendment of the Final Bauxite Mining Plan referred to in condition 11-6.
- 11-10 The proponent shall implement and comply with the amended Final Bauxite Mining Plan referred to in condition 11-6.
- 11-11 The proponent shall make the amended Final Bauxite Mining Plan referred to in condition 11-6 publicly available.

12 Rehabilitation

- 12-1 The proponent shall, within twelve months following the formal authority issued to the decision-making authorities under section 45(7) of the *Environmental Protection Act 1986*, prepare and submit a draft Rehabilitation Plan for review to:
1. the Department of Conservation and Land Management;
 2. the Conservation Commission of Western Australia;
 3. the Environmental Management Liaison Group (refer Procedure 5); and
 4. the Stakeholder Consultation Group (refer Procedure 6).

The objectives of the draft 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;
- planning and implementation of rehabilitation is carried out in a manner consistent with relevant objectives and strategies in the Forest Management Plan 2004 - 2013;
- rehabilitated native vegetation in State Forest areas will ultimately develop into sustainable ecological systems which 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, which at least maintains the extent of the existing native vegetation and enhances ecological connectivity; and
- the matters identified in the report entitled, '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 Rehabilitation Plan shall address the following topics which are relevant to long term sustainable rehabilitation:

1. objectives for rehabilitation, including site specific variation, and objectives of the Forest Management Plan 2004 - 2013;
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;
 - the return of key fauna habitat;
 - the translocation of mature specimens of long-lived species required for fauna habitat (eg. Xanthorrhoea and Macrozamia);
 - the recolonisation of invertebrate fauna; and
 - the 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 entitled, '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 areas 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.
- 12-2 The proponent shall, at least twelve months prior to commencement of ground disturbing activities (including mining and transport corridor construction), prepare and submit a final Rehabilitation Plan, taking into account all comments and recommendations (if any) received under condition 12-1, to the Minister for the Environment for endorsement on the advice of the Environmental Protection Authority and the Department of Conservation and Land Management.
- 12-3 The proponent shall implement and comply with the endorsed Rehabilitation Plan referred to in condition 12-2.
- 12-4 The proponent shall make the endorsed Rehabilitation Plan referred to in condition 12-2 publicly available.
- 12-5 The proponent shall review the endorsed Rehabilitation Plan annually and present its findings in an Annual Environmental Report submitted to the Department of Environment.
- 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.
- 12-6 The proponent may revise and amend the endorsed Rehabilitation Plan referred to in condition 12-2, in accordance with the review of condition 12-5 and subject to the amended Rehabilitation Plan undergoing review and revision as specified in conditions 12-1.
- 12-7 The Minister for the Environment may initiate a review and/or amendment of the endorsed Rehabilitation Plan referred to in condition 12-2.

- 12-8 The proponent shall submit the amended Rehabilitation Plan referred to in condition 12-6 to the Minister for the Environment for endorsement on the advice of the Environmental Protection Authority and the Department of Conservation and Land Management.
- 12-9 The proponent shall implement and comply with the endorsed amended Rehabilitation Plan referred to in condition 12-7.
- 12-10 The proponent shall make the endorsed amended Rehabilitation Plan referred to in condition 12-7 publicly available.

13 Water Supply Protection

- 13-1 Prior to the commencement of any ground disturbing activities in areas proclaimed as water reserves or catchment areas under the *Metropolitan Water Supply, Sewerage, and Drainage Act 1909* or under the *Country Areas Water Supply Act 1947*, the proponent shall prepare a Water Resource Management Plan to the requirements of the Minister for the Environment on advice of the Water and Rivers Commission and the Water Corporation.

The Water Resource Management Plan shall demonstrate that the ground disturbing activities shall have negligible impact on the quantity and quality of water supplies in the catchments.

- 13-2 The proponent shall implement and comply with the Water Resource Management Plan referred in condition 13-1.
- 13-3 The proponent shall make the Water Resource Management Plan referred in condition 13-1 publicly available.

14 Air Quality Management Plan

- 14-1 Prior to commencement of construction, the proponent shall prepare an Air Quality Management Plan to the requirements of the Minister for the Environment on advice of the Environmental Protection Authority.

The objective of the Air Quality Management Plan is 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.

The 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. the results of 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 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.
- 14-2 The proponent shall implement the Air Quality Management Plan required by condition 14-1.
- 14-3 The proponent shall make the Air Quality Management Plan required by condition 14-1 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 Environment for the preparation of written advice to the proponent.
2. Where a condition states that a report, plan or program will be submitted to the Minister for the Environment for endorsement on the advice of the Environmental Protection Authority and the Department of Conservation and Land Management, the proponent shall seek the advice of the Environmental Protection Authority and the Department of Conservation and Land Management and provide that advice to the Department of Environment. The Department of Environment will then provide notice of that advice, along with other relevant information, to the Minister for the Environment for consideration of endorsement of the document. The endorsed document will form part of the implementation conditions.
3. Where a condition states that a report, plan or program will be submitted to the Minister for the Environment for endorsement on the advice of the Department of Conservation and Land Management and the Conservation Commission of Western Australia it is expected that these two agencies would prepare a co-ordinated response.
4. 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.
5. 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.

6. 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 officers 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 which 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 (refer condition 8-2);
 - provide comment on draft Rehabilitation Plan and revisions and amendments (refer conditions 12-1 and 12-6);
 - provide comment on the draft Bauxite Mining Plan(s) and revisions and amendments (refer conditions 11-1 and 11-6).;
 - 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; and
 - review the proponent's environmental performance annually against its Bauxite Mining Plan(s) and Rehabilitation Plan.
7. The Stakeholder Consultation Group will comprise 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, including the Shire of Collie which have established research or related activities in or adjoining proposed new mining areas.

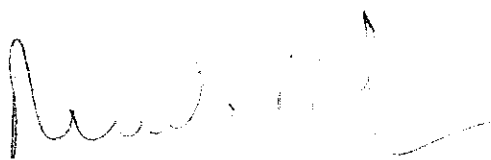
The Stakeholder Consultation Group will have the following functions:

- provide comment on the draft Scope of Biodiversity Investigations;
 - provide comment on the draft Rehabilitation Plan and revisions and amendments (refer conditions 12-1 and 12-6); and
 - provide comment on any draft Bauxite Mining Plan(s) and revisions and amendments (refer conditions 11-1 and 11-6).
8. The revised draft Bauxite Mining Plan will be reviewed by an independent accredited Environmental Auditor(s) (i.e. an individual currently certified/ accredited by RABQSA as a Lead Environmental Auditor or an individual currently certified as a Lead Environmental Auditor by an organisation accredited to ISI/IEC 17924 (by JAS-ANZ or a body recognised by JAS-ANZ) as follows:

- (a) within one month of the proponent submitting a revised draft Bauxite Mining Plan to it, the Environmental Protection Authority will provide the proponent with a list of names of five independent Environmental Auditors to whom the proponent may submit a revised draft Bauxite Mining Plan;
 - (b) within one month of receiving a revised draft Bauxite Mining Plan, the independent Environmental Auditor shall prepare a draft report on whether, in its opinion, the Plan will comply with condition 9 (Protection of Biodiversity). The draft report should be submitted to the proponent for the proponent's consideration; and
 - (c) within one month of receiving a revised draft Bauxite Mining Plan, the Environmental Auditor will prepare a final report on whether, in its opinion, the Plan will comply with condition 9 (Protection of Biodiversity).
9. The proponent should undergo consultation as established within condition 11 (Bauxite Mine Plans) prior to making any application to the Minister for the Environment under condition 9 (Protection of Biodiversity).

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".



HON MARK McGOWAN MLA
MINISTER FOR THE ENVIRONMENT;
RACING AND GAMING

13 APR 2006

Schedule 1

The Proposal (Assessment No. 1526)

Worsley Alumina Pty Ltd proposes to upgrade the Worsley alumina 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 13.2 Mtpa (dry) to approximately 16.5 Mtpa (dry). In the long term, mining is proposed to extend into additional areas to those currently approved. The proposal will result in ground disturbance and progressive rehabilitation of approximately an additional 100 hectares per annum, 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).

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 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 bauxite transport corridors that may contain conveyors (Figure 2):

- extension of the bauxite conveyor from Saddleback to Marradong and Hotham North mining envelopes;
- 34km extension of a bauxite transport corridor from the Hotham North mining envelope which will cross both the Albany Highway and the Wandering-North Bannister Road;
- 16km bauxite transport corridor from the south east of the Central mining envelope to the Luptons mining envelope; and
- 28km bauxite transport corridor 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

Element	Description
Bauxite-Alumina Project	
Alumina Production	4.4Mtpa.
Greenhouse gases	3.7Mtpa of CO _{2-e} .
Bauxite Mining¹	
Mining areas	Refer to Figures 1 & 2.
Mining rate	Up to 16.5Mtpa (dry).
Areas of disturbance to native vegetation: 1. Within Primary Bauxite Area (PBA) 2. Outside PBA (includes transport corridors)	1. Areas of bauxite reserves (unchanged) as specified in CER (1995) (refer Figure 2). 2. Up to 8,400 ha (refer Figure 2).
Water supply sources	Groundwater and surface water in the vicinity of mining areas.
Water usage (average)	500 ML/a on average
Crushing plant	4 primary crushers, 1 secondary crusher
Bauxite transport²	
Existing cable belt conveyor (location) Capacity Operation	Refer Figure 2 Increase to 3,200 tph Up to 140 hours per week (unchanged)
Extension of bauxite transport corridor within PBA from Saddleback to Hotham North Capacity Operation	Refer Figure 2 3500 tph Up to 140 hours per week
New transport corridor outside of PBA Preliminary alignment	Conventional idler-type conveyors and/or truck transport. Refer Figure 1
Refinery³	
Refinery lease area	2,500ha.
Operation	24 hours per day 365 days per year.
Digestion process area Emissions control	Regenerative thermal oxidiser
Calciners - fuel Particulate emission control	Natural gas Electrostatic precipitators on five calciners, baghouse system on one calciner
Liquor burner Emission control	Baghouse, regenerative thermal oxidiser and wet scrubber
Bauxite stockpiles	1.92 Mt approximately
Power and steam raising facilities	
Existing gas fired cogeneration - capacity	120 MW
Existing coal fired facility - capacity Particulate emission control	110 MW (electrical) Electrostatic precipitators on three boilers
New coal fired boiler – nominal capacity Emissions control	35 MW (electrical), 204 MW thermal Baghouse and sulphur dioxide scrubber
New gas fired cogeneration (alternative) ⁴ – capacity	120 MW
Bauxite Residue Disposal Areas	
Deposition rate Footprint and location	16Mtpa (wet) (no change to footprint of BRDA) Figure 3

Element	Description
Raw Water supply	
Sources	Freshwater lake (Augustus River) and offsite purchase from water provider as required
Usage (average)	2.6 GL (from Freshwater lake)
Air emissions	
Sulphur dioxide (SO ₂) from coal fired facilities	Up to 12,220tpa.
Nitrogen oxides (NO _x) from combustion, liquor burner and calciner sources	Up to 6,890tpa.
Particulates from combustion, liquor burner and calciner sources	Up to 520tpa.
Carbon monoxide (CO) from combustion, liquor burner and calciner sources	Up to 940tpa.
Total volatile organic compounds (VOCs) from all sources	Up to 270tpa.

Abbreviations

BRDA's	Bauxite residue disposal area	Mt	million tonnes
GL/a	1000 million litres per annum	Mtpa	million tones per annum
ha	hectares	tpa	tones per annum
ML/a	million litres per annum	tph	tones per hour
MW	million watts		

Definitions

¹ **Bauxite mining:** includes all mining operations and related activities such as exploration, development and operation of haul roads, crushers, material handling facilities, water supply, electricity supply and mining related infrastructure, and mine site maintenance (clearing of regrowth around minesite infrastructure, clearing and re-shaping of previously cleared rehabilitated areas)

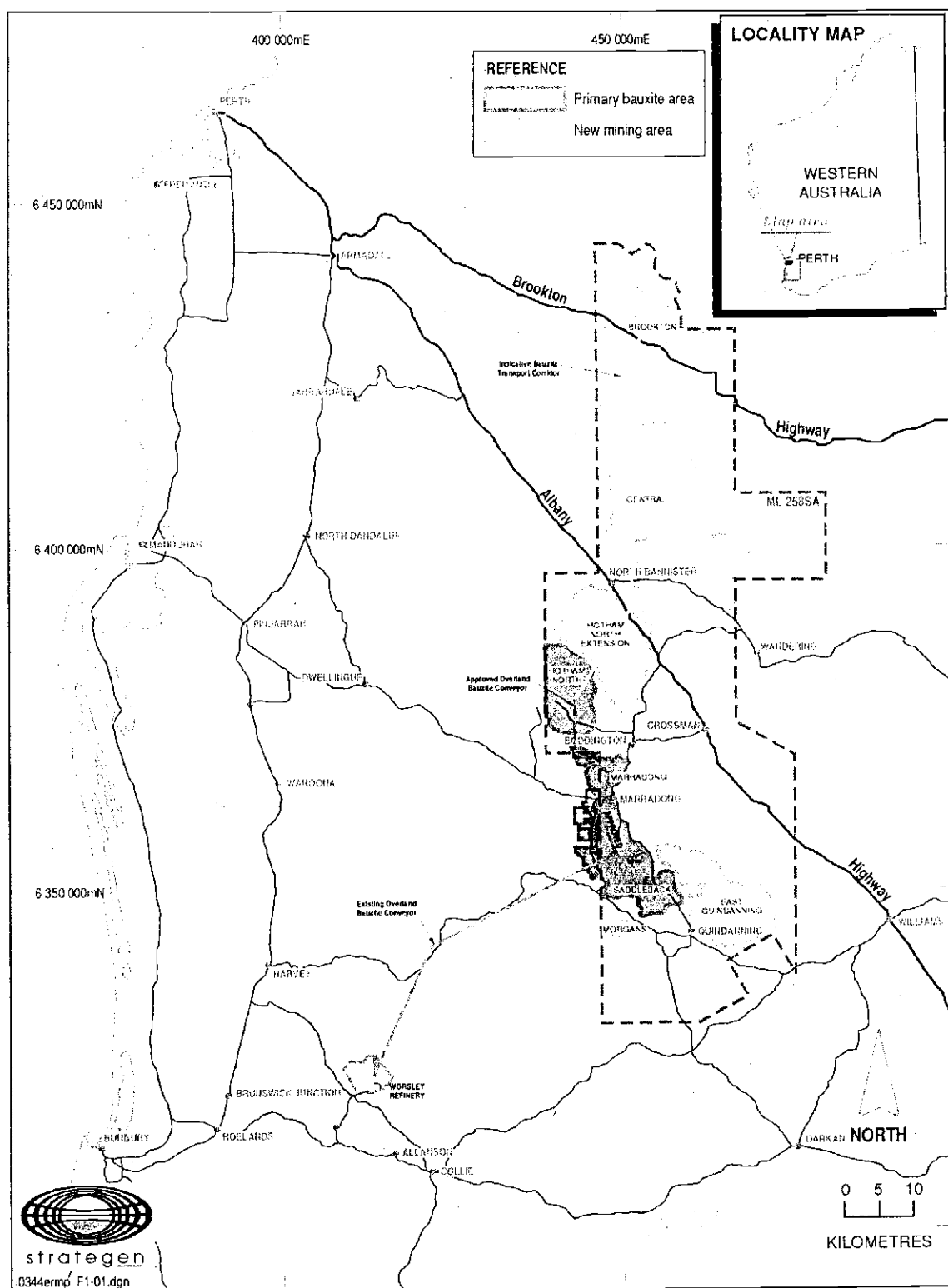
² **Bauxite transport:** includes construction of new overland bauxite conveyors (or other transport systems) from mining areas to the existing overland bauxite conveyor. Also includes transport corridor maintenance activities (clearing and removal of regrowth encroaching on corridor infrastructure, maintenance of corridor drainage system).

³ **Worsley Refinery:** includes maintenance of the Refinery Lease Area (clearing and removal of regrowth vegetation encroaching on infrastructure within Lease Area, clearing and stabilisation of previously cleared rehabilitated areas).

⁴ **New gas fired cogeneration:** alternative option to new coal fired boiler.

⁵ **Mining activities:** include all mining operations and related activities such as haul roads, crushers, material handling, water supply, electricity supply and mining related infrastructure.

⁶ **Transport Corridor Construction:** includes construction of new overland bauxite conveyors or other transportation systems from mining areas to the existing overland bauxite conveyor, refinery facility.



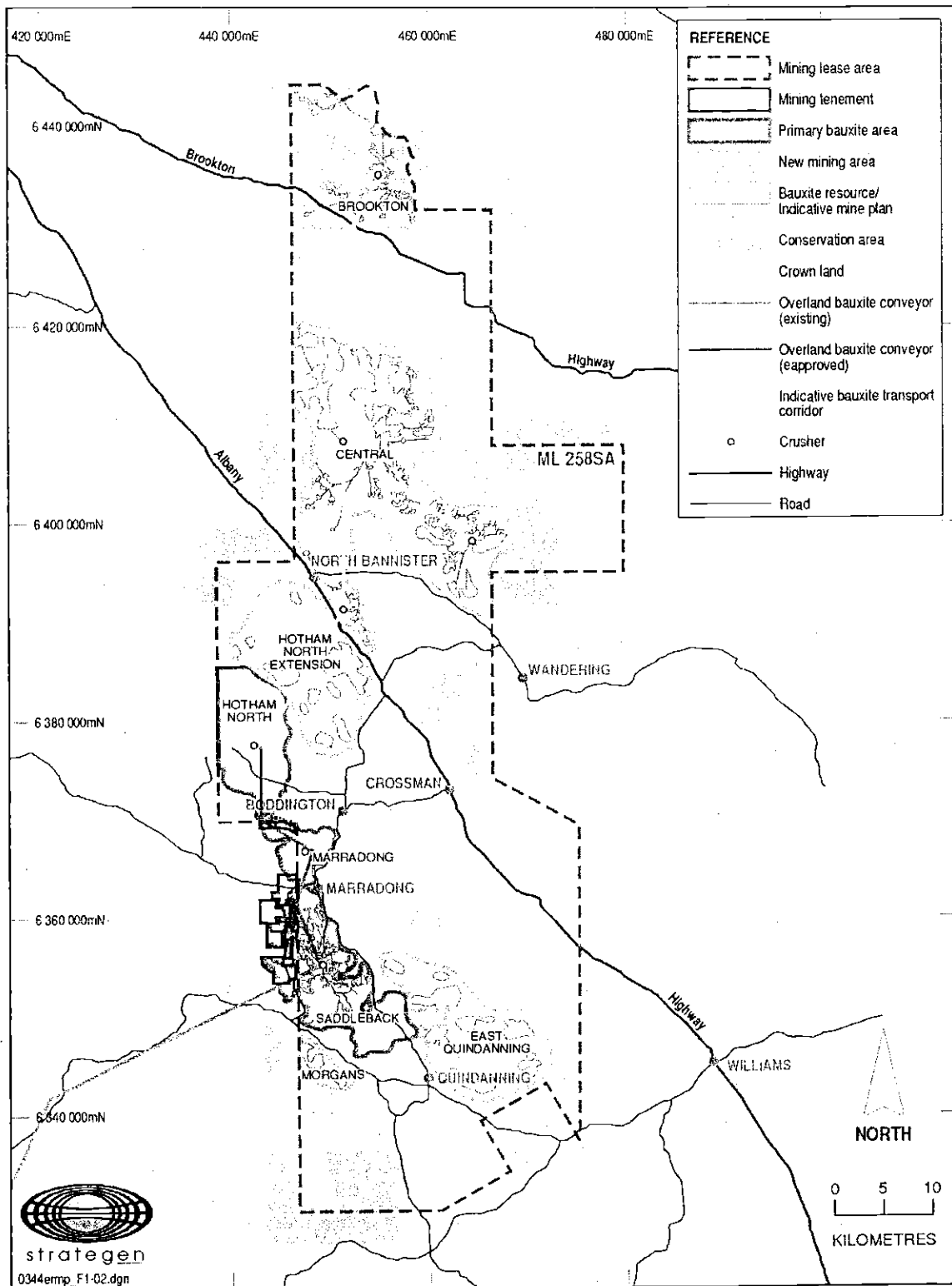
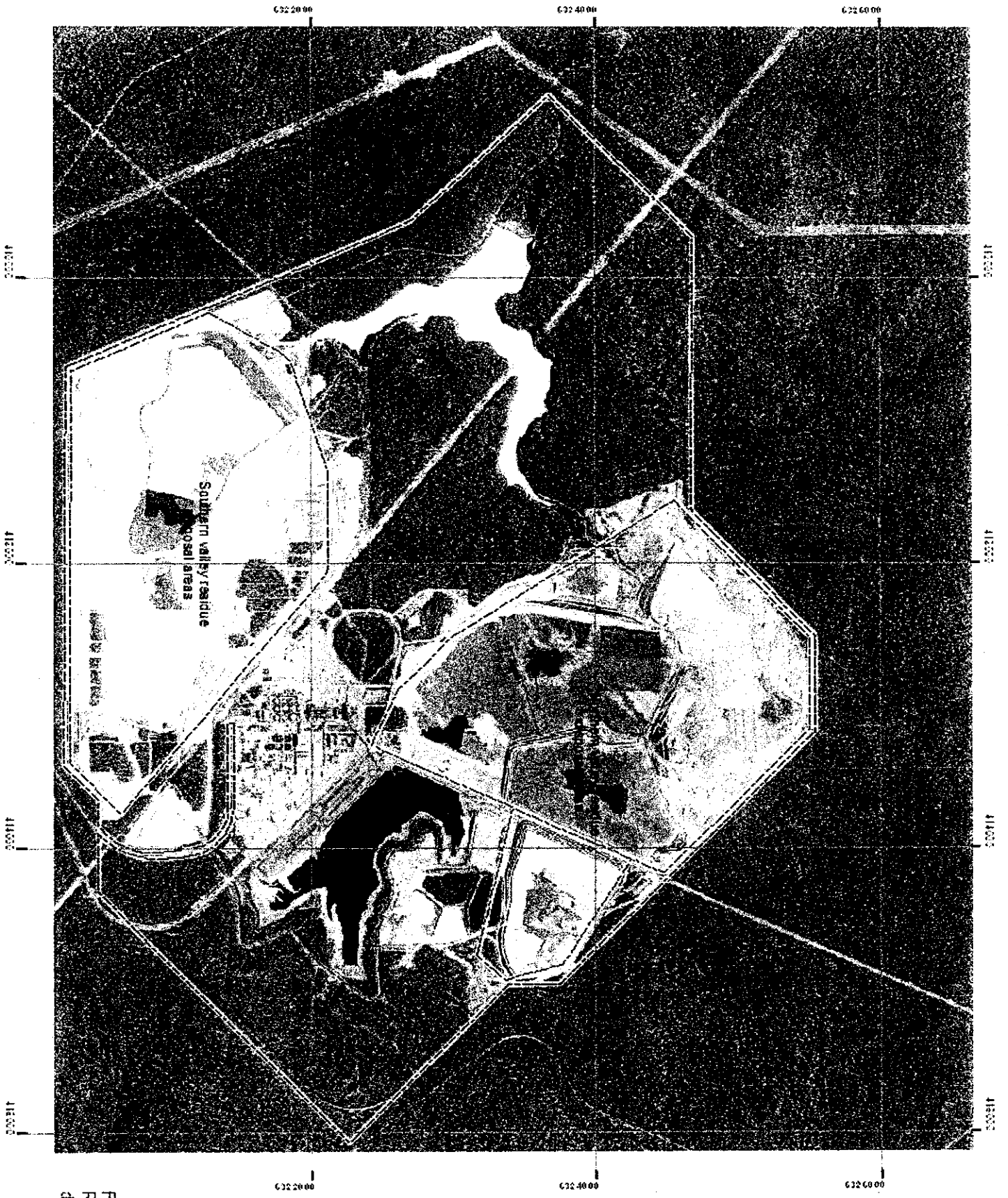


Figure 2: Existing and proposed mining envelopes (Source: Figure 1.3 from Strategem, 2005)



Legend

☐ Refinery Lease Area
☐ Residue Disposal Areas

Note: Residue area leases do not show full extent of clearing within Refinery Lease Area

Figure 3 Worlesey Alumina Refinery location of residue disposal areas

Proponent's Environmental Management Commitments

December 2005

**WORSLEY ALUMINA - PRODUCTION TO
MAXIMUM CAPACITY OF 4.4MTPA ALUMINA
AND ASSOCIATED MINING**

(Assessment No. 823 &1526)

Worsley Alumina Pty Ltd

Proponent's Environmental Management Commitments - December 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
All mining areas, bauxite transport corridors and overland conveyors.					
1	Water Resources	To ensure that the environmental values of surface and groundwater resources are maintained and protected from adverse impacts of bauxite mining activities and construction of bauxite transport corridors.	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 salinity and level of groundwater 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;	Within 12 months of the formal issuance of this statement	EMLG/DoE

Commitment Number	Topic	Objective	Action	Timing	Advice From
4	Offsets	To achieve a net environmental benefit as a result of land disturbance due to mining activities.	Worsley will prepare and implement an offsets program that addresses the following: - Establishing conservation areas: - provision of an area of land comparable to the area of State Forest disturbed in new mining areas for conservation by means of conservation covenants or agreements; - the timeframe for establishment of conservation areas in conjunction with Worsley's Ten Year Mine Plan. - Catchment and landscape enhancement for previously cleared land in the region: - provision of up to \$100,000 pa for the duration of mining of private land, up to a maximum of ten years; - the timeframe for establishment catchment and landscape enhancement initiatives in conjunction with Worsley's Ten Year Mine Plan. - Specific management programs - identification and contribution to jarrah forest conservation initiatives including: - research and understanding of jarrah forest biodiversity values; - forest disease management; - flora and fauna conservation programs.	Prior to entering into new mining areas	EMLG

Commitment Number	Topic	Objective	Action	Timing	Advice From
Bauxite transport corridor					
5	Noise	Ensure noise emissions for the overland bauxite conveyor and proposed extension comply with statutory requirements (Agreement Act conditions)	Worsley will prepare and implement a Noise Management Plan – Bauxite Transport, which will address: • construction of bauxite transport corridors and operation of overland conveyors • the use of noise emissions modelling results in the siting of transport corridors; • monitoring of noise emissions from conveyor systems to demonstrate compliance with Agreement Act requirements; • corrective and preventative actions where in house targets are exceeded; • identification of potential noise sensitive premises; • community consultation; and • response to complaints.	Within 12 months of the formal issuance of this statement	EMLG/CALM

Primary Bauxite Area.					
6	Management of biodiversity, forest resources and rehabilitation in Primary Bauxite Area	To ensure biodiversity and sustainability of Eastern Darling Range forest ecosystems are maintained from adverse impact of Worsley's bauxite mining activities and construction of bauxite transport corridors and operation of overland conveyors. To minimise the risk of bauxite mining activities introducing or spreading jarrah dieback or other forest disease into areas of State and private forest. To ensure that rehabilitated areas of State Forest is timely, sustainable and meets completion criteria agreed by the State. To ensure that rehabilitation of mined areas on private property leaves the land in an environmentally stable and sustainable conditions and meets the requirements of the private property owner.	Worsley will prepare and implement a Biodiversity and Forest Management Plan - Primary Bauxite Area that will address the following: 1. Vegetation, flora and fauna: - a program of baseline flora and fauna surveys before mining to determine: - the occurrence and extent of vegetation communities; - the occurrence and extent of forest disease, and - occurrence and abundance of vertebrate fauna, significant Short Range Endemic and other significant invertebrate taxa; - seasonal flora and fauna surveys in and adjoining mining areas; - weed and feral animals control. Programs; - forest hygiene procedures; - identification of areas of potentially high conservation values in the Primary Bauxite Area; - control measures to ensure that the biodiversity and sustainability of these areas will not be substantially adversely affected by mining and bauxite conveyors; and - creation of wildlife corridors and establishment of fauna habitat zones in consultation with the State.	Within 12 months of the formal issuance of this statement	EMLG/CALM

			2. Rehabilitation: • description of the rehabilitation process; • a program of research to improve rehabilitation outcomes, in particular to encourage recruitment of recalcitrant or rare and priority flora and fauna species into rehabilitated areas; • monitoring of the establishment of flora and the recruitment of fauna species into rehabilitated areas • a process for progressive development of completion criteria; • the use of local provenance seed in rehabilitation; • the re-creation of fauna habitat in rehabilitation; and • rehabilitation of forest project areas affected by jarrah dieback caused by mining operations.		
Worsley Refinery					
7	Water resources	To ensure that the environmental values of surface and groundwater resources are maintained from adverse impacts of refinery operations.	Worsley will prepare and implement a Water resources management Plan – Refinery that takes into account changing rainfall patterns and addresses: • 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 • Surface and groundwater quality monitoring • Management and cleanup of spills and onsite contamination		

Key

EMLG: Environmental Management Liaison Group.
 CALM: Department of Conservation and Land Management
 DoE: Department of Environment

Appendix 2
Approval Instrument EPBC 2004/1566



Australian Government

Department of the Environment and Heritage

Mr Peter Wilshaw
General Manager
Worsley Alumina Pty Ltd
PO Box 344
COLLIE WA 6225

Worsley Alumina Expansion Project (EPBC 2004/1566)

Dear Mr Wilshaw

I refer to the proposal by Worsley Alumina Pty Ltd to expand the existing bauxite mining operations within the Darling Plateau in the south-west of Western Australia and to extend ore transportation facilities and undertake upgrades to the alumina refinery near Collie.

I have considered the proposal in accordance with Part 9 of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and have decided as delegate to the Minister for the Environment and Heritage, the Hon Malcolm Turnbull MP, to grant an approval to Worsley Alumina Pty Ltd. The proposal must be undertaken in accordance with the conditions in the approval instrument. A copy of the approval is attached for your information. This approval applies only to the proposal as described in the referral document.

I would appreciate your assistance by informing me when you start the action and who will be the contact officer.

Please note, any plans or reports required as conditions of approval, will be regarded as public documents, unless you provide sufficient justification to warrant commercial-in-confidence status.

It should also be noted that, although an approval has been granted under Part 9 of the EPBC Act, this approval does not relieve the person to whom it has been granted from an obligation to comply with any other law of the Commonwealth, State or Territory that is applicable to the action, and to have any right, title or interest that is required to access land or waters and to do the action.

Yours sincerely,

A handwritten signature in cursive script that reads "Vicki Middleton".

Vicki Middleton
Assistant Secretary
Environment Assessment Branch

6 June 2007

COMMONWEALTH OF AUSTRALIA

ENVIRONMENT PROTECTION AND BIODIVERSITY CONSERVATION ACT 1999

DECISION TO APPROVE THE TAKING OF AN ACTION

Pursuant to section 133 of the *Environment Protection and Biodiversity Conservation Act 1999*, I, VICKI JANE MIDDLETON, delegate for the Minister for the Environment and Heritage, approve the taking of the following action:

to expand existing bauxite mining operations, located on ML258SA and other mining leases within the Darling Plateau in the south-west of Western Australia and to extend, upgrade and modify ore transportation facilities and undertake refinery modification and upgrades and all associated activities (EPBC 2004/1566), by Worsley Alumina Pty Ltd, subject to the conditions set out in ANNEXURE 1.

This approval has effect for:

Sections 18 and 18A (Listed threatened species and communities) and
Sections 20 and 20A (Listed migratory species)
of the *Environment Protection and Biodiversity Conservation Act 1999*

This approval has effect until 30 June 2047.

Dated this 6th day of June 2007

Vicki Middleton

.....
Assistant Secretary
Environment Assessment Branch
Department of the Environment and Water Resources

ANNEXURE 1

1. Within six months of the date of this approval, the person taking the action must submit for the Minister's approval a Biodiversity Investigations Scope (BIS), detailing survey methodology for investigating the following matters in each mining 'pod' and transport corridor:
 - (a) the occurrence and extent of flora species listed under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act),
 - (b) the identification and spatial extent of habitat for EPBC Act listed fauna species.

The BIS must include investigations for but not necessarily be limited to the following EPBC Act listed species:

The Cossack Spider Orchid (*Caladenia dorrienii*), Narrogin Pea (*Pultenaea pauciflora*), Shy Featherflower (*Verticordia fimbrialepis*), Slender Tailflower (*Anthocercis gracilis*), Carnaby's Black Cockatoo (*Calyptorhynchus litorostris*), Baudin's Black cockatoo (*Calyptorhynchus baudinii*), the Chuditch (*Dasyurus geoffroii*) and the Phascogale (*Phascogale calura*).

The BIS for each pod must be approved prior to *vegetation clearing*. The BIS must be implemented.

2. Prior to vegetation clearing for each mining 'pod' or transport corridor, the person taking the action must submit to the Minister a Biodiversity Investigations Report (BIR), detailing the following:
 - (a) a map including GPS coordinates for each 'pod'
 - (b) the biodiversity investigation survey results for each EPBC listed species
 - (c) measures proposed to minimize, monitor and manage the impacts on EPBC listed species. These measures must be implemented.
3. Within 14 days of commencement of the action the person taking the action must advise the Department of the actual commencement date.
4. By 1 October of each year after commencement of the action, the person taking the action must provide the Department with a report addressing compliance with the conditions of this approval.
5. If the Minister believes that it is necessary or desirable for the better protection of listed threatened species and ecological communities to do so, the Minister may request that the person taking the action make specified revisions to the BIS and submit the revised BIS for the Minister's approval. The person taking the action must comply with any such request. The revised approved BIS must be implemented.

6. The person taking the action must maintain accurate records of all activities associated with or relevant to the above conditions of approval, and make them available on request by the Department. Such documents may be subject to audit by the Department, and used to verify compliance with the conditions of approval.
7. If, at any time after 5 years from the date of this approval, the Minister notifies the person taking the action in writing that the Minister is not satisfied that there has been substantial commencement of the Worsley Alumina expansion project (mill upgrade or pod mining), then the project must not thereafter be commenced without the written agreement of the Minister.

Definitions

Biodiversity Investigations Scope (BIS) is a report covering the proposed new mining areas and surrounding land to provide a context for the information obtained by the Biodiversity Related Investigations. Matters to be addressed in the BIS include the occurrence and abundance of threatened species listed under the EPBC Act.

Biodiversity Investigations Report (BIR) is a report of investigations conducted in accordance with the BIS. The BIR is to include outcomes and findings for each of the listed threatened species investigated.

Vegetation clearing is defined as vegetation clearing (ie removal of, or damage to, native vegetation) for any purpose other than for exploration activities."

Mining pod is defined as a discrete area delineated by the presence of economically recoverable bauxite.

Transport Corridor is defined as a cleared path for the transport of bauxite as defined in the Transport Corridor Route Plan.

Appendix 3
Table of Responses to Stakeholder and
Peer Reviewer Feedback

Table 1. Response to Stakeholder and Peer Reviewer Feedback on Worsley Alumina's *Draft Scope of Biodiversity-related Investigations*.

Item No.	Reviewer	Findings (<i>Reviewer</i>)	Subject	Response (<i>Proponent</i>)
1.1	DEC	Section 4.4 outlines the process for the identification (and management) of ecological linkages. It is considered appropriate that the required level of avoidance and management of disturbance on ecological linkages be assessed and determined after the location and significance of identified ecological linkages has been identified.	Ecological Linkages	Identification of 'key ecological linkages' in document was proposed to be linked to how the ecological linkages identified in the studies are proposed to be managed. Methodology amended to remove mine planning and related management aspects. Also, the definition and assignment of 'key ecological linkages' will be undertaken in consultation with the EMLG (which includes DEC).
1.2	DEC	Condition 9-1 (5) of the Minister's statement refers to 'key ecological linkages' and there is therefore an apparent need for this terminology to be referred to and defined within the scope document and such areas to be documented within the Biodiversity Investigations report.	Ecological Linkages	Section 4.4 has been amended to include preliminary definitions for 'ecological linkages', 'regionally significant ecological linkages' and 'key ecological linkages', for the purposes of these biodiversity-related investigations. The 3rd definition is proposed to satisfy the intent of the use of the term 'key ecological linkages' in Condition 9-1(5) of Ministerial Statement 719. The three definitions are preliminary, and Worsley proposes to finalise these definitions in consultation with the EMLG.
1.3	DEC	Section 4.4: Regarding 'Red Zones' as ' <i>Ecological linking corridor (or part thereof) ... located within an area where disturbance for mining is proposed</i> ', it is considered inappropriate to propose mechanisms in the draft Scope that predict or prescribe measures for their protection or management.	Ecological Linkages	Methodology (in the new sub-section 4.4.4) has been amended to reduce reliance on future measures for their protection or management, and to explicitly state that the development of measures for the management of ecological linkages are beyond the scope of the revised Scope document, and that they are more appropriately addressed in the future <i>Bauxite Mining Plan, Transport Corridor Route Plan, and/or Rehabilitation Plan</i> , and will be developed in consultation with stakeholders, as required by the Ministerial Statement.
1.4	DEC	As the draft Scope is currently worded, the assessment and approval process (for ecological linkages) is potentially contradictory to advice in other sections.	Ecological Linkages	Noted: Document did not clarify that proposed mining of key ecological linkages is subject to Ministerial approval of a future Bauxite Mining Plan. As above, amendments made in sub-section 4.4.4 to clarify that management measures are beyond the scope of the revised Scope, and that such issues are more appropriately addressed in other planning documents, as required by Ministerial Statement 719.

Table 1. Response to Stakeholder and Peer Reviewer Feedback on Worsley Alumina's *Draft Scope of Biodiversity-related Investigations*.

Item No.	Reviewer	Findings (<i>Reviewer</i>)	Subject	Response (<i>Proponent</i>)
1.5	DEC	Section 4.2.3: DRF and other threatened flora may need to be surveyed outside the project area to clarify or add to the collective understanding and distribution of these flora. Objective #4 should be expanded to include 'and bauxite corridors and adjoining areas and as appropriate at the local and regional scale'.	Flora	Agreed this is the intention. Section 4.2.3 amended as suggested.
1.6	DEC	Worsley is also encouraged to investigate the presence of, and where appropriate develop protective measures for, other significant flora (such as new or undescribed species and significant range extensions) as a component of best practice environmental management.	Flora	Agreed. Investigation of these is a standard component of the flora studies, as per Guidance Statement 51. Measures for management and protection are (or will be) defined outside of the Revised Scope (e.g. documented in existing environmental procedures, in the future <i>Biodiversity Investigations Report</i> and/or other planning documents specified in the Ministerial Statement).
1.7	DEC	The flora and vegetation survey methodologies should: (i) clarify how they are compatible with other regional surveys; (ii) clarify how the survey data will be integrated with data from previous surveys; and (iii) consider advice from a specialist DEC botanist on the appropriateness of analysing data from differing sized quadrats.	Flora	(i) Method of data collection for baseline study is compatible with relevant historical regional surveys (e.g for RFA). Section 4.2.4 amended to clarify this. (ii) Current baseline data collection is building on data collected for the 2005 ERMP. Long term monitoring plots will also be established that will be compatible with current and historical monitoring at Saddleback (iii) Dr Libby Mattiske and Dr Bill Loneragan have been consulted, and the current quadrat methodology for the baseline surveys is considered suitable for baseline investigations, and will also be compatible with historical data for the RFA. Representative long term monitoring plots will also be established using the alternative quadrat method currently used for Worsley forest and rehabilitation monitoring. Section 4.2.4 amended to clarify this.
1.8	DEC	Section 4.3.1 (page 26). Third paragraph should refer to 'baseline vertebrate fauna surveys'.	Fauna	Amended in the Revised Scope.
1.9	DEC	Section 4.3.3 Reference to Dept of CALM should be amended to Dept of Environment and Conservation.		Amended in the Revised Scope.

Table 1. Response to Stakeholder and Peer Reviewer Feedback on Worsley Alumina's *Draft Scope of Biodiversity-related Investigations*.

Item No.	Reviewer	Findings (<i>Reviewer</i>)	Subject	Response (<i>Proponent</i>)
1.10	DEC	Section 4.3.4 (page 28): (i) Addition of amphibians to baseline faunal surveys; (ii) Point count survey area of within 25m for birds is considered too small. An appropriate sampling area would be a 200m quadrat, comparable to the original Worsley phase 1 bird surveys; and (iii) Advice on the appropriateness of analysing data from differing sized quadrats should be sought from a fauna expert with specialist data analysis skills and experience.	Fauna	(i) Section 4.3.4 amended as suggested; (ii) Section 4.3.4 amended to include mention of 50m x 50m quadrats containing 3 x 3 (i.e. 9) census points (including pitfall traps) established at some sampling points along many of the transects, to provide more intensive quadrat-based data for relevant taxa and relevant soil and vegetation types. Larger quadrats (e.g. 200m x 200 m) may unavoidably include additional vegetation types (among other factors), thus potentially confounding the data analysis (correlations, etc). Furthermore, as it is generally difficult to get sufficient data for fauna in the Jarrah Forest (especially birds), all census points will be repeat sampled (i.e. across multiple survey days), to increase the data collected from each site, and to compensate for otherwise potentially limited observations. (iii) Fauna ecologist is confident analysis can be undertaken as intended and to produce useful data (i.e. with the inclusion of the above-mentioned 50m x 50m quadrats).
1.11	DEC	Section 5.1.3, Point #2: Reference should be made to sampling the diet of predators to allow some determination of which fauna species are most at risk.	Fauna	The effect of introduced fauna species (pests) will be qualitatively assessed as described in Section 5.1.3. However, large resources over a large area may be required to trap potential predator species (e.g. feral foxes and cats), and may still be difficult to discern dietary preference and prey species most at risk. As such, a specific program for dietary sampling of predators is not currently proposed, although may be undertaken opportunistically, and interpreted with this in mind. Section 5.1.3 amended to include the possibility of undertaking some dietary sampling of introduced carnivores on an opportunistic basis.

Table 1. Response to Stakeholder and Peer Reviewer Feedback on Worsley Alumina’s *Draft Scope of Biodiversity-related Investigations*.

Item No.	Reviewer	Findings (<i>Reviewer</i>)	Subject	Response (<i>Proponent</i>)
1.12	DEC	Section 5.1.4: Include reference to range contractions as well as range extensions.	Fauna	This was the intention. Text has been amended (Section 5.1.4 heading removed) and moved to a new Section 8.1.3, including mention that particular focus will be given to whether range extensions or contractions of particular species and communities (including changes in distribution and representation) are potentially resulting from changes in climatic conditions.
1.13	DEC	Section 7.1.1: Last sentence requires additional causes such as climate change.		Section 8 (formerly Section 7) has been amended to include more discussion about assessing the effects of climate change (especially the new Section 8.1.3).
2.1	WA Museum	The ‘interval’ length along the transects should be defined, page 28.	Fauna	Section 4.3.4 amended to specify 50m interval length between transect sampling points.
2.2	WA Museum	Justification should be provided for the need for different transects (page 29) to evaluate the likely impact of developments on CWR fauna.	Fauna	Amendments made for clarification in Section 4.3.4
2.3	WA Museum	It would be advantageous to know what level of sampling ‘throughout the year’ is intended.	Fauna	Table 4 has been added to Section 4.3.5 summarising the timing of the field surveys for each fauna group.
2.4	WA Museum	It would be advantageous to know what groups of invertebrates will be evaluated for their ‘Short Range Endemic’ status.	Fauna	A preliminary list of invertebrate groups to be targeted has been included in Section 4.3.4, namely millipedes, scorpions, pseudo-scorpions, and trap-door spiders. Invertebrate groups and sampling methodologies required will be identified and developed in consultation with the WA Museum, as stated.
2.5	WA Museum	It is reassuring to know that many issues will be ‘adaptively managed’ by regular reference to the Environmental Management Liaison Group and that this group will be able to be advised and informed on the progress of the biodiversity related studies.		Noted
2.6	WA Museum	Consideration of the vexatious question of ‘Linkages’ is also critical, as outlined in the draft, and it is encouraging that considerable effort will be directed to establishing the most useful linkages for a variety of populations and ecological processes.	Ecological Linkages	Noted
3.1	WA Naturalists’ Club	The WA Naturalists’ Club suggest fungi should be added to the key areas of investigation of hydrology and landform, flora and vegetation, and fauna and fauna habitat, as fungi are an important component of biodiversity. This is acknowledged in the state government’s draft report ‘ <i>A 100 Year Biodiversity Conservation Strategy for Western Australia</i> ’.	Fungi	Section 6 proposes to undertake more specific targeted field work programs to further define the significant biodiversity values and key biodiversity areas within the new mining envelopes. This may include special studies, such as the evaluation of the fungal component of the ecosystem. Section 6.1.1 amended.

Table 1. Response to Stakeholder and Peer Reviewer Feedback on Worsley Alumina's *Draft Scope of Biodiversity-related Investigations*.

Item No.	Reviewer	Findings (<i>Reviewer</i>)	Subject	Response (<i>Proponent</i>)
3.2	WA Naturalists' Club	Page 24, item 6: 'where a part of an ecological linkage is located within an area that is likely to be disturbed for mining...' and page 33, 'Emphasis will be placed on fulfilling the requirements of <i>Ministerial Condition 719:9-1</i> ... using blue and green areas, thereby reducing the reliance on red (bauxite resource) areas to maintain ecological linkages.' The WA Naturalists suggest that using blue and green areas does not constitute fulfilling Ministerial Condition 719:9-1 (Protection of Biodiversity) as these areas are not significantly impacted upon by mining. They would rather see red areas protected where possible by either maintaining existing corridors or establishing additional corridors nearby before mining of red areas starts.	Ecological Linkages	Acknowledged. Amendments have been made in Section 4.2.4 and a new Section 4.4.4 added (see also Item No's 1.1 to 1.4, above).
3.3	WA Naturalists' Club	Section 5 under Threatening Processes and Climate Change and 5.1.1 The Objectives. The objectives only list 3 of the 7 potential key threatening processes that could influence biodiversity within the new mining areas.	Threatening Processes	Sections 5.1.1 and 5.1.2 have been amended to include the additional objectives and relevant discussion.
4.1	Water & Environmental Consultants	Top of page 18 should read "This desktop mapping exercise will use a combination of published and available data including:"	Hydrology	Section 4.1.2 amended.
4.2	Water & Environmental Consultants	Middle of page 18 should read "Aerial photographs and LANDSAT analysis will aid the process by highlighting where vegetation form and density also indicate possible groundwater dependence. Areas that are identified as potentially being of special interest will be ground-truthed to establish any groundwater dependency..."	Hydrology	Section 4.1.2 amended.
5.1	BWG Peer Review Panel, Dr Bill Loneragan.	Reference is made (p 19) to characterising surface water dependent ecosystems and that "streams with persistent baseflow will require special consideration in flora and fauna investigations". While streams with presently persistent flow may be well known, more problematic may be streams that have reduced persistence owing to recent low rainfall years. These should not be overlooked as the vegetation associated with such streams may be exhibiting evidence of change.	Hydrology, Flora & Fauna	Section 4.1.2 has been amended to include reference to streams (ephemeral or permanent) with persistent or intermittent baseflow will require special consideration in the flora and fauna investigations.
5.2	BWG Peer Review Panel, Dr Bill Loneragan	The Draft Scope document refers many times to identifying long-term trends but nowhere is a time frame given. The period over which the proposed investigations is to be conducted is around 5 years, This is not long term when fire intervals are around 6-8 years and the vegetation is dominated by resprouting species.	Flora & Fauna	Agreed with peer reviewers no timeframe required providing monitoring is for measurement of changes over time, not a set long term period.

Table 1. Response to Stakeholder and Peer Reviewer Feedback on Worsley Alumina’s *Draft Scope of Biodiversity-related Investigations*.

Item No.	Reviewer	Findings (<i>Reviewer</i>)	Subject	Response (<i>Proponent</i>)
5.3	BWG Peer Review Panel, Dr Bill Loneragan	No detail is given regarding the assessment of the potential effects of climate change. It is proposed that this will be determined by identifying “any long-term trends in changes to flora and vegetation values and fauna values within the new mining envelopes” (Section 5.1.4). Records made over a period of around 5 years are unlikely to be able to differentiate short-term recovery following localised disturbances from long-term change due to widespread and progressive perturbation of the climate.	Flora & Fauna	A new Section 8.1.3 has been inserted regarding evaluating the effects of climate change over time.
5.4	BWG Peer Review Panel, Dr Bill Loneragan	No account of how the effects of climate change will be addressed in the later rehabilitation, for example, by selection of species.	Flora & Rehab	It is considered beyond the scope of the Scope document to detail how Worsley will address the effects of climate change in future rehabilitation programs. However, it is acknowledged (in Section 8.1.1) that the ongoing review and analysis of the results from the monitoring programs will be used to inform the ongoing review of biodiversity management, including rehabilitation prescriptions, thus providing the basis for adaptive management.
5.5	BWG Peer Review Panel, Dr Bill Loneragan	Early vegetation datasets compiled from the general Lease Area during the 1960s or earlier may be useful if the original plots can be relocated though the sampling methods are likely to be different to those proposed for the current investigations.	Flora	The new Section 8.1.3 includes reference to the possibility of accessing historical vegetation survey records for the Jarrah Forest, to assess changes over the longer term.
5.6	BWG Peer Review Panel, Dr Bill Loneragan	Modelling with packages such as BIOCLIM and CLIMEX are likely to be useful in projecting potential spread/contraction of native and exotic plant species and should be considered. Relevant reference given (Kriticos & Randall 2001).	Flora	Section 5.1.3 has been amended to include the possibility of utilising modelling packages (such as BIOCLIM and CLIMEX) to examine the potential for the spread and/or contraction of relevant exotic and native plant species.
5.7	BWG Peer Review Panel, Dr Bill Loneragan	It is suggested that difficulties may be encountered in the preparation of the Targeted Fieldwork Programs on an annual basis, given the logistics of completing the necessary data analyses, obtaining the proposed feedback from the EMLG and stakeholder groups, and carrying out the prescribed work within the projected time frame, especially if this work is supposed to target aspects such as climate change.	Flora	Relevant documentation (survey results, scopes of works, etc will be submitted to the EMLG and other stakeholders, prior to the workshop date, with due regard to the potentially tight timeframe and logistics involved. No amendment to the Scope deemed necessary.
5.8	BWG Peer Review Panel, Dr Bill Loneragan	The timeframe provided for monitoring change in the biodiversity values within the study area is unspecified, but is expected to “provide baseline monitoring information for use in Worsley’s rehabilitation” (page 39).	Flora, Fauna & Rehab	It is acknowledged (in Section 8.1.1) that the ongoing review and analysis of the results from the monitoring programs will be used to inform the ongoing review of biodiversity management, including rehabilitation prescriptions, thus providing the basis for adaptive management.

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Item No.	Reviewer	Findings (<i>Reviewer</i>)	Subject	Response (<i>Proponent</i>)
5.9	BWG Peer Review Panel, Dr Bill Loneragan	Concern is expressed regarding using different sized quadrat sampling protocols between the expansion areas and existing operations at Mt. Saddleback. The former is based on a single unit (100m ²) within a 400m ² area, and the latter is based on 20 x 4m ² units dispersed within a 400m ² area. This effect is likely to be most marked for estimates of diversity however this is determined.	Flora	The flora quadrat survey method used for the baseline investigations is descriptive in nature and suited to identifying patterns and understanding ecological sequences across the landscape. It is consistent with and builds on the data collected for the initial 2005 ERMP and is compatible with other regional surveys (e.g. those undertaken for the RFA). The flora monitoring quadrats used in the long-term monitoring programs will use a similar sampling protocol to those currently used for forest and rehabilitation monitoring at Worsley's Saddleback operations. Sections 4.2.4 and 8.1.2 have been amended to clarify these points.
5.10	BWG Peer Review Panel, Dr Bill Loneragan	Sect 7.1.1 (6) Suggestion is made that the current rating scale used to evaluate vegetation condition (based on Government of Western Australia 2000) is largely subjective and cannot reflect small changes. Vegetation health is not defined, but should be based on more sophisticated methods, e.g. based on leaf reflectance (e.g. http://mvh.sr.unh.edu/).	Flora	Amendments have been made in (the new) Section 8.1.2, to include consideration for using remote-sensing techniques for use in determining vegetation health and condition.
6.1	BWG Peer Review Panel, Dr Andrew Burbidge	Transects vs. Quadrats: In Section 3.3, as flora surveys (inventory component) are based on quadrat work, in order to integrate flora and fauna data, the fauna data would be best collected in similar ways. It is not clear that there will be a holistic approach to the biodiversity-related investigations.	Fauna	Transect data is highly useful for examining continuums across the landscape. Long term vegetation monitoring transects will be established near the fauna transects. This is an approach so that inter-related shifts in response to climate can be examined.
6.2	BWG Peer Review Panel, Dr Andrew Burbidge	The Draft Scope document provides little information on what analyses of data will be carried out (e.g. modelling is recommended), or how data collected will be stored. It is recommended that data analysis be considered and reviewed by an experienced biometrician in the design stage of a biogeographic survey.	Fauna	Section 3.4 has been inserted to provide further information on the integrated GIS and database management system proposed. Worsley will also develop and manage integrated GIS and database management system in consultation with other relevant expertise, such as in biometrics.
6.3	BWG Peer Review Panel, Dr Andrew Burbidge	Section 4.5 Landscape Modelling . (i) Will survey data be geocoded for use in the GIS? (ii) Concern is expressed on how the biogeographical data will be analysed and what outcomes might result.	Fauna	As above, Section 3.4 has been inserted to provide further information on the integrated GIS and database management system proposed. Further modelling information is provided in Section 4.5.

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6.4	BWG Peer Review Panel, Dr Andrew Burbidge	The DEC transect survey trapping mentioned on p.29 was developed for use by non-scientist District staff for periodic, routine 'Western Shield' monitoring and does not record some of the mammals of conservation significance that may be found in the study area. Various mammals require special techniques to trap or detect them. Contact with the DEC Science Division team led by Keith Morris may assist the development of higher quality trapping studies.	Fauna	Acknowledged. Section 4.3.4 has been amended to clarify these details.
6.5	BWG Peer Review Panel, Dr Andrew Burbidge	DEC currently have underway a detailed study of the interactions between CWR mammals and predators (indigenous and exotic) in the northern Jarrah forests, and liaison with the research team is needed.	Fauna	Acknowledged. The expertise of the DEC will be utilised through the consultations with the EMLG (e.g. at the Annual Workshops) during implementation of the surveys.
6.6	BWG Peer Review Panel, Dr Andrew Burbidge	There seems to be no recognition that transport corridors may disrupt fauna movements (migration and dispersal) as well as affecting fauna diversity and biomass via habitat modification. Are any studies planned to answer these questions?	Fauna	This matter will be investigated during the identification of 'RED' ecological linkages, as described in Section 4.4.
6.7	BWG Peer Review Panel, Dr Andrew Burbidge	Climate change effects: More details required for what will be measured and how climate change effects might be detected.	Fauna	Additional information provided in Section 8.
6.8	BWG Peer Review Panel, Dr Andrew Burbidge	Long-term monitoring is an important part of the proposed work, but little has been said about it. Section 7 is very brief and states that programs will be developed. No time frame is presented.	Fauna	As per Item 5.2, above, agreed with peer reviewers no timeframe required providing monitoring is for measurement of changes over time, not a set long term period.
6.9	BWG Peer Review Panel, Dr Andrew Burbidge	The list of parameters in Section 7.1.1 should include monitoring of a broad range of animals (e.g. in terms of life histories, and habitat specificity or otherwise), otherwise changes may be missed.	Fauna	Relevant amendments made in (the new) Section 8.1.2.
6.10	BWG Peer Review Panel, Dr Andrew Burbidge	Section 7.1.2 does not provide any criteria for identifying bio-indicators.	Fauna	Worsley will consult with the EMLG during the process of identifying relevant monitoring parameters. Section 8.1.2 amended.
6.11	BWG Peer Review Panel, Dr Andrew Burbidge	Section 7.1.2 does not provide guidance as to how factors such as impacts of key threatening processes and impacts of climate change could be separated. This may require an experimental approach.	Fauna	Section 8.1 includes detail on how potential effects of climate change may be discerned from relevant long-term monitoring data.
7.1	BWG Peer Review Panel, Dr Don McFarlane	In Section 4.1.2 (p.18), the following datasets should be added to the list: digital terrain (elevation) models, airborne geophysics, and depth to groundwater from individual bores (where available) and from surface salinity expressions from Land Monitor mapping.	Hydrology	Section 4.1.2 has been amended to include these additional datasets.

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Item No.	Reviewer	Findings (<i>Reviewer</i>)	Subject	Response (<i>Proponent</i>)
7.2	BWG Peer Review Panel, Dr Don McFarlane.	Stream water quality monitoring mentions stream salinity as the only water quality measure (p18). Consideration should be given to carrying out annual macro-invertebrate sampling and assessment using the method outlined for the AusRivAS program (http://ausriv.as.canberra.edu.au and http://www.environment.gov.au/water/rivers/nrhp/index.html) By monitoring streams that may be affected by mining as well as those unaffected it may be possible to separate the impacts on water quality of fire, climate, pests, disease, and climate from any mining impacts. The AusRivAS methodology has national legitimacy as a rapid method of assessing river health.	Fauna (aquatic)	Section 4.1.2 has been amended to provide information regarding the option of inclusion of baseline macro-invertebrate sampling and assessment (e.g. using the methodology outlined for the AusRivAS program).
7.3	BWG Peer Review Panel, Dr Don McFarlane.	Three additional broad-based methods are suggested for inclusion in Section 7, to compliment the plots/quadrats, and to ensure areas undergoing significant change, that are distant to the plots/quadrats, can also be assessed; the 3 recommended methods being: 1. Conventional aerial photography 2. Landsat TM 3. Digital aerial photography. This type has been suggested as a replacement for vegetation transects and plots, and has just been acquired for the Wungong Catchment, and may be used as a guide to suitability (contact details provided).		Section 8 (formerly Section 7), and Section 8.1.2 in particular, has been amended to include additional information derived from remote-sensing techniques (e.g. digital aerial photography).
7.4	BWG Peer Review Panel, Dr Don McFarlane.	The Premiers Water Foundation has just funded a project which will collate historical information on vegetation condition / leaf area indices (Landsat TM), rainfall, streamflows and land management issues (fire, disease, clearing) for a large part of the Darling Range Catchments. It would seem useful for WAPL to liaise with CSIRO Mathematics and Information Sciences, who have just developed a digital terrain model of the Darling Range which may encompass all or some of the proposed mining site and surrounding areas.	Flora & Hydrology	Noted. As per Section 9.1.2, Worsley will identify key partnership opportunities and establish collaborative study programs where appropriate to investigate further matters of regional significance.
8.1	Peel Development Commission	Section 1. Introduction: Addition of comma first paragraph "Statement, Worsley".	Grammar	Amended, with the inclusion of the reference to the Commonwealth Approval.
8.2	Peel Development Commission	(i) Section 1.3, 1st paragraph: last line should read as The Ten Year Mine Plan. Also comma after EMLG, second paragraph. (ii) Paragraph three, last sentence should include comment regarding operating procedures after planning processes on the last line.	Grammar	Amended. Amended.

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Item No.	Reviewer	Findings (<i>Reviewer</i>)	Subject	Response (<i>Proponent</i>)
8.3	Peel Development Commission	(i) Section 2.2: 2nd line, comma after “Specifically,” (ii) Section 2.2.4: Should read South West Aboriginal Land	Grammar	Amended. Amended.
8.4	Peel Development Commission	Section 3.1: Section should also refer to “current mining areas” not only “new mining areas”.	Definition	The Scope of Biodiversity-related Investigations is required for the new mining areas only, as per Condition 8-1 of the Ministerial Statement.
8.5	Peel Development Commission	Section 3.1, Table 3: Is this table appropriately referenced and is the information contained useful?		Table 3 provides an indication of the area of native vegetation potentially disturbed by mining activities, which directly relates to description of proposal, the subject of this section.
8.6	Peel Development Commission	Page 15: Second paragraph should also apply to local groups i e share the knowledge; not only for Worsley?		Section 3.2 amended.
8.7	Peel Development Commission	Section 4: Addition of commas in last paragraph, “field programs,” and “characterised,”.	Grammar	Amended.
8.8	Peel Development Commission	Section 4.1.2, Point #2: In relation to stream monitoring the study period has not been included.	Hydrology	Point # 2 has been amended to clarify.
8.9	Peel Development Commission	(i) Section 4.1.2, First paragraph under Point #3: Explanation of flux-density required. (ii) Section 4.1.2, Second last paragraph: No mention of wetlands regarding surface water dependent ecosystems.	Hydrology	(i) Flux density is the rate of flow of fluids per unit area, however the purpose of the ‘flux-density type analysis’ proposed is to identify areas where groundwater may be playing a role in the ecosystems of the valley floor areas. (ii) Section 4.1.2 amended, to include wetlands and streams.
8.10	Peel Development Commission	Section 4.2.1, Page 20, First paragraph: Comma after “mine pods,”. Section 4.2.1, Page 20, Fourth dot point, end of sentence: “Jarrah Forest”. Section 4.2.1, Page 21, second paragraph: comma after “botanical information,” and replace has with have, end of second line.	Grammar	Amended. Amended. Amended.
8.11	Peel Development Commission	(i) Section 4.2.4, Point #3: Capitalise “Significant Flora”. (ii) Section 4.2.4, Point #7, amend spelling of <i>cinnamoni</i> . Page 23, second paragraph, comma after “example,”. (iii) Page 24, end of Point #2: “commencement of the mining works.”.	Grammar	(i) Amended. (ii) Spelling of <i>Phytophthora cinnamomi</i> is correct. Comma inserted. (iii) Amended to read “commencement of mining.”
8.12	Peel Development Commission	Section 4.2.5, First paragraph: Change “area” to “areas”.		Amended.

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8.13	Peel Development Commission	(i) Section 4.3.4. First paragraph page 29, change program to programs. (ii) Point #3. page 29, make use of BGM work in relation to Black Cockatoo location of nest hollows. (iii) Point #3, page 29, last line: Change “mining planning” to “mine planning.”		(i) Amended. (ii) Noted, and will be considered. (iii) Amended.
8.14	Peel Development Commission	Section 4.3.5, First line: Change “through out” to read “throughout”. Also change “the year the” to “the year; the”	Grammar	Amended.
8.15	Peel Development Commission	Section 4.4.2. Red ecological linkages, add “)” after “ecological linkage”, on the second line.	Grammar	Text has been removed from the Scope (see Items 1.1 to 1.3, above).
8.16	Peel Development Commission	Section 5.1.2. Add comma after “landform”, on the second line.	Grammar	Amended.
8.17	Peel Development Commission	Section 5.1.3, Point #2: Should the potential spread of dieback by feral pigs be investigated?	Fauna	2 nd last paragraph of Section 5.1.3 has been amended to include this a consideration of how threatening processes may be operating in concert, or otherwise occurring simultaneously.
8.18	Peel Development Commission	Section 6.1.2, First paragraph after bullet points, page 38: Change “function” to “functions”.	Grammar	Amended.
8.19	Peel Development Commission	Section 8.1.1, Second paragraph: Change “years” to “year’s” Section 8.1.1, Last paragraph: Comma after “EMLG”,	Grammar	Amended (in Section 9.1.1).
9.1	A member of Worsley’s Refinery Community Liaison Committee (CLC)	Studies and monitoring programs are vital to ensure adequate protection of scarce water supplies.	Hydrology	Noted (relevant commitments already exist in Section 4.1.2). Also, responsible management of operations within proclaimed water reserves and drinking water catchments will be addressed in a specific Environmental Management Plan, as required by Condition 13 of Ministerial Statement 719.
9.2	A member of Worsley’s Refinery Community Liaison Committee (CLC)	It is also an imperative that monitoring of [impact of mining-related activities] on groundwater-dependent ecosystems and streams is continuous to ensure damage is not done to a point where it cannot be repaired.	Hydrology, Flora & Fauna	Relevant commitments already exist in Section 4.1.2 for special studies and a monitoring program regarding groundwater- and stream-dependent ecosystems.

Contributions on the *draft Scope of Biodiversity-related Investigations* were received from:

- Items 1.1 – 1.13: Mr Nicholas Woolfrey (DEC)
- Items 2.1 – 2.6: Dr Ric How (WA Museum)
- Items 3.1 – 3.3: Ms Margaret Larke (WA Naturalists’ Club)
- Items 4.1 – 4.2: Mr James Croton (Water & Environmental Consultants)

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- Items 5.1 – 5.10: Dr Bill Loneragan (BWG Peer Review Panel)
- Items 6.1 – 6.11: Dr Andrew Burbidge (BWG Peer Review Panel)
- Items 7.1 – 7.4: Dr Don McFarlaen (BWG Peer Review Panel)
- Items 8.1 – 8.19: Mr Greg Robertson (Peel Development Commission)
- Items 9.1 – 9.2: Mr Brian Easton (a member of Worsley’s Refinery Community Liaison Committee)