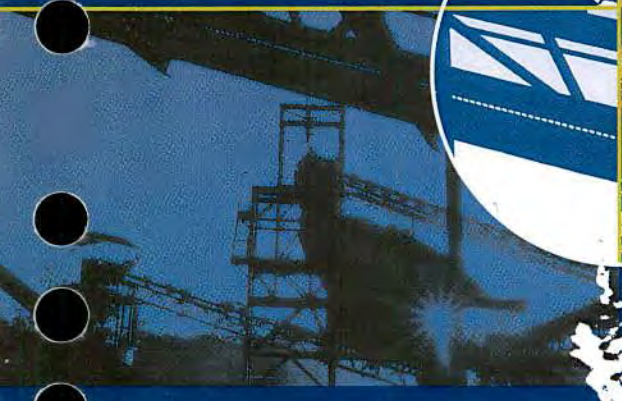
PORTMAN LIMITED

A.B.N. 22 007 871 892

Portman Limited

KOOLYANOBBING IRON ORE EXPANSION PROJECT

PUBLIC ENVIRONMENTAL REVIEW | MARCH 2002



ecologia
ENVIRONMENT

Please assist us to keep our service efficient

- Return item by the due date
- If you require an item for longer, please contact the library, (phone or email) so we can adjust our records

Date Due	
~~4/8/08~~	
~~17/3/09~~	
17/5/2011	

KOOLYANOBBING IRON ORE EXPANSION PROJECT

PUBLIC ENVIRONMENTAL REVIEW

March 2002

Portman Iron Ore Limited
(ACN 007 871 892)

Level 11, The Quadrant
1 William Street
PERTH WA 6000

Prepared by

ecologia
ENVIRONMENT

The Environmental Protection Authority (EPA) invites people to make a submission on this proposal.

Portman Iron Ore Limited proposes the development of the Koolyanobbing Iron Ore Expansion Project north of Koolyanobbing. In accordance with the State *Environmental Protection Act 1986* and the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* a Public Environmental Review (PER) document has been prepared which describes this proposal and its likely effects on the environment. The PER document is available for a public review period of four (4) weeks from **Monday 18 March 2002** closing on **Monday 15 April 2002.**

Comments from government agencies and from the public will help the EPA to prepare an assessment report in which it will make recommendations to government.

WHY WRITE A SUBMISSION?

A submission is a way to provide information, express your opinion and put forward your suggested course of action including any alternative approach. It is useful if you indicate any submissions you have to improve the proposal.

All submissions received by the EPA will be acknowledged. Submissions will be treated as public documents unless provided and received in confidence subject to the requirements of the *Freedom of Information Act*, and may be quoted in full or in part in the EPA's report.

WHY NOT JOIN A GROUP?

If you prefer not to write your own comments, it may be worthwhile joining with a group or other groups interested in making a submission on similar issues. Joint submissions may help to reduce the work for an individual or group, while increasing the pool of ideas and information. If you form a small group (up to 10 people) please indicate the names of all participants. If your group is larger, please indicate how many people your submission represents.

DEVELOPING A SUBMISSION

You may agree or disagree with, or comment on, the general issues discussed in the PER or the specific proposals. It helps if you give reasons for your conclusions, supported by relevant data. You may make an important contribution by suggesting ways to make the proposal more environmentally acceptable.

When making comments on specific elements of the PER:

- clearly state your point of view;
- indicate the source of your information or argument if this is applicable;
- suggest recommendations, safeguards or alternatives.

POINTS TO KEEP IN MIND

By keeping the following points in mind, you will make it easier for your submission to be analysed:

- attempt to list points so that the issues raised are clear. A summary of your submission is helpful;
- refer each point to the appropriate section, chapter or recommendation in the PER;
- if you discuss different sections of the PER, keep them distinct and separate, so there is no confusion about which section you are considering;
- attach any factual information you want to provide and give details of the source. Make sure your information is accurate.

REMEMBER TO INCLUDE:

- Your name;
- address;
- date; and
- whether you want your submission to be confidential.

The closing date for submissions is: **Monday 15 April 2002.**

Submissions should be emailed to:
peter.walkington@environ.wa.gov.au

OR addressed to:
Environmental Protection Authority
PO Box K822
PERTH WA 6842

Attention: Peter Walkington

Environmental Protection Authority
Westralia Square
141 St Georges Terrace
PERTH WA 6000

TABLE OF CONTENTS

TABLES

PLATES

Portman Iron Ore Limited (Portman) operates an existing iron ore mine at Koolyanobbing, located 425 kilometres east of Perth and approximately 54 kilometres north-east of Southern Cross.

Portman are proposing to increase their iron ore production rate from approximately 3.5 Mtpa to 8 Mtpa over the next 3 to 5 years by continuing to mine at Koolyanobbing whilst expanding the project to include known iron-enriched deposits to the north.

These Northern Deposits, seven of which have been evaluated by Portman, are located at Mt Jackson and Windarling Range. These areas comprise:

- Mt Jackson Deposits J2 and J3 ; and
- Windarling Range Deposits W1, W2, W3, W4 and W5

Mining of the Northern Deposits will require the development of small scale open cut mining operations, crushing plants, ore stockpile areas, waste dumps and transport of ore to processing facilities located at Koolyanobbing.

This PER document addresses environmental factors associated with the proposed Koolyanobbing Expansion Project Area, including mine areas at Windarling and Mt Jackson , and the rail route connecting these sites to current operations at Koolyanobbing. Furthermore, the expansion and/or upgrading of facilities at the existing mine at Koolyanobbing is within the scope of this PER.

The scope for which approval is sought for the current PER does not include:

- Mining iron ore below the water table (hence no dewatering is planned at this stage); and
- The impact of activities relating to the transport of ore from Koolyanobbing to the Port of Esperance or likewise the shipping of ore from Esperance.

The increase in production capacity associated with the project will require installation of new mining facilities at the two new mine areas and an upgrade of existing facilities at Koolyanobbing.

Facilities proposed at Mt Jackson and Windarling Ranges include:

- Primary crusher – this may be in the form of one mobile crusher or 2 individual small-scale crushers located at each site;
- Storage bin/stockpile for primary crushed ore; and
- Train load-out to Koolyanobbing for further processing.

A transportation corridor will need to be constructed to transport ore from the proposed mine areas to Koolyanobbing for processing. This will involve the construction of a rail link and associated access road from Koolyanobbing to Windarling (114 km) with subsequent connection to Mt Jackson (11 km).

Key characteristics associated with the Koolyanobbing Expansion Project include expansion of mining operations and processing facilities, additions to operations and infrastructure at Koolyanobbing, construction of a rail link, and a larger workforce (Table S1).

Table S1: Summary of Key Characteristics associated with the Proposal.

Component	Key Aspect	Characteristic Description
Mining Operations	Proposed Mine Locations and deposits	Mt Jackson deposits J2 and J3 Windarling deposits W1 to W5
	Estimated area of mine pits	Mt Jackson pits J2 and J3 – 18.3ha Windarling pits W1, W2, W3, W4 – 209.6ha
	Ore Type	Hematite-geothite
	Ore Mining Rate	Staged expansion to 8 Mtpa over 3 to 5 years
	Total Estimated Production	80 Mt
	Proposed Operation Commencement	2002 – Construction, Mining, Processing and Transshipment
	Project Life Span	10 years
	Anticipated Year of Decommissioning	2012
	Proposed Waste Dump No. ( ) and Area	Mt Jackson (2) – 41ha; Windarling (2) –219ha
	Ore stockpile areas	Mt Jackson – 15ha; Windarling – 34ha
	Proportion of Waste to be backfilled	Nil
	Stripping Ratio (waste:ore)	4:1 approx.
	Area of haul roads	Mt Jackson – 18.2ha; Windarling – 15.8ha
	Total estimated area of disturbance	Mt Jackson – 93 ha; Windarling – 480 ha
Processing Requirements	Processing at Mt Jackson, Windarling	Primary crushing at the two sites – possibly a single mobile unit covering the two sites.
Changes to existing facilities at Koolyanobbing	Expansion of General Facilities	Mine offices
	Expansion of Processing Facilities	Secondary crushing, screening, stockpiling and train loading
	Workforce	Increased number of employees
Railway	Length	114 km main line – Koolyanobbing to Windarling 11 km spur line to Mt Jackson
	Estimated area of disturbance	500 ha approx.
	Train Movements – proposed	4 per day
General	Workforce (rail and mine)	Construction – 200; Operation – 180
	Project Duration	Operation – 10 years Railway Construction – 12 months
	Workforce Accommodation	Accommodation Village for 80+ people Area of disturbance – 25 ha
	Infrastructure	Power source – diesel generator Water source – potable water trucked or piped from Koolyanobbing
	Water Supply Requirements (estimated)	Railway Construction – 3500 kL/day Minesite Construction – 2000 kL/day Operation – Potable and domestic supplies – Bore water for dust suppression

It is anticipated that construction of the mine infrastructure, mining and finally transshipment of the ore will be phased in during the year 2002. The mines, which will be worked concurrently in order to blend the ores to render them suitable for export, are predicted to have a life span of up to 10 years.

Development of the Project would provide an additional source of high-grade ore which increases the diversity of products and thereby market opportunities for Portman. Driving forces behind the development of the project include increased demand for iron ore from Asia following diminution of the Asian economic crisis, rationalisation within the iron ore industry creating greater opportunities for smaller independent suppliers, and potential supply of additional sources of quality lump and fine ore.

Railway Alignment

A total of 13 possible alignment options were considered as part of the rail route selection process. Location of the final alignment will take into account topographical, biological, and indigenous heritage issues, in addition to a consideration of substrate conditions. The currently preferred route, HA1 South, runs from Koolyanobbing to Windarling (114km) with a branch to Mt Jackson (11km). For environmental and mine operation reasons a southern approach to Mt Jackson is preferred. At the southern end of the preferred route a siding connecting to the existing Koolyanobbing loop is preferred.

BIOPHYSICAL

The project area lies in the Coolgardie bioregion. Landscapes can principally be classified as upland ironstone ranges and surrounding gently undulating lowland areas, although there are a range of surface conditions within each of these landscape types. Extractable groundwater is principally in palaeochannel aquifers.

Flora and fauna attributes, including species and taxa level biodiversity, Rare and Priority flora and fauna and other taxa of conservation significance, vegetation communities and fauna habitats of the project area are summarised in Table S2.

HERITAGE

A series of 15 sites and associated areas have been identified in the general Project area that are potentially of significance to indigenous people. No non-indigenous heritage sites exist in the project area.

PROJECT IMPACTS AND MANAGEMENT

Table S3 provides a summary of potential environmental issues and proposed management associated with the Koolyanobbing Expansion Project proposal. Environmental factors considered under Biophysical generally relate to direct impacts on the physical and biological environment. Pollution Management within the context of this proposal relates primarily to water quality and general pollution issues. Social Surroundings refers to heritage issues.

ENVIRONMENTAL MANAGEMENT SYSTEM

Portman are in the process of developing an Environmental Management System (EMS) for their mining operations at Koolyanobbing and the proposed Expansion Project. The Environmental Management Plan (EMP) for the Project forms an important component of the EMS and is the principal supporting document for the PER.

Table S2: Biodiversity Attributes Summary Table

Biodiversity Attribute	Project Area Characteristics	Regional Area Characteristics
Flora	365 flora species from 51 families	73 families, 333 genera, 1077 species and 1127 taxa (38 introduced) in the general Koolyanobbing area
Fauna	148 vertebrate species recorded: 81 birds, 46 reptiles, 21 mammals (15 native and 6 introduced) 3 terrestrial snails	Potentially in wider area: 275 vertebrate species: 133 birds, 104 reptiles, 38 mammals (31 native and 7 introduced)
Rare Flora (DRF)	*Tetratheca harperi* (Jackson Range) *Tetratheca paynterae* (Windarling)	Also includes; *Tetratheca aphylla* (Helena and Aurora Range) *Eremophila viscida* (Highclere Hills)
Priority Flora	12 species recorded Potentially impacted by proposal: *Ricinocarpos brevis*, P1 (Jackson Range & Windarling) *Jacksonia jackson*, P2 (Jackson Range)	73 species potentially occurring in the wider Koolyanobbing area 35 species recorded at specific localities in the region
Rare Fauna	Malleefowl *Leipoa ocellata* (S1)(JAMBA) (Jackson Range, Transportation Corridor) Rainbow Bee-eater *Merops ornatus* (JAMBA) Pink Cockatoo *Cacatua leadbeateri* (S4) (Jackson Range and Transportation Corridor) Peregrine Falcon *Falco peregrinus* (S4) (Windarling) Carpet Python *Morelia spilota imbricata* (S4) (Windarling)	Potentially; Fork-tailed Swift *Apus pacificus* (S3)(JAMBA) Woma *Aspidites ramsayi* (S4) Greenshank *Tringa nebularia* (S3) (JAMBA) Wood Sandpiper *Tringa glareola* (S3) (JAMBA) Common Sandpiper *Tringa hypoleucos* (S3) (JAMBA) Sharp-tailed Sandpiper *Calidris acuminata* (S3) (JAMBA)
Priority Fauna	Australian Bustard Ardeotis australis (P4) Jackson Range	Potentially: Central Long-eared Bat *Nyctophilus timoriensis* (P4)
Other taxa of conservation significance	15 flora taxa (6 at Jackson Range, 6 at Windarling, and 9 at Transportation Corridor)	50 flora taxa recorded Principally range extensions, but some geographically restricted and/or in need of further taxonomic work (refer to Appendix F for flora)
Vegetation communities	12 vegetation communities; Eucalypt Woodlands (E1, E2), Acacia Woodlands (A1) and Mixed Shrublands (S1 – S9) Mt Jackson: 8 vegetation communities; Windarling: 8 vegetation communities Restricted communities – S2, S4, S6, S9 at Windarling S1, S3, S5, S8 at Mt Jackson.	Bungalbin, Die Hardy (ranges) and Jackson (lowlands) Systems (Beard, 1972; 1978) Six supergroups and 35 groupings of vegetation with differentiation by locality and position in the landscape . Regional Range Comparison (Mattiske; 2001C)
Fauna Habitats	5 major and 10 minor habitat types	
Significant Ecosystems	Mixed Shrublands (S6, S) on ironstone ridges at Windarling	
Bioregion	Coolgardie (COO)	

COMMITMENTS

The following environmental commitments have been made by Portman in order to manage the Koolyanobbing Expansion Project:

1. Environmental Management Plan

Portman will prepare, implement and regularly revise an Environmental Management Plan (EMP) for the Project. The EMP will include, but not be limited to:

- monitoring of key environmental aspects;
- management of environmental impacts from construction and operation;
- rehabilitation and revegetation of disturbed areas;
- an overview of timing for implementation of commitments; and
- reporting requirements.

2. Environmental Management System

Portman will develop and subsequently implement a formal Environmental Management System (EMS) for the Project and the existing Koolyanobbing operations that embraces the ISO 14001 standards and incorporates the following:

- environmental policy and corporate commitment to the EMS;
- mechanisms and processes to ensure;
  - planning to meet environmental requirements;
  - implementation and operation of actions to meet environmental requirements;
  - measurement and evaluation of environmental performance; and
  - review and improvement of environmental outcomes.

3. Closure Plan

Portman will prepare a detailed Closure Plan for the Project. The plan will address closure actions to be taken for mine voids, waste dumps, and associated infrastructure including the rail corridor and will provide the basis for an eventual 'walk-away' closure strategy for the Project.

4. Flora and Vegetation Surveys

Additional flora and vegetation survey of any areas to be disturbed but not yet surveyed will be undertaken prior to disturbance.

5. Rare and Priority Flora Surveys

Additional surveys for Rare and Priority Flora in areas to be disturbed but not yet surveyed will be undertaken prior to disturbance.

6. Threatened Flora MP

Portman will prepare and implement a Threatened Flora Management and Conservation Plan for the Project. The Plan will address management of Threatened Flora impacted by the proposed development.

7. Fauna Surveys

Additional targeted surveys for Rare and Priority Fauna in areas to be disturbed but not yet surveyed.

8. Malleefowl Conservation Plan

Portman will develop and implement a Malleefowl Conservation Plan for the project area, including detailed survey of proposed impact areas for Malleefowl and their mounds

9. Groundwater

Portman will implement a monitoring plan to ensure that groundwater levels are not significantly reduced in and near extraction areas.

10. Dust

Portman will implement dust management measures for mining operations, including a dust-monitoring programme if considered necessary.

11. Weeds

Portman will develop and implement a Weed Management Plan, including implementation of weed hygiene procedures.

12. Aboriginal Site Surveys

Portman will involve the appropriate indigenous custodians in additional archaeological and ethnographic surveys to identify sites and their significance within the Project area likely to be disturbed, where required.

13. Future Aboriginal Site Surveys

Additional Aboriginal site surveys will be undertaken in accordance with a heritage survey protocol that is to be agreed with the Ballardong and Central West people through establishment of a Land Use Agreement.

14. Consultation on Section 18 Application

Portman will consult with the appropriate indigenous custodians on Aboriginal sites in the Project area prior to any Section 18 application being developed in keeping with an agreed protocol.

15. Submission of Section 18 Application

Portman will make a written application to the Aboriginal Cultural Materials Committee (for subsequent consent by the Minister for Aboriginal Affairs) if any identified Aboriginal site in the Project area is required to be disturbed.

16. Establishment of a Land Use Agreement

Portman will establish a Land Use Agreement with the Ballardong and Central West native title claimants to identify and assess any social and cultural aspects of the physical and biological environment impacted.

17. Visual Amenity Study

Portman will undertake a Visual Amenity Study of the project area.

18. Establishment of a MOU with CALM

Portman will establish a Memorandum of Understanding with CALM to progress conservation tenure arrangements and integrate environmental management practices to enhance the conservation values of the area whilst permitting a variety of land uses (including mining).

19. Biodiversity Management Plan

Portman will develop and implement a Management Area Biodiversity Management Plan in collabaration with CALM.

20. Conservation Tenure Implementation Plan

Portman will develop and implement a Conservation Tenure Implementation Plan in collabaration with CALM

Table S3: Issues and Management for the Koolyanobbing Expansion Project

Issue/Factor	EPA Objective	Scope of Work for PER	Existing Environment	Potential Impacts	Proposed Management	Predicted Outcome
BIOPHYSICAL						
Vegetation Communities	Maintain the abundance and diversity of species, and geographic distribution and productivity of vegetation communities.	Baseline studies to identify existing vegetation communities. Assessment of potential impacts (direct and indirect) on vegetation communities as a result of mining activities and infrastructure. Proposed measures to manage impacts.	Vegetation and flora surveyed throughout the project area including the rail corridor. 12 vegetation communities identified belonging to 3 broad vegetation types. Mt Jackson – 8 vegetation communities. Windarling – 10 vegetation communities. Rail Corridor – several broadscale vegetation types; detailed mapping when alignment finalised. Vegetation communities restricted: Windarling area– S2, S4, S6, and S9. Mt Jackson area – S1, S3, S5, S8	93 ha at Mt Jackson, 480 ha at Windarling and 500 ha along Rail Corridor will be cleared. Windarling will be most affected: S2, S4, S6 and S9 communities significantly impacted. Mt Jackson: S1, S3 and S5 not significantly impacted. S8 not affected.	Site disturbance to be minimised – areas to be cleared only when required. Periodic spraying (or other means) to control weeds. Weeds/introduced plants to be monitored as part of rehabilitation monitoring programme. Progressive rehabilitation to be undertaken. Local seed to be used if required in rehabilitation. Weed Management Plan to be developed and implemented.	Loss of 93 ha of vegetation at Mt Jackson and 480 ha at Windarling. Approximate area of disturbance along rail corridor is 500 ha. 10 vegetation communities impacted to varying degrees. Impact on vegetation type S6 significant at State scale. Impacts to Windarling ironstone vegetation significant at regional scale. Weed introduction and spread controlled through weed hygiene and management.
Declared Rare and Priority Flora/Flora of Conservation Significance	Protect Declared Rare and Priority Flora, consistent with the provisions of the *Wildlife Conservation Act 1950*. Protect other flora species of particular conservation significance (eg undescribed species).	Baseline studies to identify any Declared Rare Flora, Priority Flora or other species of conservation significance and discussion of the results in a regional/ecosystem context. Assessment of potential impacts (direct and indirect) on Declared Rare Flora, Priority Flora and flora of particular	Two DRF species and 12 species of Priority Flora have been recorded from the project area. Mt Jackson: 1 DRF, 8 Priority Flora Windarling: 1 DRF, 3 Priority Flora	One species of Declared Rare Flora will be impacted: *Tetratheca paynterae* Priority Flora taxa that will be impacted are *Jacksonia jackson* and *Ricinocarpos brevis*.	Impact areas that contain rare flora to be minimised in final design of infrastructure. Additional flora surveys will target known Priority species. Appropriate Priority species to be encouraged to establish in rehabilitation areas. Prepare and implement a	Significant reductions to populations of *Tetratheca paynterae*(DRF)(89% loss) and *Ricinicarpos brevis* (P1)(62% loss) at Windarling. Impact on local and regional status of DRF and Priority species controlled through management actions detailed in Threatened Flora Management and

Issue/Factor	EPA Objective	Scope of Work for PER	Existing Environment	Potential Impacts	Proposed Management	Predicted Outcome
		conservation significance as a result of mining activities and infrastructure. Proposed measures to manage impacts.	Railway Corridor: 3 Priority Flora		Threatened Flora Management and Conservation Plan.	Management and Conservation Plan.
Terrestrial Fauna	Maintain the abundance, species diversity and geographical distribution of terrestrial fauna.	Baseline studies to identify existing terrestrial fauna throughout the areas to be affected by the proposal and discussion of the results in a regional/ecosystem context. Review of existing invertebrate data for the area and identify any species of significance. Assessment of potential impacts (direct and indirect) on terrestrial fauna as a result of mining and associated activities. Proposed measures to manage impacts.	Vertebrate fauna surveys of five major and ten minor habitats throughout the project area. Recorded 158 species including 85 birds, 51 reptiles and 22 mammals (16 native and six introduced). Three species of terrestrial snails recorded.	Loss of habitat due to clearing. Increased numbers of feral fauna. Increased road fauna deaths. Drill hole deaths.	Clearing of habitats to be minimised and undertaken progressively to facilitate animal movement from areas of disturbance. Rehabilitated areas to receive plant debris to provide shelter. Drill holes to be capped. Biodiversity Management Plan to be developed in collaboration with CALM.	Some limited loss of fauna habitat. Maintenance of fauna populations in the area.
Specially Protected (Threatened) Fauna	Protect Specially Protected (Threatened) Fauna, consistent with the provisions of the *Wildlife Conservation Act 1950*.	Baseline studies to identify Specially Protected (Threatened) Fauna (including invertebrates) found within the area affected by the proposal. Assessment of potential impacts (direct and indirect) on terrestrial fauna as a result of mining and associated activities. Proposed measures to manage impacts.	Malleefowl *Leipoa ocellata* (Schedule 1) and Pink Cockatoo *Cacatua leadbeateri* (Schedule 4) recorded from the project area.	Loss of habitat for Rare Fauna. Loss of individuals and mounds of the Malleefowl.	Implement a Malleefowl Conservation Plan for protection of local Malleefowl populations. Additional targeted Rare Fauna surveys to be conducted if required. Biodiversity MP to be developed in collaboration with CALM.	Malleefowl and their mounds protected. Rare Fauna conservation status maintained or enhanced.
Landscape Values	Manage and mitigate impacts to landscape	Assessment of potential impacts of the proposal on existing	Visual Amenity Study undertaken.	Impact to portions of prominent ironstone	Landform reconstruction, and progressive rehabilitation and	Limited impact to ironstone range landforms from mine

Issue/Factor	EPA Objective	Scope of Work for PER	Existing Environment	Potential Impacts	Proposed Management	Predicted Outcome
	values.	landforms/landscape values. Evaluation of the landscape values of the project area and how these will be affected by the proposal and proposed measures to manage such impacts. Details of measures proposed to rehabilitate the impacted areas to an acceptable standard and which will integrate the post mining landform with the surrounding environment.	undertaken. Abrupt ironstone ranges form prominent features in subdued landscape. Remote location and presence of few established roads limit access although minor tracks exist throughout the ranges.	hill landscape features.	revegetation of impacted areas to minimise erosion	pits. Limited landscape/topography altered by mine pits and waste dumps (minor at Mt Jackson).
Decommissioning and Rehabilitation	Ensure that decommissioning and rehabilitation are carried out in a planned sequential manner consistent with best practice and the ANZMEC Strategic Framework for Mine Closure (ANZMEC, 2000). Ensure that the post-mining landform is safe, stable, non-erodible and is integrated into the surrounding environment. Avoid State liability Ensure ecosystem function is maintained following mine closure.	Present as part of the review document: -an integrated mining, decommissioning and rehabilitation strategy (which includes progressive rehabilitation of disturbed areas including the Rail Corridor) -a close out strategy to ensure ecosystem function will be maintained following mine closure and impacts on landscape values will be minimised.	Some existing land degradation due to previous exploration activity. Much of the area relatively undisturbed, pastoral use only No current Environmental Management System for the project	Alterations to landforms and vegetation at Mt Jackson, Windarling, and along the Rail Corridor.	Rehabilitation and revegetation of all areas impacted including haul roads, waste dumps, ore stockpile areas and rail infrastructure. Mine pits will be amenable limited to rehabilitation. Mine Closure Plan developed and implemented, and to reflect the status and characteristics of the project. Provision made for maintenance and monitoring following decommissioning.	Post mining landscape will resemble pre-impact status with the exception of mine pits. Waste dumps will be rehabilitated. Post mining landform stable and vegetated.
Watercourses	Maintain the integrity, functions and environmental values of	Baseline studies to identify watercourses, and types of surface water flow throughout	No permanent watercourses within the area. Seasonal or intermittent drainage in	Minor disturbance of watercourses	Incorporate drainage maintaining structures within the rail easement.	Maintenance of natural water flow patterns.

Issue/Factor	EPA Objective	Scope of Work for PER	Existing Environment	Potential Impacts	Proposed Management	Predicted Outcome
	watercourses and sheet flow.	the areas to be affected by the proposal. Assessment of the potential impacts on surface water flow rates, drainage patterns, erosion and sediment transport, as a result of mining and associated activities. Proposed measures to manage impacts.	palaeochannels and minor drainage lines.			
Groundwater Quantity	Maintain (sufficient) quantity of groundwater so that existing and potential uses, including ecosystem maintenance, are protected.	Details of the hydrogeological systems of the project area, existing uses of groundwater (including ecosystem maintenance) and the proposed dewatering operations. Assessment of the potential short-term and long-term impacts on groundwater systems as a result of below-the-watertable mining. Proposed measures to manage impacts, including managing impacts on dependent vegetation.	Hypersaline groundwater found in exploration drill holes Palaeochannels inferred to contain groundwater reserves Detailed survey of groundwater reserves not yet undertaken	Localised decrease in groundwater levels at extraction sites. No mining below the water table, and hence dewatering not included under current proposal.	Monitoring of groundwater quantity at extraction sites.	Maintenance of sufficient quantities of groundwater
POLLUTION MANAGEMENT						
Surface Water Quality	Maintain or improve the quality of surface water to ensure that existing and potential uses, including ecosystem maintenance are protected, consistent with the Australian and New Zealand Water Quality Guidelines	Details of potential for acid mine drainage, hydrocarbon use/storage, dewatering activities, and fate of water used/pumped. Assessment of the implications for local and regional surface/ground water quality. Proposed measures to manage	Seasonal or intermittent drainages carry sediment loads. The majority of the mined material is oxidised so acid mine drainage will not be an environmental issue.	Minor localised impacts to sediment loads Saline water to be used in dust suppression, hence increased salinity of surface water along haul roads	Periodic removal of deposited salts from haul road spoon drains Mine waste characterisation study to be undertaken to determine likelihood of acid mine drainage.	Surface water quality maintained.

Issue/Factor	EPA Objective	Scope of Work for PER	Existing Environment	Potential Impacts	Proposed Management	Predicted Outcome
	Quality Guidelines (ANZECC, 2000).	impacts.				
Groundwater Quality	Maintain or improve the quality of groundwater to ensure that existing and potential uses, including ecosystem maintenance are protected, consistent with the Australian and New Zealand Water Quality Guidelines (ANZECC, 2000).	Details of the existing water quality of groundwater aquifers. Identification of potential sources of groundwater contamination associated with the proposal, including the potential for acid mine drainage. Assessment of the potential impacts on local/regional groundwater quality. Proposed measures to manage impacts.	Existing groundwater principally hypersaline.	Negligible impacts to groundwater quality.	Monitoring of groundwater quality at extraction sites.	Groundwater quality maintained
Particulates/ Dust	Use all reasonable and practicable measures to minimise emissions. Ensure that particulate/dust emissions both individually and cumulatively, meet appropriate criteria and do not cause an environmental or human health problem.	Identification of sources of particulates/dust (including emissions associated with rail transport) and estimates of project-wide emissions. Analysis of the significance of these emissions with regard to human health and environmental impacts, in particular, impacts on vegetation. Proposed measures to manage potential impacts.	Dust generated currently primarily through natural causes. Some dust generation along roads.	Dust will be generated from mine blasting and excavation, ore handling and haulage, and crushing and processing.	Dust suppression through watering on unsealed haul roads, and water sprays on crushing and processing plants.	Control measures will minimise dust impacts. No significant dust impacts are expected.
Noise	Ensure that noise levels meet acceptable standards. Ensure that noise emissions meet appropriate criteria and do not cause an	Identification of sources of noise including that associated with rail transport. Analysis of the significance of these emissions with regard to human health and environmental impacts.	Project location in a remote area. Mine areas and Rail Corridor not near towns or station homesteads.	Localised increase in sound levels due to construction and operation activities.	Personnel supplied with protective hearing equipment. Diesel generators to be located in sound enclosures.	No significant impacts to surrounding areas from noise emissions are expected.

Issue/Factor	EPA Objective	Scope of Work for PER	Existing Environment	Potential Impacts	Proposed Management	Predicted Outcome
	environmental or human health problem.	environmental impacts. Proposed measures to manage potential impacts.				
Solid Waste	Ensure that wastes are contained and isolated from ground and surface water surrounds and treatment or collection does not result in long term impacts on the natural environment.	Details of the composition, storage and disposal of all solid wastes. Proposed measures to manage impacts.	No existing landfill/solid waste disposal facilities in the area. Construction and operation activities will generate a variety of solid waste materials.	Solid waste and sewage waste generated from accommodation village. Purpose-built landfill site to be established in the project area. Septic system to be established.	Landfill site to be selected in accordance with DEWCP Code of Practice and licenced to DEWCP requirements Recycling to be undertaken where possible. Septic system licenced to DEWCP and Health Department requirements.	Localised impact from landfill site. Volume of waste will not be significant so overall impact minor.
SOCIAL SURROUNDINGS						
Aboriginal culture and heritage	Ensure that the proposal complies with the requirements of the *Aboriginal Heritage Act 1972*; Ensure that changes to the biological and physical environment resulting from the project do not adversely affect cultural associations with the area.	Identification of Aboriginal cultural and heritage sites of significance through archaeological and ethnographic surveys of the project area and through consultation with local Aboriginal groups and the Department of Indigenous Affairs. Consultation with the Aboriginal people of the area to determine potential impacts of the proposal on cultural associations within the project area. Proposed measures to manage impacts.	Archaeological and ethnographic survey of the area undertaken. 15 sites of potential indigenous heritage significance identified in the general area. Three sites listed by the Department of Indigenous Affairs within the project area.	Sites KY05-09 in vicinity of Rail Corridor but will not be directly impacted.	Ensure that the Rail Corridor does not transgress areas of indigenous heritage significance. Limit access to Aboriginal cultural and heritage sites of significance near to the mine areas.	Rail Corridor will avoid sites of indigenous significance. No impact to sites of indigenous heritage significance.
Non-indigenous heritage	Ensure that changes to the biological and	Identification of non-indigenous heritage sites that may be	Search of relevant databases indicates that no sites of	N/A	N/A	No impact to non-indigenous heritage sites

Issue/Factor	EPA Objective	Scope of Work for PER	Existing Environment	Potential Impacts	Proposed Management	Predicted Outcome
	physical environment resulting from the project do not adversely affect cultural associations with the area.	adversely impacted by the proposal. Proposed measures to manage impacts.	National, State or local heritage significance occur within the project area.			

1.1 BACKGROUND

Portman Iron Ore Limited (Portman) currently mine iron ore at Koolyanobbing, located 425 kilometres east of Perth and approximately 54 kilometres north-east of Southern Cross (Figure 1.1). The Koolyanobbing iron ore deposits are classified as supergene, haematite-goethite ores and are located within the Yilgarn Block, a major geological feature of Western Australia.

Mining operations at Koolyanobbing are carried out under the *Mining Act 1978*, and focus primarily on the A, B, C, D and K deposits. They are distributed over 7 km of the Banded Iron Formation (BIF) Koolyanobbing range, with an additional resource, the 'F' deposit, located 5 km southeast of deposit 'D' (Figure 1.2). At Koolyanobbing approximately 3.5Mt are mined annually, with a waste to ore ratio of 3:1 and a lump to fine product ratio of 47:53.

The Koolyanobbing deposits were originally discovered by prospectors in 1887, and first mined in 1948 by the West Australian Government to supply the charcoal iron industry at Wundowie. BHP Limited were responsible for further development of the mine in the 1960s and focussed primarily on the subsequently named 'K deposit' up until 1983.

Through extensive pre-feasibility studies it has been determined that there are a number of iron-enriched satellite deposits to the north of Koolyanobbing. Portman are proposing to increase their production of iron ore from approximately 3.5 Mtpa to 8 Mtpa over the next five years, by continuing to mine at Koolyanobbing whilst expanding the project to include some of the northern deposits. These deposits, seven of which have been evaluated by Portman, are located in two proposed mining areas (Figure 1.2):

- Mt Jackson, in the Jackson Range, comprising deposits J2 and J3; and
- Windarling, in the Windarling Range, comprising deposits W1, W2, W3, W4 and W5.

Mining of the northern deposits would require the development of small scale open cut mining operations, crushing plants, ore stockpiling areas and waste dumps. A rail line will be required to transport ore to processing facilities at Koolyanobbing.

It is anticipated that construction of mine infrastructure, mining of iron ore and transshipment will be phased in during 2002/3. The mines, which will be worked concurrently in order to blend the ores to render them suitable for export, are predicted to have a life span of approximately 10 years. However it is anticipated that additional exploration, such as in the Mayfield area, may result in further iron ore discoveries resulting in a longer mine life.

As a result of this proposal the Koolyanobbing Expansion Project was referred to the Environmental Protection Authority (EPA) who determined that the level of environmental assessment be set at Public Environmental Review (PER), with a four week public review period.

This PER document identifies potential environmental impacts that may arise from the proposal and recommends methods of preventing or reducing their effect on the environment. The PER document has been prepared in accordance with guidelines issued by the EPA for the Koolyanobbing Expansion Project (Appendix A).

1.2 THE PROPONENT

The proponent for the proposed Koolyanobbing Expansion Project is:

Portman Iron Ore Limited (ACN 007 871 892)
Level 11, The Quadrant
1 William Street
PERTH WA 6000
Telephone: 08-9426-3333
Fax: 08-9426-3344
e-mail: www.portman.com.au

Portman is an Australian owned iron ore group and is Australia's fourth largest iron ore producer with current focus on the expansion of the Koolyanobbing and Cockatoo Island Projects. The acquisition by Portman in January 2000 of Angang's 40% interest in Koolyanobbing increased their ownership of the venture to 100%. The other principal area of interest for Portman is the Cockatoo Iron Ore Joint Venture in the Kimberley region of Western Australia.

Correspondence in regard to this PER document should be directed to Mr Garry Connell, Manager Environment, at the Portman offices or by e-mail to gconnell@portman.com.au.

1.3 LOCATION

Koolyanobbing is located 425km ENE of Perth and approximately 54km north east of Southern Cross in the Eastern Goldfields region of Western Australia. Access to the site is from the Great Eastern Highway, turning north at Southern Cross to Koolyanobbing. The three proposed mine areas are located from 70 to 150 kms north of Koolyanobbing (Table 1.1).

Table 1.1: Location of the Northern Deposits

Mine Area	Location	Latitude	Longitude	Exploration Lease
Mt Jackson	65 km NNW of Koolyanobbing	30 15 46 S	119 14 31 E	E 77/511 E 77/896
Windarling	90 km NNW of Koolyanobbing	30 00 45 S	119 17 03 E	E 77/1032

Kalgoorlie is located 250 km to the east of the project area, and the port of Esperance, situated on the south coast of Western Australia, lies approximately 450 km south of Kalgoorlie. Iron ore processed at Koolyanobbing is currently transported by rail via Kalgoorlie to the port of Esperance for export.The two proposed mining areas lie in the Shire of Yilgarn within the Goldfields Region.

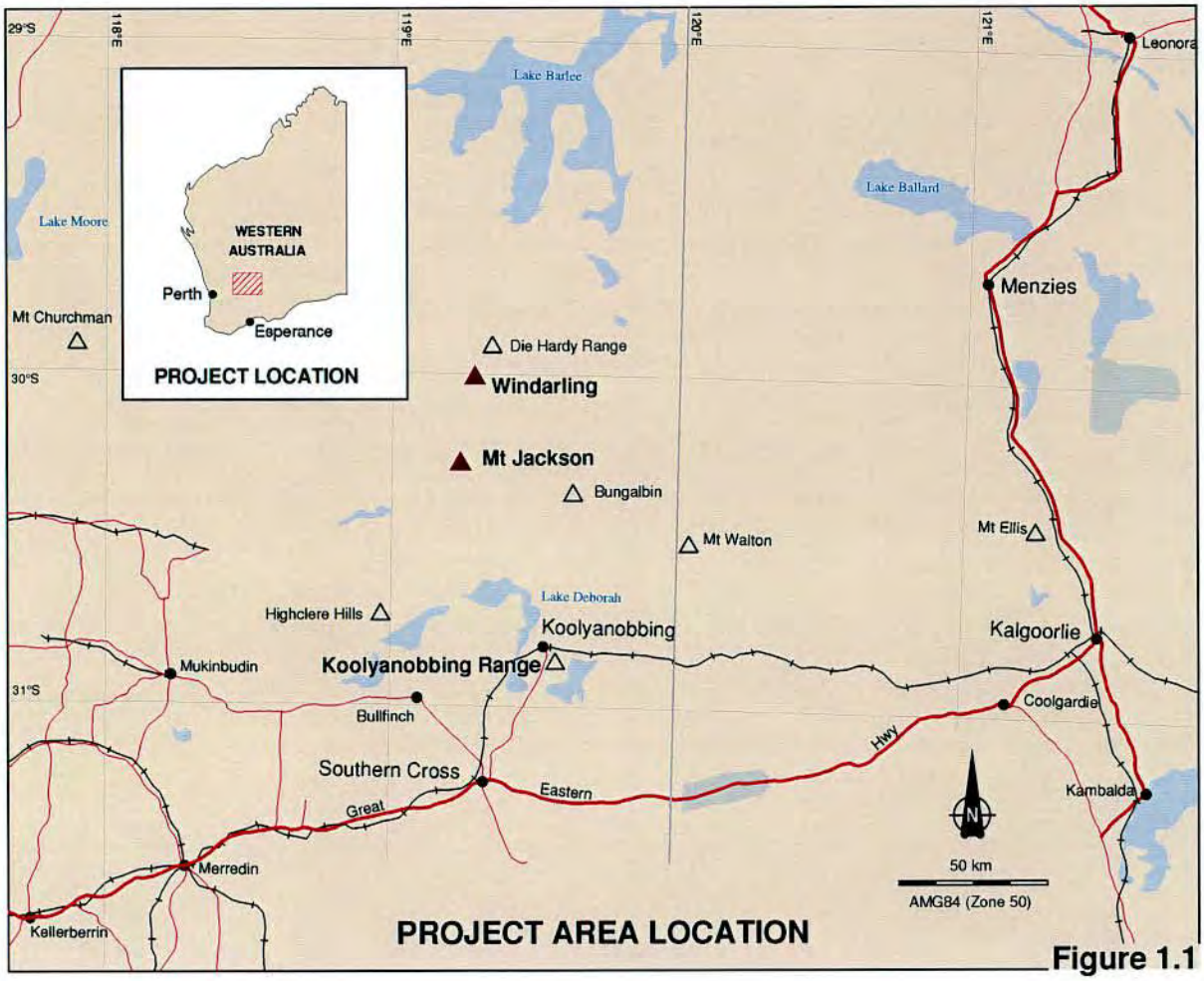

29°S
118°E
119°E
120°E
121°E
Lake Barlee
Lake Ballard
Lake Moore
WESTERN AUSTRALIA
Perth
Esperance
PROJECT LOCATION
Mt Churchman
30°S
Die Hardy Range
Windarling
Mt Jackson
Bungalbin
Mt Walton
Menzies
Leonora
Mt Ellis
Lake Deborah
Highclere Hills
Koolyanobbing
Kalgoorlie
Mukinbudin
Koolyanobbing Range
31°S
Bullfinch
Coolgardie
Southern Cross
Great Eastern Hwy
Kambalda
Merredin
Kellerberrin
N
50 km
AMG84 (Zone 50)
PROJECT AREA LOCATION

Figure 1.1

KOOLYANOBBING AND PROPOSED EXPANSION AREAS

Figure 1.2

1.4 PROJECT SCOPE AND TIMING

This PER document examines the environmental implications associated with the expansion of the Koolyanobbing mine to include two new mine areas at Windarling and Mt Jackson, and the associated construction of a new rail link from Koolyanobbing to the proposed sites. The two main components of the project are;

- Mine areas – two new mine areas at Windarling and Mt Jackson that include at least seven known deposits.

Transport corridor – construction of a rail line and associated access road from Koolyanobbing to the proposed Windarling mine site with a subsequent connection to Mt Jackson via an additional spur line. The main rail line from Koolyanobbing to Windarling will be 112km in length with a 11km spur line connecting to Mt Jackson (Figure 1.2).

The term 'Koolyanobbing Expansion Project' will be used in this document when considering these components as a whole.

Construction of mine infrastructure and associated facilities is proposed to commence in the middle of 2002 with production of ore commencing in the second half of the year. Transportation of ore to Koolyanobbing is scheduled for the first half of 2003. Portman is ultimately proposing to mine the two areas concurrently, facilitating blending to render the ore suitable for export to Asian markets. Mining in the region may yield up to 80 Mt of saleable iron ore. The life span of the project is estimated to be up to 10 years, with decommissioning potentially in 2012 based on current scheduling and planning.

Primary crushing will take place on site at the two individual mine areas. Ore will be transported to Koolyanobbing for secondary crushing and screening prior to transport to Esperance. In order to accommodate the anticipated increase in iron ore production due to the proposed expansion, some facilities at the existing Koolyanobbing mine will need to be upgraded or expanded and may include:

- Expanded crushing and screening facilities
- Expanded heavy vehicle maintenance workshop and warehouse;
- Expanded mine offices;
- Increased numbers of employees at the mine sites; and
- Enhanced train-loading facilities.

1.4.1 Project Exclusions

This PER document addresses environmental factors associated with the proposed Koolyanobbing Expansion Project area, including mine areas at Windarling and Mt Jackson, and the rail route connecting these sites to Koolyanobbing. Furthermore, the expansion and/or upgrading of facilities at the existing mine at Koolyanobbing is within the remit of this PER. The scope for which approval is sought for the current PER does not include:

- mining iron ore below the water table (hence no dewatering is planned at this stage); and
- the impact of activities relating to the increased transport of ore from Koolyanobbing to the Port of Esperance or likewise the shipping of ore from Esperance.

1.5 LEGISLATIVE FRAMEWORK

Portman acknowledges the requirement to comply with relevant Commonwealth and State legislation that will apply to the development and operation of the Koolyanobbing Expansion Project. This legislation includes, though is not necessarily limited to, the following:

Table 1.2: Environmental Legislation and Responsible Government Agencies

Legislation	Responsible Government Agency
Commonwealth	
Aboriginal and Torres Strait Islander Heritage Protection Act 1984	Aboriginal and Torres Strait Islander Commission
Australian Heritage Commission Act 1975	Australian Heritage Commission
Environment Protection and Biodiversity Conservation Act 1999	Environment Australia
Native Title Act 1993	National Native Title Tribunal
State	
Aboriginal Heritage Act 1972	Department of Indigenous Affairs
Agricultural and Related Resources Protection Act 1976-1981	Agriculture Western Australia
Bushfires Act 1954-1981	Bush Fires Board
Conservation and Land Management Act 1984	Department of Conservation and Land Management Management
Dangerous Goods Regulations 1992	Department of Minerals and Petroleum Resources
Environmental Protection Act 1986	Department of Environment, Water and Catchment Protection/DEWCP
Environmental Protection (Noise) Regulations 1997	Department of Environment, Water and Catchment Protection/ DEWCP
Explosives and Dangerous Goods Act 1961	Department of Minerals and Petroleum Resources
Heritage of Western Australia Act 1990	Heritage Council of Western Australia
Land Act 1933	Department of Land Administration
Land Administration Act 1997	Department of Land Administration
Local Government Act 1995	Department of Local Government/Shire of Yilgarn
Mining Act 1978	Department of Minerals and Petroleum Resources
Mines Safety and Inspection Regulations 1995	Department of Minerals and Petroleum Resources
Mines Safety and Inspection Act 1994	Department of Minerals and Petroleum Resources
National Parks and Wildlife Act 1972	Department of Conservation and Land Management
Rights in Water and Irrigation Act 1914	Water and Rivers Commission
Soil and Land Conservation Act 1945	Agriculture Western Australia
Wildlife Conservation Act 1950	Department of Conservation and Land Management
Water Authority Act 1984	Water and Rivers Commission

1.6 ENVIRONMENTAL APPROVAL PROCESS

1.6.1 State Assessment Process

This PER has been prepared in accordance with guidelines issued by the EPA as detailed in Appendix A. This PER is based on the EPA's assessment and approval process, which is illustrated in Figure 1.3 and summarised below.

At the State Government level the EPA is required to assess all development proposals that may have a significant environmental effect. In this instance, the EPA has decided to formally assess the proposal at the level of Public Environmental Review, pursuant to the provisions of Part IV of the *Environmental Protection Act 1986*.

In setting the level of environmental impact assessment for the proposed Koolyanobbing Expansion Project, the EPA has required that the PER document be released for a four (4) week public review period. During this period any interested individual, community group, organisation, or Government agency can peruse the document and lodge a submission on the proposal with the EPA. This PER is a public document and is part of the statutory public environmental impact assessment process established by the *Environmental Protection Act 1986*.

The EPA's formal environmental impact assessment process allows members of the public to obtain details of the proposal being assessed and to comment on any matters of interest or concern. It also enables Government authorities to consider the environmental and social implications of the proposal and provide comments as appropriate to the EPA. Government agencies involved in the approvals process may include:

- Department of Conservation and Land Management (CALM)
- Department of Environment, Water and Catchment Protection (DEWCP)
- Department of Indigenous Affairs (DIA)
- Department of Land Administration (DOLA)
- Department of Mineral and Petroleum Resources
- Conservation Commission (CC)
- Water and Rivers Commission (WRC)
- Western Australian Museum (WAM).

The EPA considers all comments received from government agencies and the public, and provides a summary of submissions to the proponent for their response.

Following completion of the public review period and receipt of the proponent's response to the summary of submissions, the EPA will complete its assessment of the proposal and submit its report to the Minister for the Environment. The EPA's report to the Minister provides advice to the State Government about whether the proposal meets the EPA's objectives for environmental protection.

The EPA's Assessment Report is released for a two week period during which the public can scrutinise the conclusions and, if warranted, appeal to the Minister against the recommendations made in regard to the proposal. The Minister for the Environment will assess any appeals received and ultimately determine whether or not the proposal can proceed. If the Minister determines that the proposal can proceed, legally binding conditions dictating the environmental requirements with which the proponent has to comply will be set pursuant to Section 45 of the *Environmental Protection Act 1986*.

In order for the proposed Koolyanobbing Expansion Project to proceed, the following statutory requirements need to be completed:

- release of the PER document for a four (4) week public review period;
- DEWCP prepares a summary of submissions;
- proponent provides the DEP with written responses to all issues raised in submissions received during the public review period. Where appropriate, the proponent may amend the proposal and/or change the management commitments in response to comments raised during the public review period, provided those changes do not significantly increase environmental impacts;
- the DEP submits an evaluation of project impacts to the EPA, and any additional requirements to ensure that the proposal would satisfy environmental policies and objectives;
- the EPA provides its advice to Government on the proposal through its Assessment Report made to the Minister for the Environment. The Report and Recommendations are released to the public, and there is a 14-day appeal period regarding the Report.
- the Minister determines any appeals against the EPA's Report and if the proposal is regarded as environmentally acceptable, sets legally binding conditions on the proponent; and
- the project is commenced according to the Ministerial Conditions and Proponent Commitments set out in the Statement that a Proposal may be Implemented (Pursuant to the Provisions of the Environmental Protection Act)

1.6.2 Commonwealth Assessment Process

For this project, the environmental approvals process is a joint undertaking between the Commonwealth of Australia, in accordance with the *Environment Protection and Biodiversity Conservation Act 1999*, and the Western Australian Government under the *Environmental Protection Act 1986*. The joint review process has been triggered by the presence of rare and protected flora and fauna in the vicinity of the project area. However, due to the current accredited State PER process, involvement by the Federal government will occur only in the latter stages of the State assessment, after the EPA recommendations have been made. At this stage the Federal Minister will prepare a separate assessment report with or without additional legally binding conditions, but *only* with regard to the rare and protected flora and fauna that initially triggered the Commonwealth EPBC Act process.

1.7 PER STRUCTURE AND OBJECTIVES

This PER document is divided into three sections:

Part One: The proposed Koolyanobbing Expansion Project. This section serves as an introduction to the project, describing the project background, the proponent, relevant legislation, project justification and an overview of the mining process and methodology.

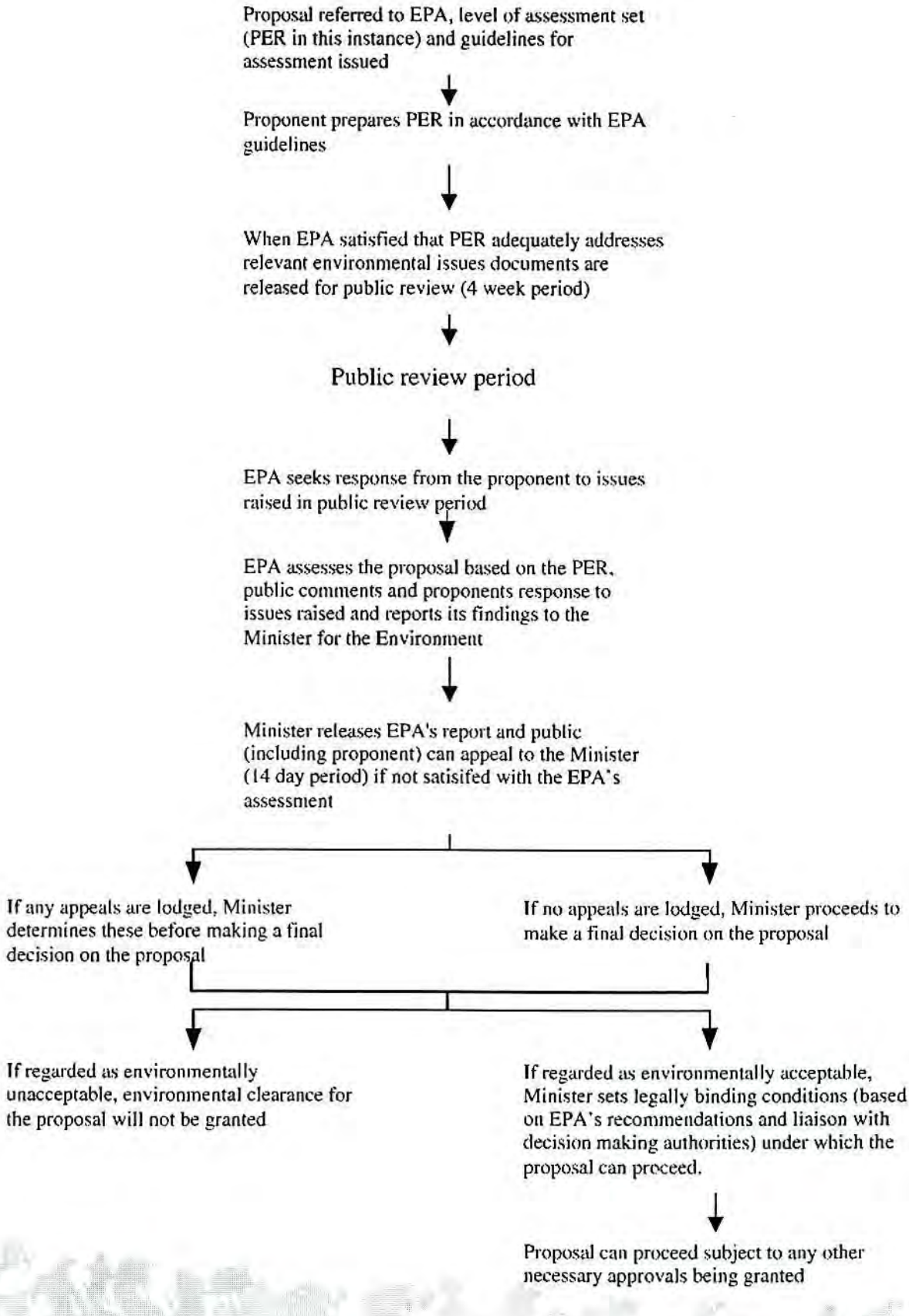
Part Two: Existing Environment. This section is primarily concerned with describing the existing physical, biological and cultural environment prior to development of the project and discusses relevant aspects such as groundwater, surface hydrology, vegetation and flora, fauna, geology and cultural heritage.

Part Three: Environmental Impacts and Management. This section is concerned with the impact of the proposed development on the existing environment and the mitigation measures and management plans that are proposed to prevent and/or reduce any resulting impacts, direct or indirect.

The objectives of this PER are principally to:

- provide information concerning the proposal to the EPA, government agencies, interested parties and the general public so that an informed decision can be made as to the environmental suitability of the project; and
- stipulate the Proponents' commitments to environmental management.

Figure 1.3: The State Environmental Assessment Process



2.1 PROJECT JUSTIFICATION

Iron ore forms the principal raw material for crude steel production. Demand for iron ore is increasing particularly from China, Taiwan and Korea with an established market in Japan. Due to the proximity of Western Australia to the high-growth Asian economies, sea borne trade is established and is forecast to show continued growth. Western Australia produces 95% of Australia's iron ore equating to 150 million tonnes per annum.

Development of the Koolyanobbing Expansion Project would provide an additional source of high grade ore, which increases the diversity of products and increases market opportunities. Driving forces behind the development of the project are:

- Demand for Iron Ore from Asia – during 2000, steel production and consequently demand for iron ore rebounded strongly from the effects of the Asian economic crisis (1998/99). Demand from China for iron ore increased by 27% from 55 million tonnes in 1999 to 70 million tonnes in 2000, while Japanese crude steel production of 106 million tonnes saw a 10% increase in demand for iron ore to 132 million tonnes.
- Other Key Developments in the Iron Ore Industry – ongoing rationalisation including the takeover in Australia of North Limited by Rio Tinto and further consolidation of iron ore interests in Brazil. This consolidation, which reduces the number of major suppliers, is such that smaller independent suppliers of high-grade iron ore such as Portman have become more attractive in the global iron ore market.
- Additional Source of Quality Lump and Fine Ore – Koolyanobbing ore is renowned for its very low concentration of alumina, and its performance as a sintering fine ore and direct charge lump ore.

2.1.1 State and National Benefits

The establishment of the Koolyanobbing Expansion Project will result in a number of benefits to the state of Western Australia and to the Commonwealth including:

- investment in the order of 150 million dollars, the majority of which will be directed into the Western Australian economy;
- increased export value of Western Australian iron ore products to international customers;
- additional Commonwealth and State Government revenue through collection of royalties, taxes and other charges;
- direct employment in the Goldfields region, peaking at around 200 people during construction and over 180 during operation;
- increased demand for goods and services creating business and employment opportunities; and
- potential for development of downstream processing.

In addition to the direct benefits of mining proposals there are flow-on benefits to the non-mining sector. The multiplying effects of mining for the rest of the economy in 1996 were estimated as:

- any increase in the output of mining results in a two fold increase in the output of non-mining industry;
- a $1 million increase in mining wages and benefits results in a $2 million increase in the non-mining sector; and
- for every 100 jobs created in the mining industry approximately 300 non-mining jobs result.

(MacLeod and Gerhardy, 1996).

From an economic standpoint the Project will provide both direct and indirect employment opportunities in the Goldfields region, as well as a substantial investment in infrastructure.

2.1.2 Need for the Proposal

Western Australia's economy is heavily dependent on mineral resource projects, and its future growth and development are dependent on the continued viability of resource development projects. Iron ore exploration, exploitation and export are essential components of the Goldfields Region and the State's employment and economic outlook.

High-grade haematitic ores are in demand from the blast furnace based steel industry. The very low alumina content of the ores makes them an ideal substitute for similar ores from Brazil. There is an emerging shortage of quality lump ores suitable for direct charge to blast furnaces. Koolyanobbing lump ore is proving to be an excellent direct charge ore and has strong market prospects. At a time of rationalisation in the iron ore industry buyers are actively pursuing alternative supply sources.

Portman is winning market support as a small but unique independent source of ore. To capitalise on these opportunities Portman needs to demonstrate a capability for supplying larger volumes on a long-term basis. Expansion of the Koolyanobbing Project to include the Northern Deposits as proposed in this PER document would be an essential step in achieving this goal.

EVALUATION OF ALTERNATIVES

2.2.1 Mining

As indicated previously a number of deposits are being explored by Portman in the Koolyanobbing area. Up to seven of these deposits are proposed for further development, pending the outcome of ongoing testing, exploration and evaluation. The deposits being evaluated are;

- Windarling – W1, W2, W3, W4 and W5 deposits; and
- Mt Jackson – J2 andJ3 deposits.

Portman is currently mining the Koolyanobbing deposits at the existing Koolyanobbing operation. In the future it is proposed that the Koolyanobbing deposits be mined in conjunction with the northern deposits encompassed by the expansion project. This will provide a production capacity of 8 Mtpa over the next three to five years. Table 2.1 summarises the results of deposit evaluations to date.

Table 2.1: Evaluation of Mining Deposits to Date

Area	Deposit	Cut-off	Category	Tonnes	Fe%	P%
Mt Jackson	J2	Fe≥58% S≤0.18	Indicated	14.7	62.10	0.040
			Total	14.7	62.10	0.040
	J3	Fe≥58%	Indicated	1.5	62.30	0.040
			Total	1.5	62.30	0.040
Windarling	W1	Fe≥60%	Indicated	10.7	62.54	0.15
			Total	13.6	62.5	0.16
	W2	Fe≥58%	Indicated	14.7	64.69	0.075
			Inferred	1.9	64.72	0.080
			Total	16.6	64.69	0.076
	W3	Fe≥58% P≤0.15	Inferred	21.0	63.86	0.121
			Total	21.0	63.86	0.121
	W4	Fe≥58%	Indicated	1.3	60.09	0.127
			Inferred	0.1	59.47	0.132
			Total	1.4	60.05	0.127
	W5	Fe≥58%	Indicated	7.9	63.35	0.097
			Inferred	1.2	63.36	0.096
			Total	9.1	63.35	0.097
Existing Koolyanobbing Site						
	A	Fe≥58%	Indicated	4.5	61.33	0.051
			Total	4.5	61.33	0.051
	K	Fe≥60% P≤0.14	Indicated	16.8	63.54	0.100
			Inferred	2.5	63.32	0.121
			Total	19.3	63.51	0.103
	D	Fe≥58%	Indicated	3.1	61.64	0.033
			Total	3.1	61.64	0.033
	C	Fe≥58%	Indicated	2.5	59.89	0.047
			Inferred	1.7	60.30	0.042
			Total	4.2	60.06	0.045
Total	Total		Indicated	66.9	62.98	0.072
			Inferred	28.4	63.62	0.112
			Total	109	63.17	0.084

2.2.1.1 Windarling W3 and W5 Depsoits

The environmental assessment studies reported in Section 5 have revealed significant biological and conservation values present on the range containing the W3 and W5 deposits at Windarling. The DRF *Tertratheca paynterae* and Priority 1 *Ricinocarpus brevis* flora species both grow directly on top of the sub-vertical ore body.

While Portman acknowledges the environmental values associated with this area, the exclusion of the W3 deposit from the proposal represents a reduction of approximately 35-40 % in blendable economic ore available to the project. Any exclusion of mining from this area severely impacts on the available tonnes. He loss of access to this ore would render the 8 Mtpa expansion project uneconomic and not viable.

Preferred Development Option

The development option preferred by Portman is to gain access and approval to mine the entire economic mineable mineralised portion of the W3 deposit at Windarling. This option would yield the maximum economic return to both Portman and the State. The primary environmental impactsa arising from this option have been detailed in Sections 6.1 and 6.2.

Alternate Development Option

An alternate development option is to gain access and approval to mine approximately 70 % of the economic mineable mineralised portion of he W3 deposit at Windarling. This option would allow the proposal to be economically viable although the economic return to both Portman and the State would be significantly reduced. It is considered by Portman that access to a minimum of 70% of the W3 deposit is required in order for the expansion project to be economically viable.

A comparison of the primary environmental impacts arising from this option with those associated with the Preferred Development Option is presented in Table 2.2.

Table 2.2: Comparison of Mining options for Windarling W3 deposit.

	Preferred Option (mining 100%)	Alternate Option (mining 70%)
Impact to *Tetratheca paynterae* (DRF):		
Number of individuals	2,413	1,712
% of population	85%	60%
population area	3.2ha	2.0ha
% of population area	80%	50%
Impact to *Ricinocarpus brevis* (P1):		
Number of individuals	3,220	2,240
% of population	40%	20%
population area	16.1ha	11.3ha
% of population area	39%	27%

2.2.2 Mode of Transport

Road and rail were the two main alternatives assessed with regard to mode of ore transport, although studies conducted to date have focussed primarily on the latter. Rail provides the most appropriate means of transport for the large tonnages of ore produced from iron ore mining operations.

A Rail Route Options report was completed by Halpern Glick Maunsell (HGM) in 2001 to investigate rail route options to the proposed mines and to estimate the capital cost of the rail option. The results of this study are discussed in Section 2.2.3. A similar study has been undertaken for road alternatives. One of the principal advantages in using road transport over rail is that installation of the road infrastructure could be expedited for earlier commencement of mining operations.

2.2.3 Rail Route Options

The objective of the Rail Route Options study (HGM, 2001) was the assessment of alternative rail route options to proposed mine sites and identification of a preferred route. The results of this study have been summarised in the following section.

A total of 13 possible alignments were considered during the rail route selection process. These were identified based on the possible sequence of mining operations and estimated geotechnical conditions. In summary, there are three main route options, HA1, HA1 South, and HA2, with minor variations within these forming the other options. The principal alignment options are as follows:

- HA1 – Koolyanobbing to Windarling Railway line with spur line, HA4, to the northern flank of Mt Jackson. The alignment leaves the existing line approximately 5 km east of Koolyanobbing and has a total length of 112 km.
- HA1 South – The first 75 km of this alignment is identical to HA1. A spur line, HA8, to the southern side of Mt Jackson diverges from alignment HA1. Along HA8, alignment HA9 begins and heads north towards Windarling Peak. For the first 25km, alignment HA9 is located to the east of HA1.
- HA2 – Koolyanobbing to Mt Jackson. This alignment leaves the railway line approximately 10km east of Koolyanobbing and resumes the HA1 alignment at chainage HA1 Ch67,500. An option to cross from alignment HA2 to HA1 is provided at chainage HA2 10,000. This small section of alignment is referred to as HA6.
- HA7 – Alignment HA7 provides an alternative route for the first 20km of alignments HA1 and HA1 South. This alignment leaves the Koolyanobbing mine loop further to the west than HA1 and HA2.

Preferred Route

The preferred rail route option that evolved during the route selection assessment process was HA1 South, running from Koolyanobbing to Windarling (114km) with a branch to Mt Jackson (11km) using the alignment HA7 for the first 25km. The train will carry run of mine ore or primary crushed ore from the northern mines to a centralised ore processing facility at Koolyanobbing.

Sidings and connecting spur line options have been developed for both the north and south sides of the Jackson Range. For environmental and mine operation reasons the southern approach to Mt Jackson is preferred. This route avoids core habitat of the threatened Mallee Fowl in the vicinity of Mt Jackson. To reduce track length, the line to Windarling passes through a gap in the line of low hills that cross the area from northwest to southeast.

One of the influences on selection of the Mt Jackson route was the possible existence of areas with poor substrate conditions. The suggestion that these conditions occur in the area is based on various sources of local experience, and is particularly the case during wet conditions and in watercourses leading to large salt lakes in the area e.g. Lake Deborah East. This tended to bias the route to Mt Jackson to the east of a more direct line, so as to reduce the extent of land types considered to be unsuitable.

The rail is single track throughout, with a triangle at the Mt Jackson junction and loco run-rounds at the mines and at Koolyanobbing. A run-around the length of a train on either of the dump station is allowed in the design at Koolyanobbing. However, a single train length run-around with a "dead-end" is assumed at the mines.

At the southern end of the preferred route a siding connecting to the existing Koolyanobbing loop is preferred because this supports the use of Koolyanobbing for centralised processing and blending of ore. This will enable separate rail operations that could justify an alignment north of Koolyanobbing with lower grades and lower operating costs, rather than designing to Esperance line standards.

The length of track from Koolyanobbing to Windarling is 111.9km with an 11km spur line on the south side of Mt Jackson and a triangle at the junction. Total length of the preferred route is 124.5km. The total track length including sidings is 128.5km.

2.3 NO DEVELOPMENT OPTION

The consequences of not proceeding with the proposed Expansion Project are that the employment and economic benefits of the proposal as outlined in Sections 2.1.1 and 2.1.2 will not be achieved.

The lump and sinter fines products that will be produced from the mine area are of high quality. The Koolyanobbing Expansion Project addresses the current trend and future opportunities provided for in blast furnace steel making in the Asian region. Without the ability to meet long term demand from major customers, Portman's longer-term viability as a competitive exporter of iron ore would be compromised, with substantial loss of revenue and benefits to the State of Western Australia.

Production only from the existing Koolyanobbing operation is not considered by Portman to be an appropriate long-term option. Because of the limited resource of the Koolyanobbing deposits this operation could not sustain a sufficient volume of ore for the required duration to attract and maintain the customer base that Portman requires. On the other hand a ten-year project producing up to 8 Mtpa from a combination of the Koolyanobbing and northern deposits would make Portman an attractive, independent and sustainable alternative supplier for steel producers in Asia. The considerable benefits to the State can then be realised.

3.1 OVERVIEW

Portman are proposing the expansion of the Koolyanobbing Iron Ore operation with the construction and development of new iron ore mines based on seven deposits in two areas to the north of Koolyanobbing (Tasble 3.1). The deposits at Mt Jackson and Windarling will provide the resources to increase the current rate of production from 3.5 Mtpa at Koolyanobbing to 8 Mtpa over the next three to five years. The iron ore will be crushed and screened at Koolyanobbing and loaded on to trains for transport to Esperance for shipping. The expansion project has two main components:

(i) Mining. This will involve the development of at least seven new small-scale open cut iron ore mining operations and the construction of associated waste dumps and infrastructure. The iron ore deposits are relatively small (< 30 Mt per deposit) and occur as discrete bodies at different locations within the elevated ranges in the area. The Mt Jackson area has two economic deposits (J2 & J3) and Windarling has five deposits (W1 - W5). There is also the potential for the discovery of additional deposits in the region, such as at Mayfield.

(ii) Rail infrastructure. This will involve the construction of a 114 km rail link between the existing Koolyanobbing mining area and the proposed Windarling mine area with an additional 11km spur line connecting Mt Jackson.

Ore and waste will be mined by conventional open cut methods of blasting and excavation with material loaded onto trucks and transported to stockpile areas. Mining will involve a high degree of selectivity to distinguish between ore and waste, hence requiring waste dump storage areas for overburden material.

In order to create an iron ore product that is suitable to be sold to Asian markets it will be necessary to blend ores from the various deposits. This means that deposits from each location will be mined concurrently and in quantities dependent on blending requirements.

3.2 MINING

3.2.1 Methodology

Mining of the ore bodies will be undertaken by conventional heavy earthmoving equipment in order to expose the ore body and remove blasted material. Primary crushing is the only form of processing that will be conducted at each of the two proposed mining areas and this may be in the form of a mobile crusher moving between the sites. At this stage it is envisaged that all further processing will be conducted at Koolyanobbing.

It should be noted that within the scope of this PER document mining operations refer exclusively to areas that lie above the local groundwater table. At a later stage when mining of the orebodies has proceeded to a sufficient depth that it will require penetration of the groundwater table then environmental issues associated with groundwater will need to be readdressed.

Table 3.1: Summary of Key Characteristics associated with the Proposal

Component	Key Aspect	Characteristic Description
Mining Operations	Proposed Mine Locations and deposits	Mt Jackson deposits J2 and J3 Windarling deposits W1 to W5
	Estimated area of mine pits	Mt Jackson pits J2 and J3 – 18.3ha Windarling pits W1, W2, W3, W4 – 209.6ha
	Ore Type	Hematite-geothite
	Ore Mining Rate	Staged expansion to 8 Mtpa over 3 to 5 years
	Total Estimated Production	80 Mt
	Proposed Operation Commencement	2002 – Construction, Mining, Processing and Transshipment
	Project Life Span	10 years
	Anticipated Year of Decommissioning	2012
	Proposed Waste Dump No. ( ) and Area	Mt Jackson (2) – 41ha; Windarling (2) –219ha
	Ore stockpile areas	Mt Jackson – 15ha; Windarling – 34ha
	Proportion of Waste to be backfilled	Nil
	Stripping Ratio (waste:ore)	4:1 approx.
	Area of haul roads	Mt Jackson – 18.2ha; Windarling – 15.8ha
	Total estimated area of disturbance	Mt Jackson – 93 ha; Windarling – 480 ha
Processing Requirements	Processing at Mt Jackson, Windarling	Primary crushing at the two sites – possibly a single mobile unit covering the two sites.
Changes to existing facilities at Koolyanobbing	Expansion of General Facilities	Mine offices
	Expansion of Processing Facilities	Secondary crushing, screening, stockpiling and train loading
	Workforce	Increased number of employees
Railway	Length	114 km main line – Koolyanobbing to Windarling 11 km spur line to Mt Jackson
	Estimated area of disturbance	500 ha approx.
	Train Movements – proposed	4 per day
General	Workforce (rail and mine)	Construction – 200; Operation – 180
	Project Duration	Operation – 10 years Railway Construction – 12 months
	Workforce Accommodation	Accommodation Village for 80+ people Area of disturbance – 25 ha
	Infrastructure	Power source – diesel generator Water source – potable water trucked or piped from Koolyanobbing
	Water Supply Requirements (estimated)	Railway Construction – 3500 kL/day Minesite Construction – 2000 kL/day Operation – Potable and domestic supplies – Bore water for dust suppression

3.2.2 Overburden Management

In addition to saleable ore, overburden material composed of unmineralised and low grade material is also generated as part of the open cut mining process. A life of mine strip ratio has been determined at approximately four tonnes of waste for every one tonne of ore produced. The overburden material will be stored in waste dumps constructed adjacent to each open pit, covering an area of approximately 41 ha at Mt Jackson and 219 ha at Windarling. Ore stockpile areas will also be located near to mine pits and will be connected to them by haul roads. There will be a requirement for substantial overburden storage adjacent to the mine pits because of the large volumes of waste material that will be produced and the requirement to mine pits concurrently.

The process of overburden management will involve the following steps:

- Removal of vegetation in areas of direct impact. Vegetation and associated debris is stockpiled for use in later rehabilitation procedures.
- Stripping of topsoil - in two passes, the uppermost 100mm of topsoil and the underlying subsoil to 300mm where possible, using scrapers. In areas of exposed rock along ridgelines it will not be possible to remove and store topsoil because these locations have minimal soil development. Topsoil from stripping operations will be stored near waste dump and ore stockpile areas for later use in rehabilitation procedures.
- Removal of overburden to adjacent waste dumps using large excavators and dump trucks. Some overburden may be used as fill for construction work and the remainder will be deposited in waste dumps lying adjacent to the open pits. These dumps will contain a mixture of overburden and low grade ore from the mining phase.
- Landform reconstruction - once ore extraction is complete all waste dumps are landform constructed to defined criteria to ensure the stability of the final profile. Hill slope gradients are limited to control surface run-off. The two separate strips of topsoil and subsoil are then placed over the overburden to recreate a natural soil profile. The type and origin of the soil is considered in its positioning in the rehabilitated landscape. Mulched vegetation is then spread over the topsoil, using vegetation types appropriate to the area undergoing rehabilitation.
- In the final stages of rehabilitation selective mixtures of native seed are broadcast on rehabilitated areas to match, as far as possible, the location of the associations that occured in the undisturbed landscape. The seed of some native species needs to be treated using smoke or hot water immersion to maximise germination rates.

3.2.3 Dewatering

The current proposal DOES NOT seek approval for mining below the water table for any of the Northern Deposits, hence dewatering issues will not be considered as part of the current proposal.

At a stage when mining is planned for below the groundwater table then approval on environmental issues associated with dewatering, including management of saline water, will need to be addressed.

3.2.4 Processing of Ore

Ore will be mined using heavy conventional machinery producing a fragmentation size of up to 800mm. 'Run of mine' ore will be delivered to a primary crusher by heavy haul ore trucks and fed by front-end loaders. Mine haul roads will be sprayed periodically by water trucks to keep dust to an acceptable level.

The ore will be tipped into a jaw type primary crusher for reduction to a maximum particle size of 150mm. At the truck tipping point sprays will introduce water into the ore to reduce dust emissions during processing. The lower

chambers of the primary crusher facility will be equipped with dust extraction equipment. An apron feeder will extract the crushed ore from the chamber under the primary crusher and will deliver the ore to a belt conveyor for transport to the buffer stockpile. Ore from the stockpile will be transported by rail to the secondary screening and crushing plant at Koolyanobbing.

Crushing and screening will be required to prepare the ore for sale as conventional fines (< 6.3mm particle size) and lumps (6.3-32mm particle size). This process involves screens and secondary cone crushers connected by belt conveyors, enabling oversize ores from the screens to be recycled to the secondary crushers and back to the screens.

A schematic flow concept of the mine process including crushing, stockpiling and transport of mined material is depicted in Figure 3.1.

3.2.5 Ore Processing Facilities

The increase in production capacity associated with the Koolyanobbing Expansion project will require the installation of new facilities at the two northern deposit areas and an upgrade of existing facilities at Koolyanobbing (Figure 3.2). The proposed location of facilities at the Northern Deposits are depicted in Figure 3.3 (Mt Jackson) and Figure 3.4 (Windarling).

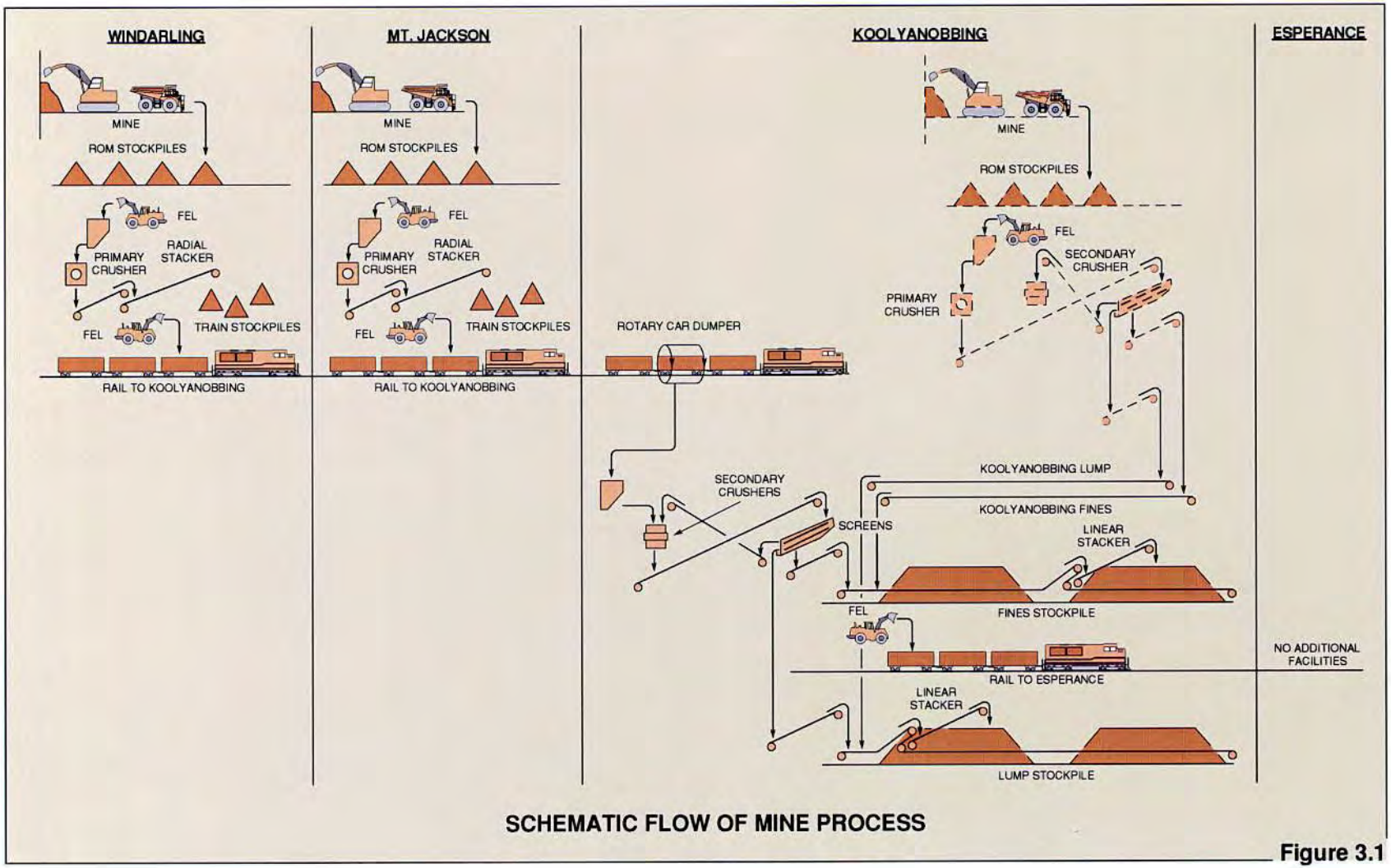
Facilities proposed at Mt Jackson and Windarling include;

- Primary crusher – this may be in the form of a single mobile crusher servicing both sites or individual small scale crushers at each site;
- Storage bin/stockpile for primary crushed ore at each mine area;
- Train load-out facilities for transport of ore to Koolyanobbing for further processing;
- Heavy vehicle maintenance workshop and associated infrastructure at a central location; and
- Accommodation facilities at a central location.

The expansion will also require additional and/or enhanced facilities at the existing Koolyanobbing operation. These include expansion of existing:

- Crushing, screening and stockpiling facilities;
- Mine offices; and
- Train-loading facilities.

For the purposes of dust control, each of the main ore processing plants (i.e. primary and secondary crushing, screening, sampling and load-out facilities) will be equipped with water sprays or dust extraction systems to minimise dust generation.



SCHEMATIC FLOW OF MINE PROCESS

Figure 3.1

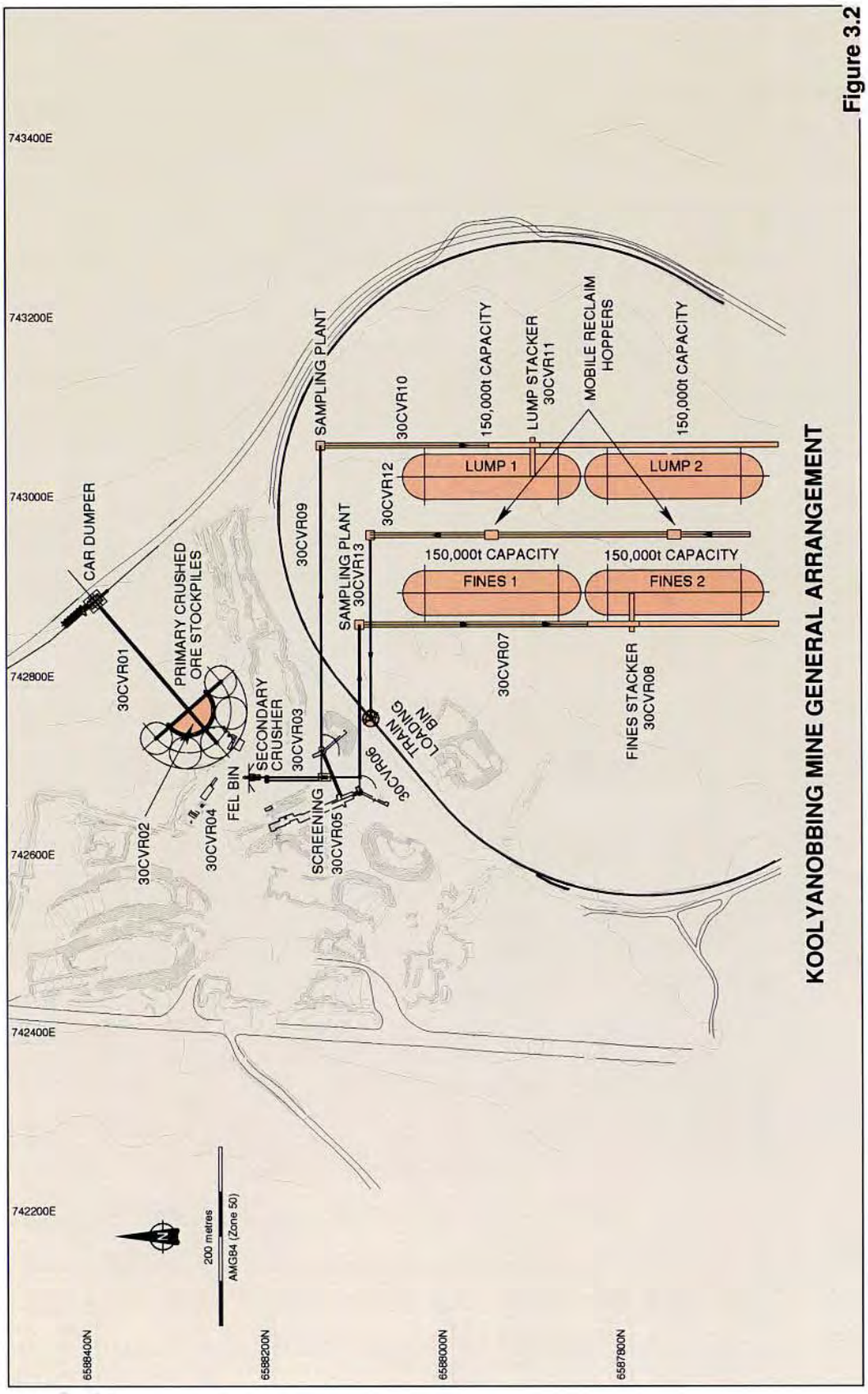
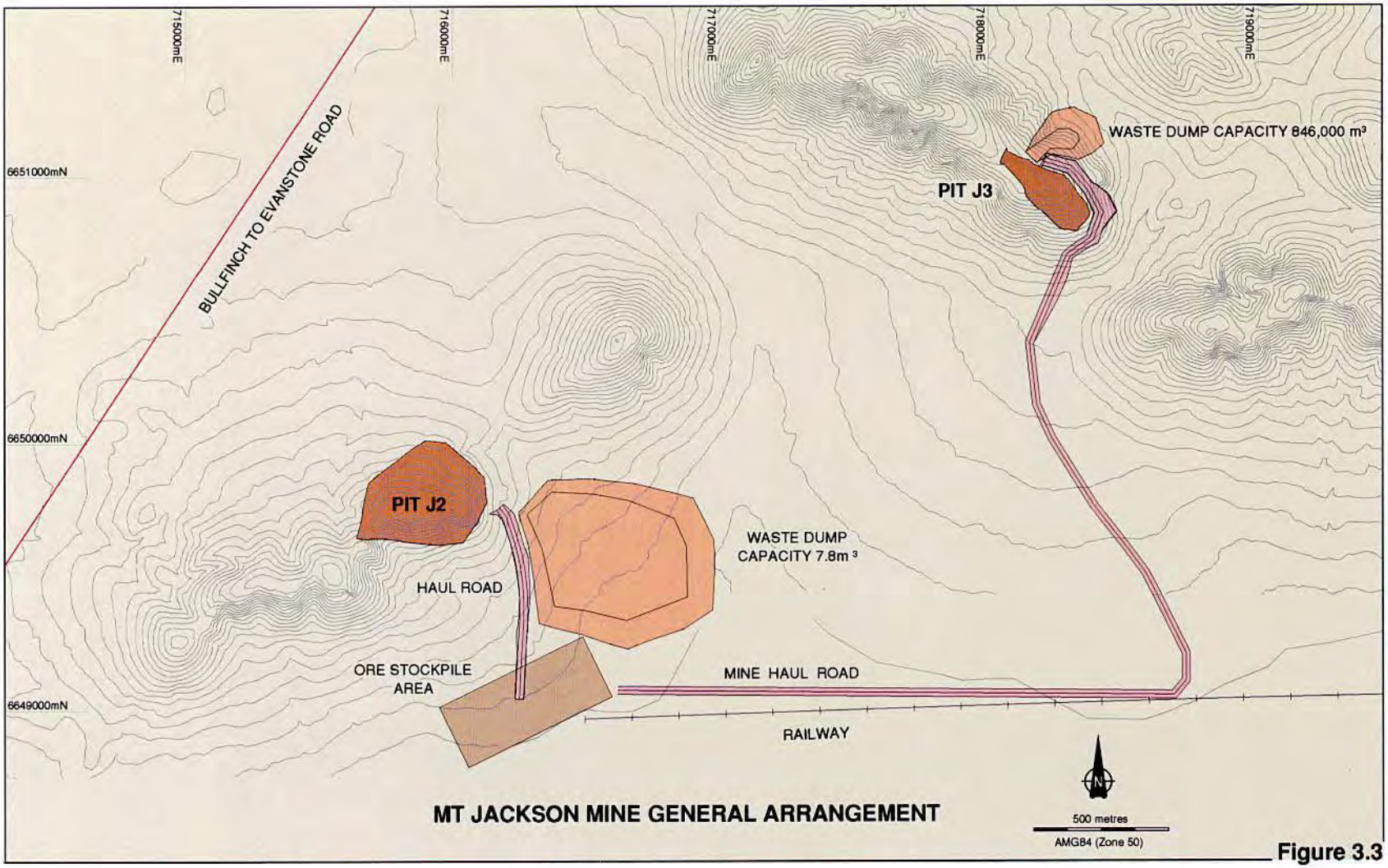
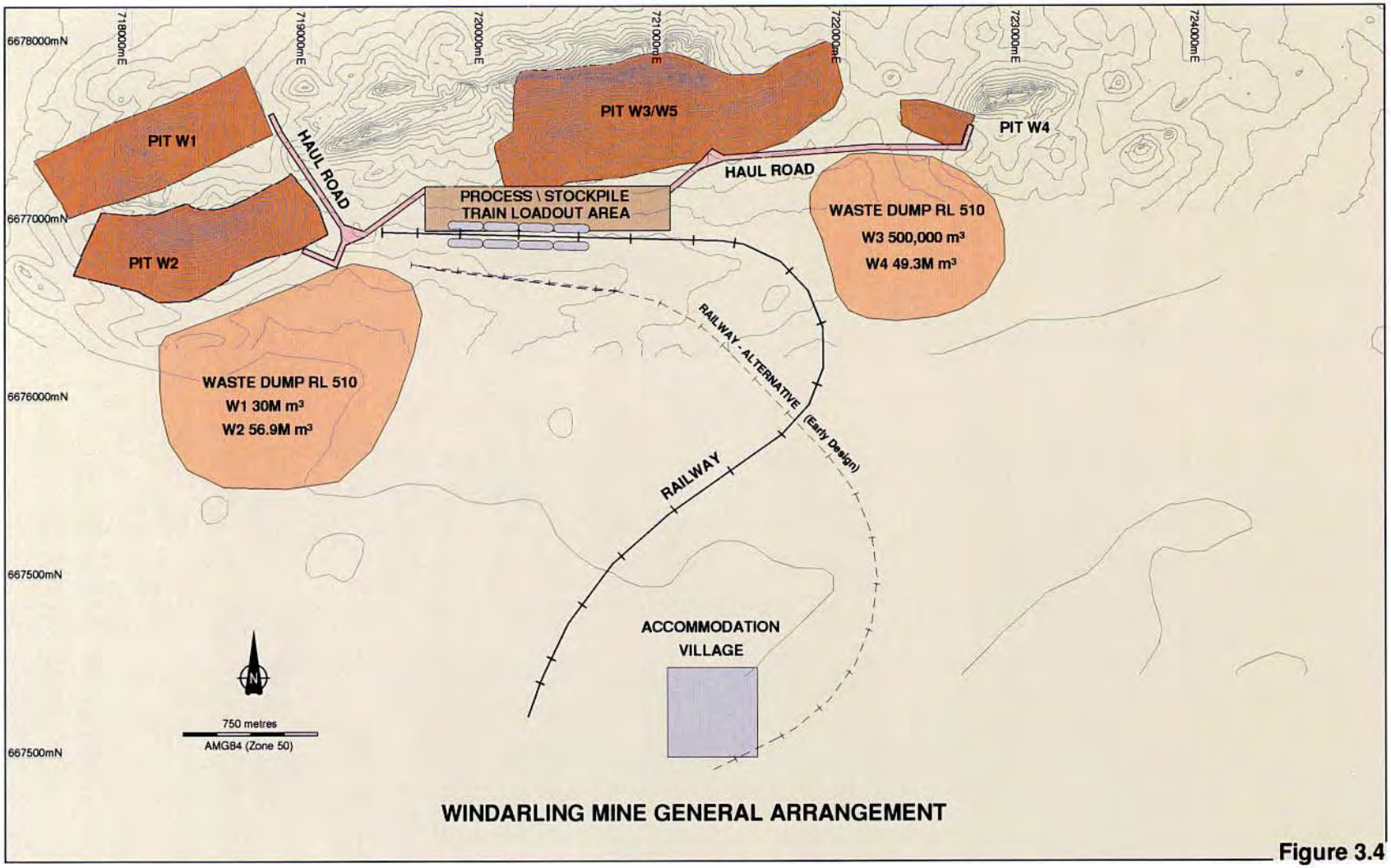

KOOLYANOBBING MINE GENERAL ARRANGEMENT
743400E
743200E
743000E
742800E
742600E
742400E
742200E
6588400N
6588200N
6588000N
6587800N
CAR DUMPER
PRIMARY CRUSHED ORE STOCKPILES
30CVR01
30CVR02
SECONDARY CRUSHER
30CVR03
FEL BIN
30CVR04
SCREENING
30CVR05
TRAIN LOADING BIN
30CVR06
30CVR07
FINES STACKER 30CVR08
30CVR09
SAMPLING PLANT 30CVR13
30CVR12
LUMP 1
LUMP 2
FINES 1
FINES 2
150,000t CAPACITY
150,000t CAPACITY
150,000t CAPACITY
150,000t CAPACITY
30CVR10
SAMPLING PLANT
LUMP STACKER 30CVR11
MOBILE RECLAIM HOPPERS
200 metres
AMG84 (Zone 50)

Figure 3.2



MT JACKSON MINE GENERAL ARRANGEMENT

Figure 3.3



WINDARLING MINE GENERAL ARRANGEMENT

Figure 3.4

3.2.6 Ore Transport

Ore will be transported to Koolyanobbing from the Northern Deposits by rail. The proposed rail line will run from Windarling to Koolyanobbing with a spur line connecting to Mt Jackson. At present the capacity of a standard Portman ore car is 60 tons. It is currently anticipated that a train schedule of 20 trains per week, of 80 wagons each with a cycle time of eight hours would be able to deliver up to 4 Mtpa of ore to Koolyanobbing. At Koolyanobbing the ore will be delivered to a centralised ore processing plant for secondary crushing and screening.

3.2.7 Support Infrastructure

Support infrastructure for mining will include:

- a private, unsealed access road immediately adjacent to the rail line to the mine areas at Mt Jackson and Windarling;
- fuel storage facilities at each of the mine areas;
- vehicle washdown facility at each mine area;
- accommodation village adjacent to the Windarling mine area;
- fire tender, ambulance and first aid areas to be located at the accommodation village; and
- explosives storage facilities, constructed according to mining regulations, to be located at each of the mine areas.

Potable water requirements for the project will be trucked from Koolyanobbing to the accommodation village at Windarling.

Bore water will be required for construction of the mine and railway, and for dust suppression during project operation. Investigative drilling for suitable groundwater sources will be undertaken in the near future. Water will be transported by pipeline.

Fuel will be delivered to the mine areas by road tanker from Koolyanobbing. Fuel storage facilities will be in the form of bulk fuel tanks located within lined bunds constructed according to DEWCP requirements and existing Australian Standards.

Power will be supplied by means of a diesel generator at each mine area.

The existing air strip at Marda, to the north of Mt Jackson, has been upgraded.

3.2.8 Workforce

During the construction period, which is expected to last approximately 12 months, the number of employees required is 200: During operation this is expected to decrease to 180 persons.

The mining operation will run 24 hours a day, 364 days a year on the basis of two 12 hour shifts. Employees will work 13 days on, 1 day off and 4 weeks on, one off.

It is proposed that an accommodation village for 80+ workers be constructed near the Windarling mine area.

3.3 PROPOSED RAIL ROUTE

With the proposed expansion of the mining operation, Portman propose to construct a rail line from Koolyanobbing to the new deposit area at Windarling (114km) incorporating a spur line to the south side of Mt Jackson (11km) and a triangle at the junction. Further detail of the preferred alignment is provided in Section 2.2.3.

Railway access roads are not designed for public use and will be required solely for maintenance purposes.

3.3.1 Borrow Areas/Material Sources

General and select fill materials will be required for construction of the railway. The majority of the alignment has fair to good sub-grade conditions, where the line may be built with nominal formation and using selected adjacent borrow areas for fill. This includes areas of shallow colluvial soil overlying laterite and raised sand plains (HGM, 2001). Alluvial plastic and reactive clayey soils in existing and remnant drainage channels along portions of the alignment, whilst having poor sub-grade conditions, with a suitable depth of formation may be adequate founding conditions. These soils cannot be used for construction and borrow for formations would need to come from adjacent areas. In some areas in situ soil may need to be removed and replaced with good fill.

Within remnant drainage channels, select material can be obtained from localised areas of granite, basalt and laterite outcroppings. Elsewhere, select fill material can be obtained from deposits of sand and outcrops of laterite from within the raised sand plains and laterite duricrust units respectively.

The relatively flat nature of the terrain and the hydrology along much of the route means the majority of the line will be on fill, albeit on nominal formation. There is unavoidably rather more fill over cut in the alignments but there is potentially usable borrow material in pits and scrapes along most of the route except in creek beds.

It is anticipated that granite and basalt rock, potentially suitable for use as ballast material, should be encountered within some of the cuts required for the railway line. However, the quality, quantity and suitability of these materials has not yet been determined.

3.3.2 Construction Camps

Construction camps will not be required along the rail route due to its short length however camps will be required at Koolyanobbing and Windarling in order to accommodate workers. A permanent rail maintenance camp is not considered necessary because it is intended that track crews will be based at Koolyanobbing.

4.0 PUBLIC CONSULTATION

Portman has undertaken consultation directly with a range of stakeholders including government agencies, local authorities and affected landholders with an interest in the proposal. Portman has also provided opportunities for members of the public to comment on the proposal prior to release of the PER document. These opportunities were provided in addition to the level of consultation required by the EPA assessment process. Table 4.1 identifies the government agencies, landholders, mining companies and community groups consulted in the formative stages of the proposal.

The consultation initiatives detailed in Table 4.1 were carried out prior to the public release of the PER document for the formal public review period in order that key stakeholders could be consulted so that the range of environmental issues associated with the project could be identified and adequately addressed.

Aboriginal spokespersons for the Ballardong and Central West people have been extensively consulted regarding issues concerning Aboriginal Heritage and Native Title. Portman will be involved in discussions with all relevant Native Title claimants and the State Government in accordance with the *Native Title Act 1993*.

Date	Stakeholder Group	Consultation Format	Issues Raised	Portman's Response
18 October 2000	Department of Environmental Protection (DEP)	Meeting	In teraction with EPBC Act.	Initial project briefing by Portman.
19 October 2000	Department of Minerals and Energy (DME)	Meeting	Mining Management Issues.	
31 October 2000	Department of Resources Development (DRD)	Meeting	Land tenure for railway.	Initial project briefing by Portman.
12 December 2000	DRD, DEP, DME, Department of Conservation and Land Management (CALM), Water and Rivers Commission (WRC), West Rail, Department of Transport	Round-table Workshop	Mining Management Issues	Developed draft mining EMP
Early January 2001	General Public – Shelly Danton, East Perth	Telephone enquiry	Requesting exploration maps and general information	Verbal advice provided – committed to follow up meeting.
19 January 2001	Environmental Protection Authority, DEP, DRD, CALM	Meeting	Assessment level for project.	PER developed.
24 January 2001	CALM	Meeting	Conservation values, biodiversity, tenure.	Developed draft MOU.
31 January 2001	Aboriginal Affairs Department	Meeting		Project update briefing.
7 February 2001	DRD	Meeting		
20 February 2001	DRD, DEP, DME, CALM, WRC, Westrail, Department of Transport	Update Memo	Project status update by Portman.	N/A
12-13 March 2001	DME CALM	Kalgoorlie Region Officers Site Visit	Impacts to rare flora, general mining management.	Developed draft threatened flora MP and mining EMP.
26-27 March 2001	EPA, DEP, DME, CALM	EPA Site Visit	Impacts to rare flora, general mining management.	PER developed.
April 2001	All key stake holders	Project status update memo	N/A	N/A
7 May 2001	Conservation Council	Project briefing meeting	Review of EMP/PER content. Visual Amenity, Dewatering, Implementation of EMP into practical framework.	Developed EMP to address these issues.
10 May 2001	WA Wildflower Society	Project briefing meeting	Flora and vegetation conservation values.	Committed to provide draft PER and Flora survey reports for comment.
18 May 2001	Shire of Yilgarn	Project briefing meeting	General support for project indicated.	N/A
6 weeks in May/ June 2001	General Public – public display, project information handout, reply-paid comment proforma	Public Information Display at Shire of Yilgarn office Southern Cross	35 brochures taken from Shire Office.	N/A

Date	Stakeholder Group	Consultation Format	Issues Raised	Portman's Response
6 weeks in May/ June 2001	General Public	Reply Paid comment submission opportunity	3 public submissions received.	Responses detailed below.
6 weeks in May/ June 2001	General Public – "Crosswords" Southern Cross local paper and the Kalgoorlie Miner	Public media advertisement of project public comment period and display information	Small number of interested visitors viewed display, less than 20.	N/A
May 2001	Key stakeholder groups including Mt Jackson and Diemals pastoral leaseholders	Mail out of project information brochure and reply paid comment proforma	Nil responses.	N/A
May 2001	CALM, Conservation Commission	Development of Memorandum of Understanding for Environmental Management of Project Area	Comments on Draft MOU	MOU ammended.
1 June 2001	Diemals Pastoral Leaseholder, Tony Macpherson	Enquiry	Would like to know the effect of the operation on pastoral activities. Requesting a timeframe for the operation.	Stakeholder was informed of proposed schedule and likely offers for pastoral activity.
1 June 2001	General Public – Shelly Danton, Woodlands	Telephone enquiry	Requesting general information about Portman exploration in area.	Arranged to meet to discuss project.
5 June 2001	Greg Carter, CEO, Shire of Menzies	Telephone enquiry	Requesting information brochure. Enquiring about prospective employment and economic opportunities for the Shire from proposed operations.	Information sent out.
14 June 2001	Eastern Goldfields Four Wheel Drive Club, Chris Jones (Secretary)	Public Submission	Primary concern is over future access of proposed mining areas. Scenery and remoteness of Bungalbin Hills are the main attractions.	Reassessment of Bungalbin Development. Bungalbin removed from proposal
18 June 2001	Diemals Pastoral Leaseholder, Tony Macpherson	Enquiry	Query about the environmental approvals process and timeframe for the process.	Stakeholder was informed
18 June 2001	General Public – Shelly Dalton, Laverton	Public Submission	Landscape obliteration/ alteration of Helena and Aurora Range and Windarling Peak (sic).	Visual Ammenity Study undertaken.
19 June 2001	General Public – Leon Hill, Environmental Officer, Lion Ore	Enquiry	Location of proposed site and general information.	Stakeholder was informed.
9 August 2001	General Public – Robert and Helen Forrester, Southern Cross	Public Submission	Disturbance of flora, fauna and natural history qualities. Request for removing timber if proposal is successful. Request for revegetation with native seed.	Rehabilitation detailed in mining EMP.
10 August 2001	General Public – public display, project information handout	Public Information Display at Shire of Yilgarn office	35 brochures taken from Shire Office	

Date	Stakeholder Group	Consultation Format	Issues Raised	Portman's Response
		Southern Cross		
September 2001	Department of CALM, DEP, WA Museum	Review of draft Fauna Assessment Survey report	Invertebrates other than gastropods should be included. Some incorrect terminology noted. Requires review of impact on flora and fauna on a regional scale. Need a commitment from company on weed control, feral animal control and bushfire contingency plan. Concern over dust suppression impacts; saline water affecting vegetation. Native fauna safety issues with regards to mine pits and road deaths.	Fauna Survey report amended.
September 2001	Department of CALM, DEP, Malleefowl Preservation Group	Review of draft Malleefowl Conservation Management Plan	Overall commendation of the Plan. Clarification of terms and statements within document. Grazing rather than clearing is a more important issue to mallefowl conservation in the project area. Possibility of traffic humps being located around malleefowl habitats. Encourage liason with established land management and conservation groups. Concern about the impact on the area of malleefowl habitat by the project. Concern over the biasness of data due to sightings by Portman workers around Portman operations (to Portman's detriment).	Comments incorporated into Mallefowl Conservation Plan.
10 October 2001	Susanne Dennings, Malleefowl Preservation Group	Comments on draft Malleefowl Conservation Plan	Request that Portman acknowledge the MPG as a source of information and support. Recommend that MPG is involved in future consultation processes. The MPG can help facilitate survey techniques for Portman.	Comments incorporated into Mallefowl Conservation Plan.
12 October 2001	Neil Gibson (CALM)	Comments on PER Flora report	Conflict with priority flora numbers throughout report. Highlight taxa with geographic restriction that have not yet been named. Recommend inclusion of local and regional endemics by ranges where they occur.	Comments assessed and integrated into report.
25 October 2001	Robert Thomas, Neil Gibson, Ken Atkins, Bradley Barton & Gordon Wyre (CALM), Peter Walkington, & Tim Gentle (DEWCP), Campbell Hawks & Kim Anderson (DMPR)	Review of draft Flora Assessment Survey in PER and EMP documents	Flora of the area is rich. Preliminary statement of areas to be impacted may help an understanding of the summary section. The Priority Flora may be more important than the DRF as they have not been adequately surveyed and could require listing.	Amended PER and Flora Survey documents.

Date	Stakeholder Group	Consultation Format	Issues Raised	Portman's Response
			A detailed analysis or conservation status and potential impact of P1 flora is needed. Recommend impact on vegeation and flora is summarised in a table. Recommend quantitative impact assessments of DRF, Priority Flora and threatened or significant communities.	
30 October 2001	Robert Thomas, Environmental Protection Branch, Department of Conservation and Land Management (CALM)	Review of draft Vegetation Report in PER and EMP	Reassessment of Portman's review period of draft PER and EMP. Portman must be aware that a more comprehensive review may pick up further issues. Meeting confirmation .	Additional reviewed period agreed to.
12 November 2001	Mark Cowan, Regional Ecologist, Goldfields Region (CALM)	Comments on Fauna Assessment Survey	Concern over the accuracy of statistical comparisons between sites, due to discrepancies in the data collection. A clearer explanation of techniques and methodology is required.	Report amended.
26 November 2001	Peter Walkington (DEWCP)	Comments on draft PER	Doubt whether Portman can defend the removal of DRF, and therefore th project. Inclusion of quantitative impact on vegetation communities. Visual impacts need to be integrated using a future ecotourism point of view. Closure planning issues. Listing of public consultation issues and liaison with Wildflower Society.	PER document amended.
29 November 2001	Robert Thomas, Neil Gibson, Ken Atkins, Bradley Barton (CALM)	Comments on draft Vegetation Report in PER & EMP	Discrepancies between background Flora report and PER. Flora maps need updating. Impacts of expansion facilities.	Issues addressed and integrated into reports.
14 December 2001	Eamonn Fennessy, Landscape Management Coordinator (CALM)	Comments on draft Visual Amenity Study	General praise is given for draft. A more detailed methodology would have been useful Concerns over the objectivity of mapping and viewshed analysis.	Issues addressed and integrated into reports.
February-March 2002	Wildflower Society	Review of Draft PER and Flora and Vegetation reports.	Short term development vs long-term impact, impacts to landscape values, unacceptable impact to rare flora.	Issues addressed in PER
11 March 2002	Wildflower Society	Meeting to discussed proposal management and research programmes.	Final closure landscape, would prefer pit-infilling, degree of impact to rare flora unacceptable despite proposed extensive management programme.	Amendments to be incorporated into Final Threatened Flora Conservation & Management Plan.

5.1 CLIMATE

The climate of the Goldfields region is defined as semi-arid Mediterranean. It is characterised by hot, dry summers and mild, wet winters. The mean average rainfall at Southern Cross, 54km south west of Koolyanobbing, is 292mm. Seasonal variation is high with an average number of 69 rain days per year. Most rainfall is in winter, and is generally associated with frontal activity from May through to August. Summer falls are highly erratic and result from thunderstorms. Heaviest rainfalls are associated with rain bearing depressions forming from tropical cyclones (Newbey, 1985). At Mt Jackson, where rainfall has been recorded intermittently for 28 years an annual average rainfall of 232 mm has been calculated (Beard, 1979). Evaporation is relatively high, at approximately 2780 mm per year.

Throughout spring, summer and autumn most winds are from northeast to southeast and average approximately 6-20km/hour. During winter the winds are predominantly westerly to northwesterly at 0-10km/hour.

Temperature data from Southern Cross show that mean monthly maximum temperatures are highest in January (34.6^{o}C), with December through March all recording average temperatures above 30^{o}C (Table 5.1). The highest daily temperature on record is 45.6^{o}C recorded in January and February. The lowest mean minimum temperatures of below 5^{o}C are recorded in the winter months of July and August. The lowest daily minimum temperature on record was -3.8^{o}C *(Bureau of Meteorology 2001; based on data 1889-2000).*

Table 5.1: Summary of Climatic Data for Southern Cross

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Temperature (°C)													
Mean Daily Max.	34.6	33.6	30.5	25.7	20.5	17.1	16.3	18.0	21.8	25.4	29.6	33.0	25.5
Mean Daily Min.	17.2	17.1	15.1	11.5	7.6	5.7	4.4	4.8	6.5	9.2	12.8	15.5	10.6
Mean Rainfall mm													
Mean # Rain days	14.6	20.2	23.7	24.3	34.9	41.4	38.9	31	19.1	15.8	15.7	12.5	292.0
	2.7	2.9	3.5	4.9	7.6	10.3	10.9	9.3	6.3	4.7	3.5	2.7	69.3

(Source: Bureau of Meteorology, 2001)

5.2 TOPOGRAPHY AND LANDFORMS

The majority of the region is gently undulating and mainly of subdued relief standing about 335-400m above sea level. Topography is closely related to the underlying geology and the ironstone ridges that rise abruptly from the surrounding wooded plains are the only prominent features in the area. These ridges include the Koolyanobbing, Mt Jackson, Helena and Aurora, Die Hardy and Mt Manning Ranges. The hills rise up to 100 metres above the surrounding plain with stony slopes and bedrock exposures common on the steep slopes and crests, and include abrupt cliffs, exfoliated rock and many deep crevices and small caves. Scree slopes mainly support a variety of shrub species and mallee eucalypts growing in the shallow skeletal soils.

Much of the region is characterised by undulating areas of sandplain and low granite exposures. Dissection of the country has arisen from ancient drainage during a period when rainfall was higher. The flat extensive sandplains are remnants of the large undissected lateritic duricrust or 'old plateau'. Low lying broad alluvial valleys contain palaeochannels and playa lake sytems.

Newbey (1985) developed a classification of 10 landform units to describe the landscapes of the Eastern Goldfields. These units are classified according to sub-surface geology, soil type, slope and drainage patterns. Based on that classification system, five landform units are present within the project area (Figure 5.1):

(1) Breakaway: Underlying the plains is granite that has been highly weathered to a depth of several meters. Breakaways occur where the highly weathered rock has been laterised, and later exposed to case-harden the surface. Case-hardening is up to 2m thick. The result is a summit with a shallow covering of soil and a rim with soil in shallow and small pockets. The back-cutting face has a scree slope. A pediment of colluvial material develops at the base. Within the study area, one breakaway and its associated land system was identified.

(2) Hills (banded ironstone): Hills rise to 100m above the surrounding plains and have stony slopes with bedrock exposures common on the steep slopes and crests. The eroding upper slopes are inclined at 10^{o}-20^{o}, while the lower colluvial slopes are 5^{o}-10^{o}. Soils on the upper slopes are mainly skeletal becoming shallow on the lower slopes. The Helena-Aurora, Mt Jackson and Windarling ranges are all representative of this unit. Bungalbin Hill is the highest point in the region with an altitude of 680 metres.

(3) Sandplain: The almost flat upland plain and upper and middle valley slope areas are referred to as Sandplain. The dividing line between Sandplain and Broad Valley is the change from erosional to colluvial valley slopes. Sandplain slopes rarely exceed 20^{o}. Soils of the Sandplain have developed over a long period of time and have been laterised to some extent. In some situations extensive sand sheets have developed with a major component of colluvium from slightly higher places on the sandplain. Occasionally, vegetated remnants of small dunes from drier periods are present. The last major dry period appears to have occurred about 15000 years ago. Definite drainage lines are absent in Sandplain areas but flow may occur over short distances following heavy and intense falls of rain. This landform unit is represented along portions of the proposed rail corridor.

(4) Undulating Plain: This unit consists of low rises and ridges interspersed with colluvial flats. Most rises and ridges are less than 5m above the flats. Slopes on the latter rarely exceed 10^{o}. Soils are shallow on the rises and skeletal amongst bedrock exposures on the ridges. Broad colluvial flats are each drained by a single channel up to 1m deep and 5m wide. Soils of the colluvial flats rarely exceed 1m thickness. This unit occurs in areas surrounding the Mt Jackson Range.

(5) Broad Valley: Broad Valley is the choked remnant of a former drainage system active under a higher rainfall regime than that which occurs at present. The valley floors are flat to gentle-concave, with slopes of less than 2^{o} and are 20-50m below the surrounding Sandplain. The soils have an intricate history of in situ weathering, colluvial, alluvial and aeolian action. An important soil aspect is the calcareous B horizon. Valley carbonates have been largely leached from the surrounding Sandplain. This unit is extensively represented along the proposed transportation corridor.

5.2.1 Mine Areas

The majority of the areas that will be impacted by the Mt Jackson and Windarling mine developments are located within the Hills (banded ironstone) landform unit (Figure 5.1). These include the peaks and inclines of this highly weathered remnant landform unit. These areas include exposed rock formations and eroded material forming skeletal soils on the upper and mid slopes of the hills.

The lower slopes grade into the Undulating plain landform unit, particularly in the Mt Jackson area. Associated with this unit at the base of the hills are distinct zones of vegetation that reflect edaphic and hydrologic factors largely dictated by the hills. As distance from the hills increases soil depth is greater encouraging penetration by plant roots. Runoff from the impermeable hills flows to nearby areas where it is distributed as determined by topography and permeability of the substrate.

The location of overburden storage and infrastructure areas will be dictated by the mining process but are likely to affect lower Hill slopes, Broad Valley and Undulating Plain landform units.

5.2.2 Transportation Corridor

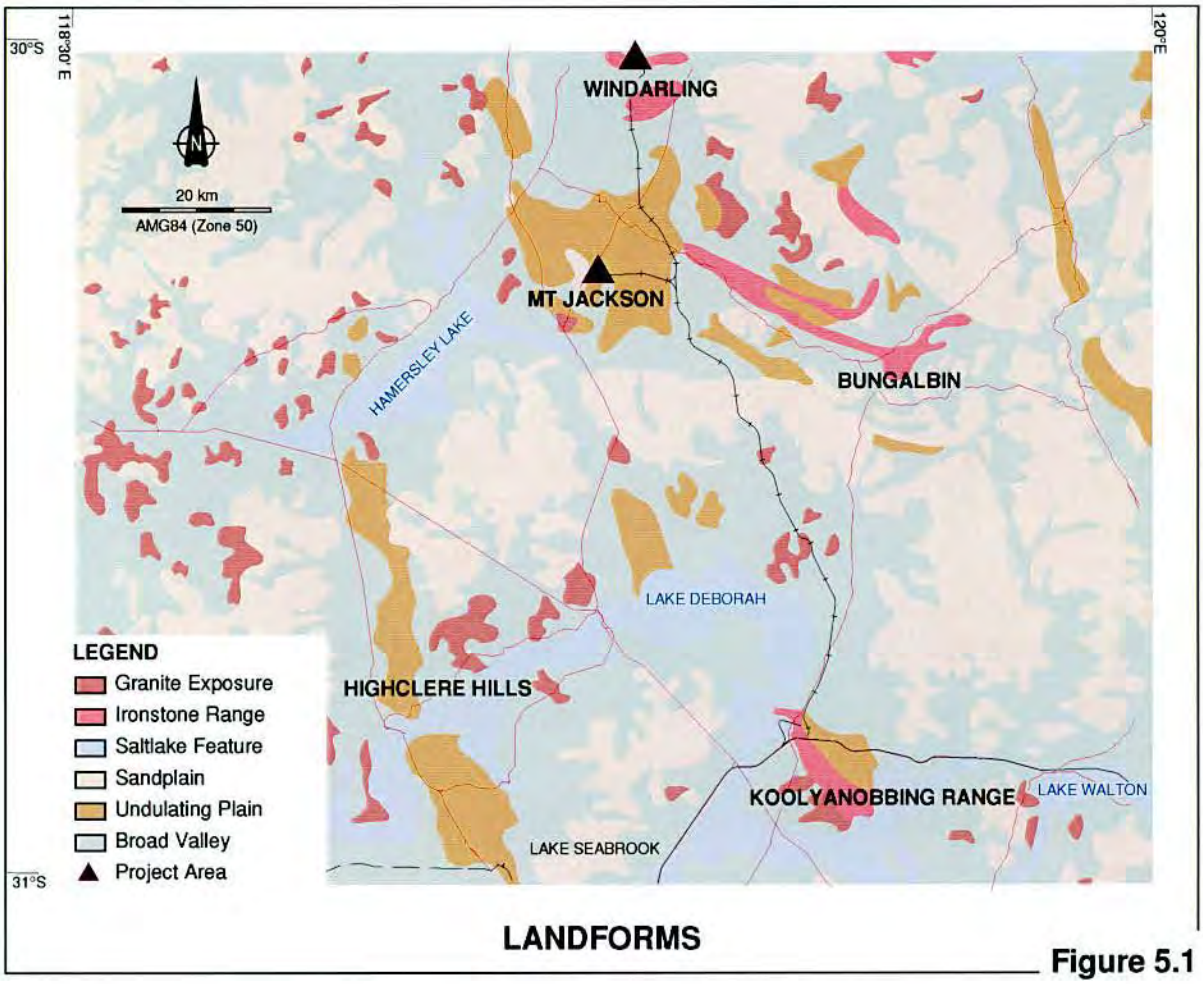
The transportation corridor traverses four of the identified landscape types (Figure 5.1):

- Broad Valley. Low lying remnant drainage channels associated with the Lake Deborah salt lake system containing Quaternary eolian, alluvial and colluvial sediments. Lacustrine sediments are confined to the playa lakes and these areas are not traversed by the currently planned rail alignment.
- Sandplain. Raised sand plains formed during the Tertiary era (2 to 6 mya).
- Breakaway. Foothills of Laterite duricrust formed during the Tertiary era (2 to 65 mya), intersected by recent high level drainage paths which discharge into the Hamersley lake system.
- Hills (banded ironstone). Greenstone Mountain Belts identified by ridgelines of Banded Iron Formation (BIF) and outcrops of Archaean (600 to 5000 mya) bedrock.

5.3 GEOLOGY

5.3.1 Regional Geology

The area lies on the ancient Yilgarn craton, an area that has been tectonically stable since the Proterozoic (600-2500 mya). The major landscape features are controlled by the Archaean (2500-3700 mya) granites which underlie most of the project area and have weathered gently undulating plains and broad valleys covered by Tertiary and Quaternary soils. Trending roughly north-south are linear bands of Archaean banded ironstone formations (which were formed from ancient lacustrine deposits of iron oxides and quartz sand) and Archaean greenstone formations (mafic and ultramafic lithologies). Widespread laterization is believed to have occurred during the Cainozoic era (the last 65 my). The net result is a very subdued landscape due to extensive weathering over the millenia with the exception of the highly resistant ironstone sediments, which form a series of abrupt rocky ranges such as the Mt Manning, Mt Jackson, and Helena-Aurora Ranges (Milewski and Hall, 1995).



LANDFORMS

Figure 5.1

Past volcanic/tectonic activity is evident in the region in the form of four major greenstone mountain belts. These mountain belts, which are easily identified by ridgelines of BIF lithologies, are referred to as the Koolyanobbing, Bullfinch, Hunt and Marda Complex Mountain Belts.

Outcrops of BIF and interbedded sedimentary and volcanic rock dominate the ridge lines and upper slopes of the Marda Mountain Belt. On the surrounding 'foothills', the landscape is dominated by an undulating laterite duricrust with minor outcrops of volcanic rock. A thin layer of colluvium generally overlies the laterite and a number of broad drainage paths intersect the laterite duricrust. Most of these channels drain into the Lake Hammersley system. Some localised alluvium and slopewash deposits are anticipated along these existing drainage paths. The laterite duricrust is gradually supplanted with the remnant sand plains.

Broad remnant drainage channels intersect the lower lying landscape between the two mountain belts. The lower remnant drainage channels contain a number of existing drainage channels, which are still active and drain into the nearby salt lake systems of Lake Deborah. Within the existing drainage paths, alluvium is evident. Elsewhere colluvium and sheet wash materials are anticipated. Evidence of minor past volcanic activity is also visible between the two mountain belts, usually in the form of isolated outcrops of igneous rock. Laterite is occasionally associated with these outcrops.

5.3.2 Mine Areas

Archaean granites or gneisses underlie most of the project area and although the surrounding areas contain Proterozoic granite intrusions, the mine areas are devoid of these elements. Archaean geology is mainly expressed in the project area as NNW to SSE tending banded ironstone formations (Biological Surveys Committee, 1985). These ranges rise over 100 metres above the surrounding duricrust surface (Chin and Smith, 1983). The banded ironstone of the Koolyanobbing belt is up to 300 metres thick where folded, i.e. it penetrates several hundred metres below the present ground surface. The units consist of alternating dark-grey to black, iron-rich bands and brown to red-brown quartz-rich bands generally in the order of 10mm thick. Several types of schists are interlayered within this unit.

The banded ironstones of the Mt Jackson and Windarling areas have two stratigraphic levels separated by basalt. The alternation here with the bands of iron ore are with bands of red jaspilite. The stratigraphically lower unit below the basalt is that which contains the iron-ore mineralisation and is consequently the material proposed to be mined.

Detailed descriptions of the local lithology at proposed mine areas are provided below. This information is based primarily on explorative drilling that has been undertaken by Portman.

Broadscale geology of the project area is detailed in Figure 5.2.

Mt Jackson

J2 Deposit: This deposit is approximately 500 metres long and 100 metres wide and consists of three distinct types of mineralisation:

- A capping of geothite-limonite;
- An underlying zone of hematite which is sometimes pyritic; and
- A carbonate-rich magnetite-pyrite BIF which in places is almost pure siderite.

The oxide cap is approximately 100 metres thick and has a sub-horizontal contact with the primary BIF. The J2 Deposit is characterised by moderate to high Fe, very low P (0.004%) and by highly variable levels of S in the hematite zone.

J3 Deposit: The J3 deposits consist mainly of hematite in shallow synclinal structures in otherwise barren jasper-rich BIF. The deposit is characterised by relatively high Fe and low P with variable S.

Geology and location of deposits at Mt Jackson are depicted in Figure 5.3.

Windarling

W1 Deposit: The W1 Deposit consists of parallel bands of hematite and geothitic hematite which dip at approximately 65^{o} to the south. The base of hematite enrichment has not been defined. The deposit is characterised by high Fe and relatively high P with uniformly low S.

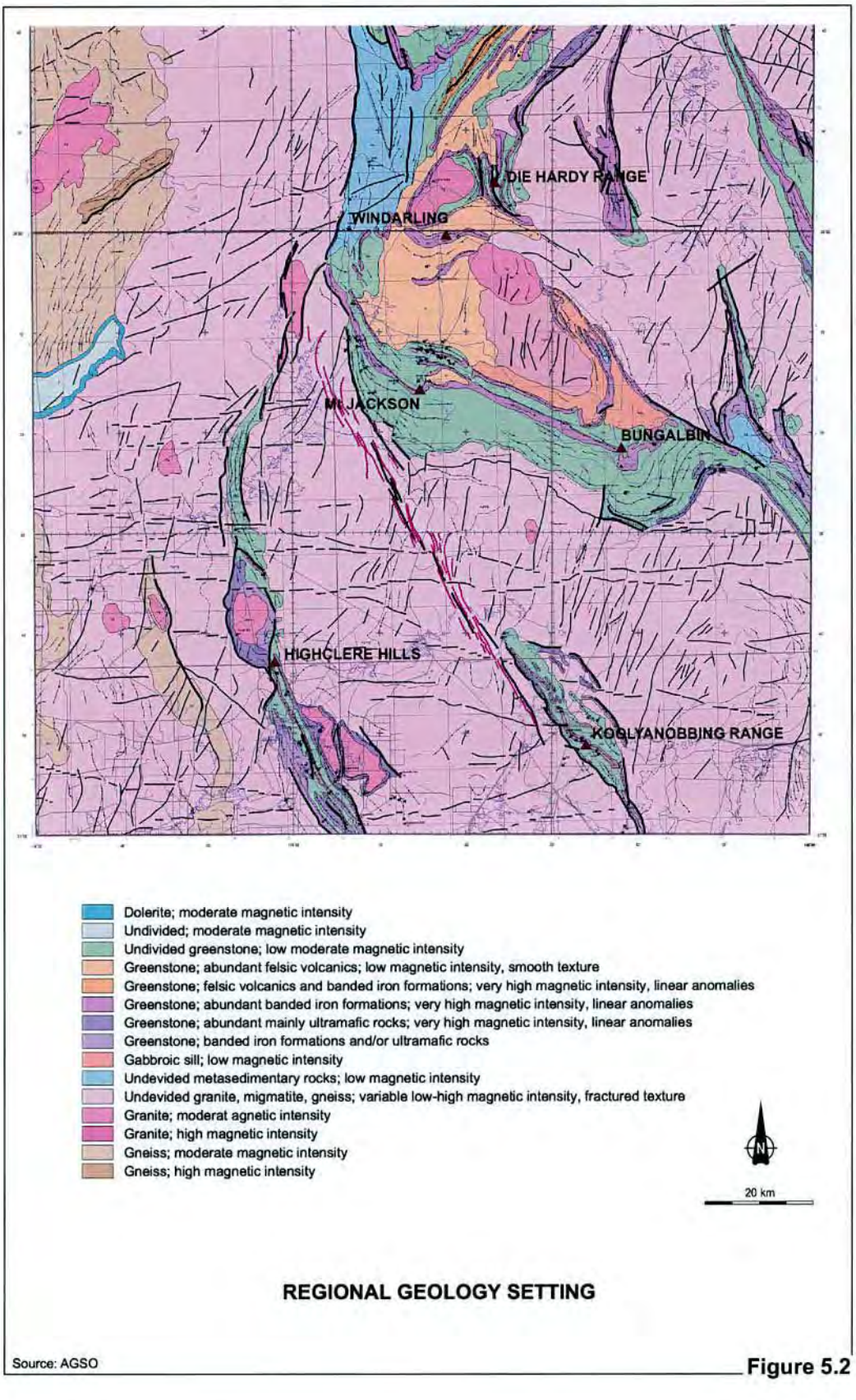
W2 Deposit: The W2 deposit consists of parallel bands of high grade hematite which dip at approximately 65^{o} to the south. The base of hematite enrichment has not been defined. The deposit is characterised by high Fe and moderate P with relatively low S.

W3 Deposit: The W3 Deposit consists of parallel bands of high-grade hematite and geothitic hematite which dip at approximately 65^{o} to the south. The base of hematite enrichment has not been defined. The deposit is characterised by high Fe and moderate P with uniformly low S.

W4 Deposit: The W4 Deposit consists of parallel bands of geothite with minor hematite which dip at approximately 65^{o} to the south. The base of Fe enrichment has not been defined. The deposit is characterised by relatively low Fe and high P with uniformly low S. The mineralisation in the deposit is quite different from the other Windarling deposits.

W5 Deposit: This W5 Deposit consists of parallel bands of high-grade hematite and un-enriched jasper BIF which dip at approximately 65^{o} to the south. The base of enrichment has not been defined. This deposit is characterised by high Fe and moderate P with uniformly low S.

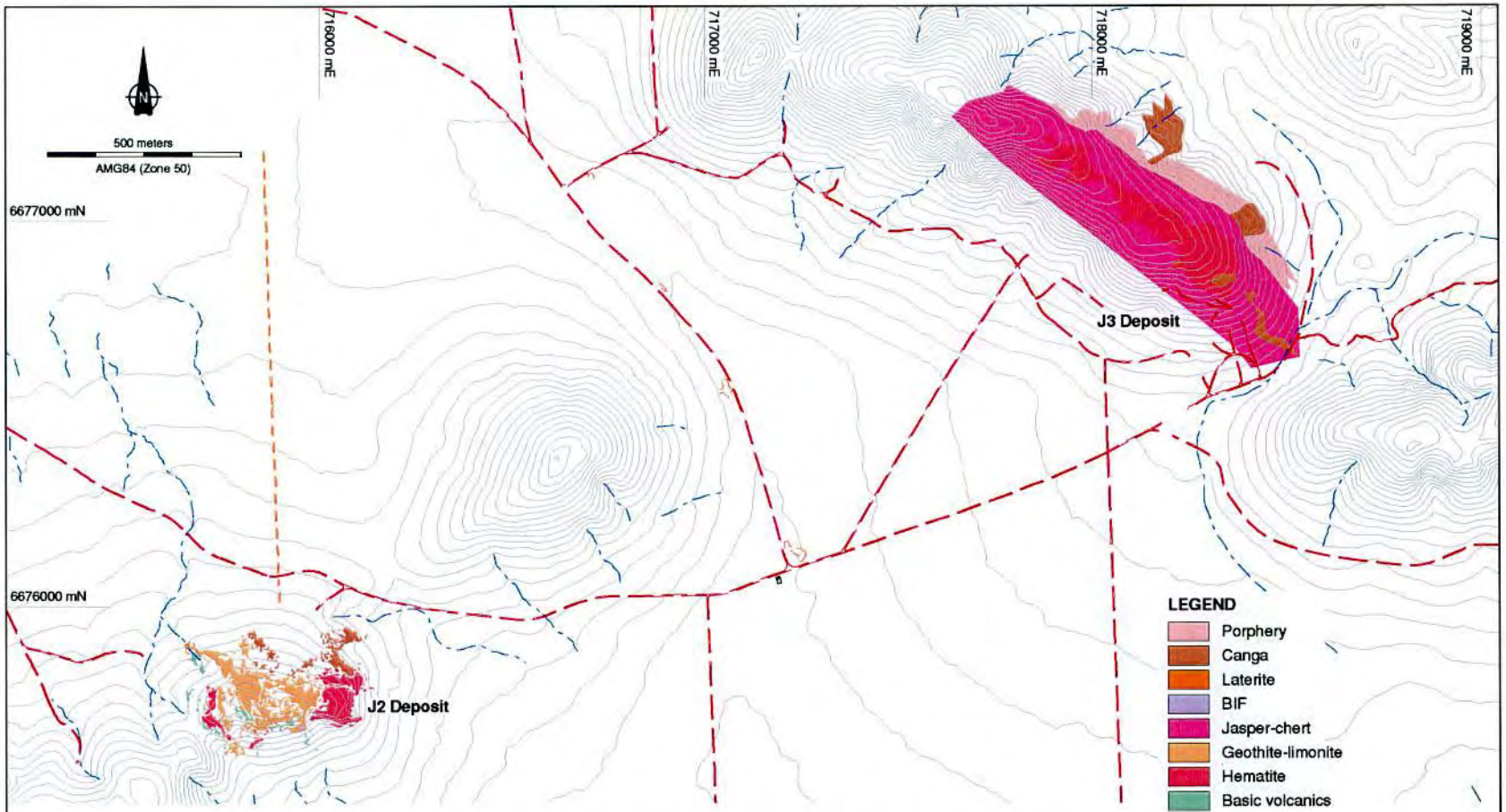
Geology and location of deposits at Windarling are depicted in Figure 5.4.



REGIONAL GEOLOGY SETTING

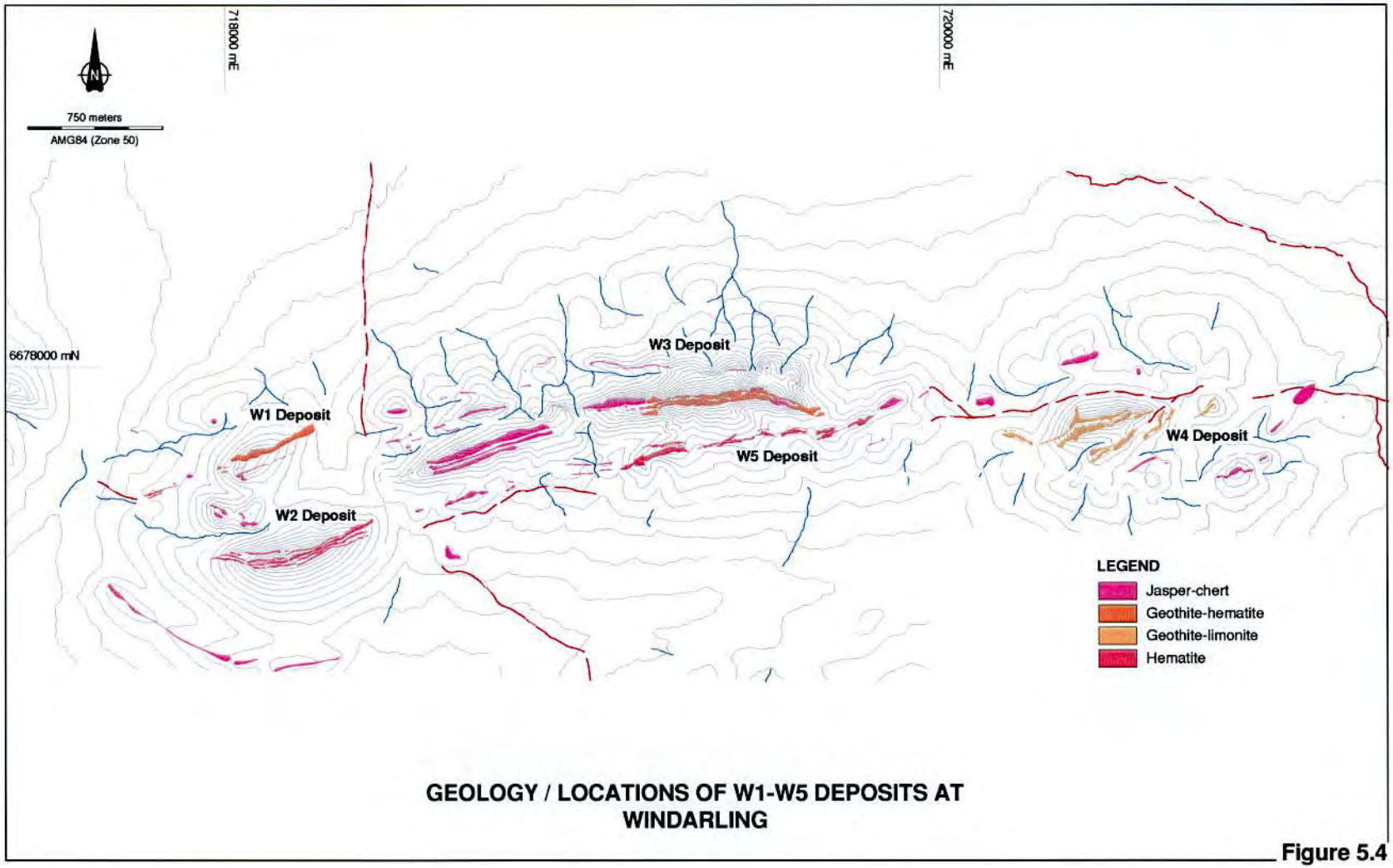
Source: AGSO

Figure 5.2



GEOLOGY / LOCATIONS OF J2 AND J3 DEPOSITS AT MT JACKSON

Figure 5.3



GEOLOGY / LOCATIONS OF W1-W5 DEPOSITS AT WINDARLING

Figure 5.4

5.3.3 Transportation Corridor

The four major greenstone mountain belts in the Mt Jackson region, incorporating ridgelines of BIF lithologies, are referred to as the Koolyanobbing, Bullfinch, Hunt and Marda Complex Mountain Belts. The existing railway line services the mine located within the Koolyanobbing Mountain Belt, whilst the proposed satellite mines are located at Mt Jackson and Windarling within the Marda Complex Mountain Belt. The proposed transportation corridor traverses low lying ground from the existing railway line near the Koolyanobbing Mountain Belt to the proposed mines within the Marda Belt.

Surface Geology

The proposed railway alignment traverses three landscape types determined by the underlying geology, with a variety of ground conditions:

- Low lying remnant drainage channels associated with the Lake Deborah salt lake system which contain Quaternary alluvial and colluvial sediments. Near surface materials encountered within the remnant drainage channels associated with Lake Deborah typically include:
  - Channelled alluvium near former and present stream channels
  - Sheet material within overland flow areas
  - Colluvium/slopewash on undulating hill slopes; and
  - Isolated outcrops of rock and laterite.

These remnant (palaeochannels) and existing drainage channels are evident across much of the lower lying landscape areas between Koolyanobbing and Mt Jackson.

- Sandplains: The sandplains provide a transition between the low lying drainage channels and slightly higher relief laterite duricrust which essentially forms the foothills of the Marda Complex and Koolyanobbing Mountain Belts.

- Laterite Duricrust and High Level Drainage Channels: Comprised of residual deposits high in hydrated iron oxides which forms by leaching and this material is hence sometimes referred to as ferricrete. Laterite is generally associated with the lower foot slopes of the Marda Complex Mountain Belt and hence occurs at a slightly higher elevation than the remnant drainage channels. Observations along the railway alignment indicate that laterite and in some areas calcrete outcrops occur at a number of locations. Based on regional geology the laterite is likely to be underlain by weathered sedimentary bedrock including siltstone and sandstones.

5.4 SOILS

Within the project area shallow calcareous earths tend to be present on rises and ridges. Scree slopes have skeletal and stony soils while breakaways have minor areas of Gritty Loams in various deposits, as pockets, sheets, or pediments (Biological Surveys Committee, 1985). Much of the ridgeline areas along the ranges are composed of exposed bedrock, and have minimal soil development.

Sandplains are a major component of the project area. These sandplain areas have arisen from erosion of the underlying granite bedrock. They are highly leached, silicious and slightly acidic. The sand plains quickly become gravelly at the bases of low rises and this is typically colluvium deposits from the banded ironstone ranges. These are Red Sands as opposed to the real Deep Sands of the true sand plains. Saline, Subsaline or Aeolian Sands are present

around the study region in the many salt lakes. However, cracking Red Clays are more common on the floor of the freshwater claypans.

5.4.1 Mine Areas

Soils are generally gravelly to coarsely granular at the bases of low hills and ridges with typically colluvium deposits arising from the banded ironstone ranges. Scree slopes have skeletal and stoney soils while breakaways have Gritty Loams in various deposits, as pockets, sheets, or pediments. On rocky cliff faces and at the top of ridgelines, exposed rocks have no or minimal soil development, minor soil deposition occurring where moss and lichen trap debris.

5.4.2 Transportation Corridor

The transportation corridor will traverse variable ground conditions. The types of soils and surface conditions encountered along the rail corridor are summarised in Table 5.2 in relation to the landscape units within which they were encountered.

Sandplains are a significant component of the area through which the rail corridor traverses. Saline, sub-saline or aeolian sands are present around the periphery of the many salt lakes in the general region, however cracking red clays are also common on the surrounding plain floor. The railway corridor traverses country to the east of Lake Deborah with soils associated with the saline playa lakes and the 'Clarkson Flat' area.

Areas of cracking clay were also encountered along the proposed rail corridor. Shallow calcareous earths are present on low rises and are derived from localised calcrete deposits. Skeletal soils and soils derived from deeply weathered bedrock occur on and in the vicinity of the scattered granite exposures that occur particularly in the southern portion of the corridor.

Table 5.2: Ground Conditions along the Transportation Corridor

Landscape Unit	Subsurface Conditions	Soils and Surface Conditions
Remnant Drainage Channels	Alluvium	Deep (3m) reactive clayey soils of high plasticity and locally dispersive. Encountered within and adjacent to existing stream channels and salt lakes.
	Colluvium/Slope wash	Deep silty sand soils of low plasticity. Locally with gravel and/or clay. Encountered across most of this unit.
	Rock Outcrops	Random outcrops of granite, calcrete and laterite.
Sandplains	Sand plains	Medium (1-3m) to deep silty sands with little to no clay content. Locally with laterite gravel. Some laterite and calcrete outcrops.
Laterite Duricrust	Laterite	Shallow (<1m) to medium (1 to 3m) colluvial surface soils underlain by laterite or calcrete which outcrops throughout the unit. It is anticipated that this material is underlain by weathered sedimentary rock. Encountered along most of this unit.
	Alluvium	Shallow to medium clayey soils which are reactive and of high plasticity.

5.5 GROUNDWATER

5.5.1 Regional Hydrogeology

Surveys of groundwater resources in the nearby Northern Goldfields (Laverton to Wiluna) indicate that groundwater occurs in the bedrock, in Tertiary palaeochannels, and in overlying alluvial, colluvial and calcrete deposits (Johnson *et al.*, 1998). Most of the new mining developments in the region exploit groundwater from the palaeochannels, as these aquifers are easier to explore and access than the bedrock aquifers.

The hydrogeology of Tertiary palaeochannels in the Kalgoorlie Region has been described by Commander *et al.* (1992). The distribution of groundwater salinity is related to topography, with a tendency to increase along drainage lines, particularly the palaeodrainages, and hypersaline groundwater mainly in palaeochannels and in bedrock adjacent to playa lakes. Brackish groundwater (1000-3000 mg/L TDS) is widely distributed through the Northern Goldfields (Johnson *et al.*, 1998) and similar conditions are likely to prevail within the project area.

Almost no information is available regarding the occurrence of groundwater in the vicinity of Koolyanobbing. Geological sections from BHP suggest that groundwater was present in the area of the 'A' Deposit at the existing Koolyanobbing site at an elevation of about 335m AHD, about 60m below the current level of Pit 'A'. Other records indicate that the watertable near Koolyanobbing lies at about 20m below the plains (Dames and Moore, 1993). No information is available regarding the quality of the groundwater in the area except that a single sample at Koolyanobbing was found to be hypersaline (> 50 000 mg/L TDS).

Following an extensive drought relief drilling program in the southwestern Goldfields it was suggested that prospects for the discovery of potable groundwater in the region were poor (Beard, 1979).

5.5.2 Mine Areas

Rockwater (2001) undertook a preliminary study of groundwater supply in the project area. This initial study included an assessment of existing information from drillholes and water bores, site inspection, sampling and air-photo interpretation.

The main potential aquifers in the project area include alluvium, palaeochannels, iron deposits, and areas of fractured granite or greenstone. In general, the groundwater will have lowest salinity in elevated ground, particularly in the vicinity of the BIF ridges. Salinities increase toward the palaeodrainages where the groundwater is hypersaline.

Rockwater (2001) indicate that 'West Bungalbin Creek', a 70 km long drainage line passing 12 km south of Mt Jackson and draining westwards to the Hamersley Lakes System, is likely to contain a buried palaeochannel with a basal sand deposit. This potentially has supplies of hypersaline groundwater, but no drilling has been undertaken in the area as yet.

The iron ore deposits J1, J2 and J4 at Mt Jackson were shown by the mineral exploration drilling to contain groundwater of low to moderate salinity (3 000 to 30 000 mg/L TDS). The rates of supply were not measured but are qualitatively assessed to be low to moderate. Deposits W1 and W2 at Windarling also gave indications of limited groundwater in some exploration drill holes.

An existing bore at Marda (to the north of Mt Jackson) was found to have a static water level of 58 metres below ground surface and water salinity of 4 500 mg/L TDS.

5.6 SURFACE WATER

5.6.1 Regional Hydrology

Koolyanobbing lies in the Internal Drainage Division of Western Australia (Beard, 1972). Surface drainage in this division does not reach the coast but instead flows to the many large and small salt lakes that dot the inland parts of the state. The major hydrological features of the Koolyanobbing area are Lake Deborah East, Lake Deborah West and Lake Seabrook, which form part of a chain of large, ephemeral salt lakes north-west, west and south west of the project area. These lakes follow the course of an ancient river channel (paleodrainage). A number of much smaller saline and brackish ephemeral lakes exist to the west of the Koolyanobbing township.

To the southwest of the Mt Jackson area lies the Lake Hamersley salt lake system. This low-lying area receives drainage from the hills of the Jackson range, and the remnants of the paleodrainage in the areas surrounding the Helena and Aurora Range. This intermittent drainage has been referred to as 'West Bungalbin Creek'. Due to the relative uniformity of the landscape and the relatively low rainfall, these stream channels rarely flow except in extremely wet years, and much of the drainage is undifferentiated.

Surface water or permanent water in the area is scarce. Primarily it consists of artificially created dams for agriculture (Biological Surveys Committee, 1985). Streams within the region are generally ephemeral and non-cyclical. After seasonal rain, water can be held for periods of time in the steep drainage gullies of some of the ranges, but few rockpools in the area are considered permanent. Gnamma holes are rare but one is thought to occur just to the north of the Mt Jackson project area; it is known as Bulgine Rock Hole.

5.6.2 Project Area

There is no significant defined surface drainage in the project area. The ranges in the area rise up to 100m above the surrounding plain and are drained by short limited drainage gullies, which shed water into the surrounding countryside. The majority of runoff would occur as minor flows in gullies draining the ironstone hills. Occasional small, ill-defined creek lines exist in runoff areas from the Koolyanobbing, Jackson and Helena-Aurora Ranges. These terminate in broad outwash zones where they reach flat ground and would flow only rarely, following heavy rainfall.

Much of the area comprises undulating plains and broad valleys with few minor defined drainage systems. The only obvious watercourses/waterbodies present in the project area that are indicated on topographic maps of the area are the salt lakes of the Lake Deborah System 40 km to the south of Mt Jackson and the Hamersley Lakes to the south west of Mt Jackson.

5.7 VEGETATION AND FLORA OVERVIEW

5.7.1 Regional Vegetation

The Project Area is located in the Coolgardie Botanical District which is located within the South-western Interzone between the South-West and Eremaean Botanical Provinces (Beard, 1990). The Coolgardie Botanical District has considerable environmental significance since it not only contains numerous species which are either specifically arid tolerant or have restricted geographic distributions, but also contains flora with biogeographic affinities with the more southern Southwestern Botanical Province. As a result of this overlap, the species diversity of the flora is greatly enhanced.

The general vegetation of the region reflects the underlying geology and soils. Plant communities are dominated by Salmon Gum (*Eucalyptus salmonophloia*) and Gimlet (*Eucalyptus salubris*) woodlands on low lying clay loam areas, mallee and shrublands on sandplains, halophytic communities on saline flats and playa lakes, and *Eucalyptus torquata* and *E. lesouefii* and various shrubland and mallee communities on the rocky slopes of the ranges. The District marks a vegetation transition from the species rich southwest to the arid communities of the desert regions (Beard, 1990).

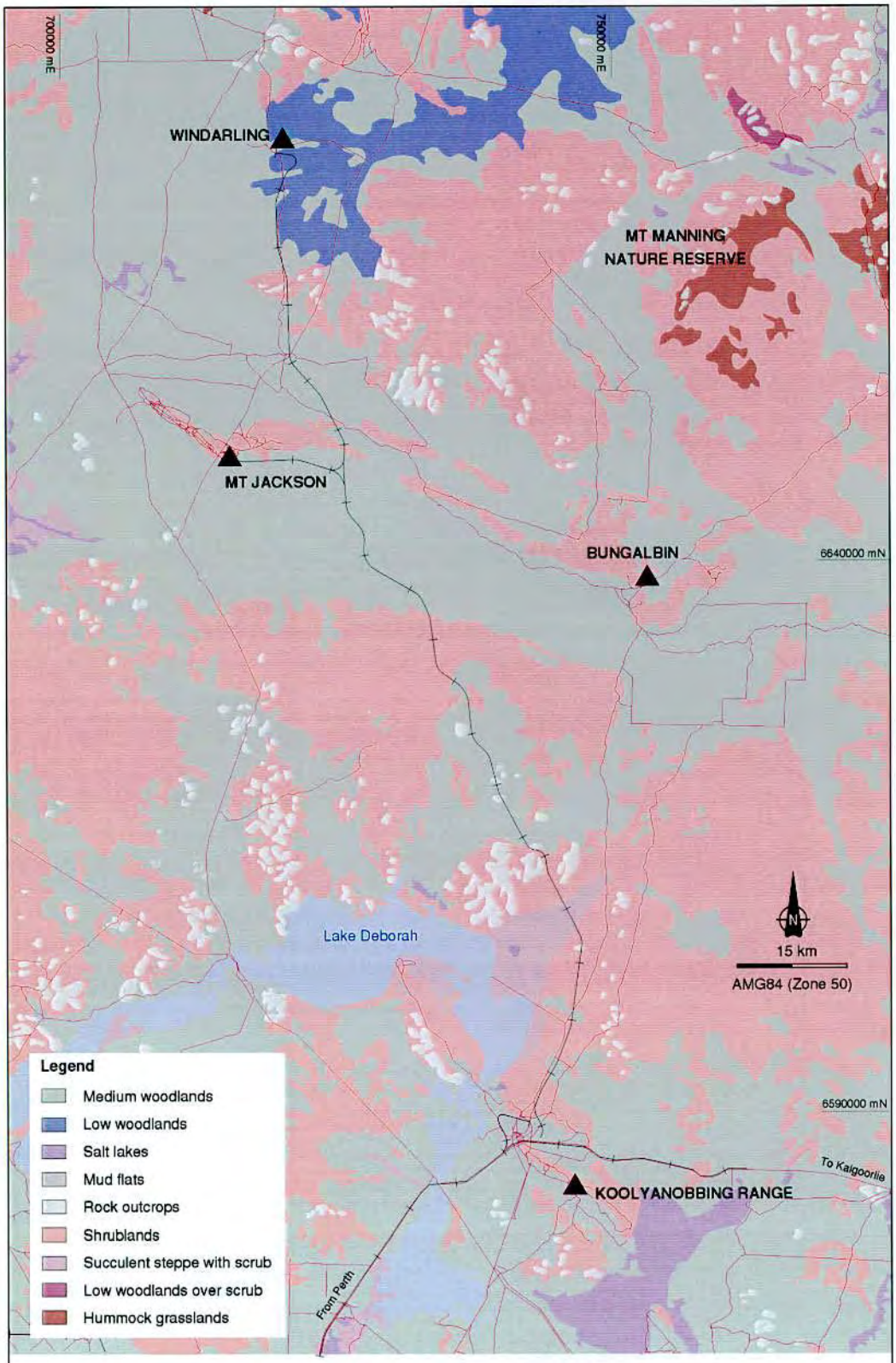
The Coolgardie Botanical District (Beard, 1990) is equivalent to the Coolgardie Biogeographic Region within the framework of the Interim Biogeographic Regionalisation for Australia (IBRA) (Thackway and Cresswell, 1995). This is a system of biogeographic regions covering the whole of Australia and is recognised as a suitable unit for decision-making in terms of representation of conservation reserves by state and national government agencies. It is also the largest unit utilised in the assessment of threatening processes and level of sensitivity to impact (EPA, 2000).

Beard (1972, 1978) first described the major structural formations of the vegetation of the Mt Jackson area, which he grouped into vegetation systems. He defined the vegetation of the Watt and Yendilberin Hills and the Hunt Range as forming part of the Bungalbin System. This system also encompasses the ironstone and greenstone areas of the Helena and Aurora Range, Koolyanobbing Range and Jackson Range. Beard (1978) ascribed low-lying areas surrounding the hills, including salt lakes, to the broad Jackson System. The Windarling area lies in Beard's Die Hardy System, which extends to the north of the Jackson System. Broadscale vegetation types as described by Beard include woodlands, shrublands and features associated with salt lakes (Figure 5.5).

The Bungalbin System is most well developed on the massive banded ironstone ranges (Helena and Aurora, Mt Jackson and Koolyanobbing Ranges). The system is characterised by low thickets of *Acacia quadrimarginea, A. tetragonophylla* and *Allocasuarina acutivalvis* with trees of *Brachychiton gregorii* and *Dryandra arborea* on massive outcrops. This system typically has an understorey of *Dodonaea* spp., *Eremophila clarkei, Eriostemon brucei, Grevillea paradoxa* and a range of annual species (Beard, 1972).

Dominant plant families within the Coolgardie Botanical District

include Myrtaceae (myrtles), Asteraceae (daisies), Chenopodiaceae (samphires) and Poaceae (grasses). The region is characterised by eucalypt woodlands, and covers approximately five percent (125 000 square kilometres) of the state of Western Australia.



MAJOR VEGETATION TYPES

Figure 5.5

5.7.2 Previous Floristic Surveys

Flora surveys undertaken in the general area in the last decade have shown that the Jackson, Mt Manning, and Helena and Aurora ranges have significant flora conservation values including several taxa of rare or significant conservation value, and species endemic to the ranges. At a localised scale, vegetation surveys relevant to the context of the current proposal have been conducted at several sites in the Jackson-Kalgoorlie region (Newbey and Hnatiuk, 1985). These include Mt Manning Range to the northeast of the project area, the Hunt Range, Yendilberin and Watt Hills to the northeast of Koolyanobbing (Gibson and Lyons, 1997b), the Highclere Hills to the northwest of Bullfinch (Gibson and Lyons, 1997c) and the Helena and Aurora Range to the east of the Jackson Range (Gibson *et al.*, 1997).

The 'Biological Survey of the Eastern Goldfields of Western Australia' (Biological Surveys Committee, 1985) involved the study of vegetation and flora at 166 sites within the 'Jackson-Kalgoorlie' region which lies within the Coolgardie Botanical District (Table 5.3). The sites represented 52 broad vegetation types. The vascular flora comprised 3 species of fern, and 777 species, 16 subspecies and 20 varieties of flowering plants, a total of 816 taxa. Fifteen undescribed species were collected and a further 19 had been poorly collected previously. No Gazetted Rare Flora were recorded although 18 taxa were considered confined to the area.

The botanical survey conducted by CALM in 1995 concentrated on the flora and plant communities of the Helena and Aurora Range. A series of 55 quadrats were established on the range, foot slopes and surrounding outwash plain, including 27 primarily upland sites (Gibson *et al.*, 1997). A total of 324 plant taxa were recorded from the area comprising 303 native and 21 introduced taxa. The most speciose families were the Asteraceae, Myrtaceae, Poaceae, Mimosaceae, Chenopodiaceae and Myoporaceae. The most common genera were *Eucalyptus* (Myrtaceae), *Acacia* (Mimosaceae) and *Eremophila* (Myoporaceae). One species of Declared Rare Flora and 10 Priority Flora taxa were recorded during the survey.

In the Mt Manning Range area a total of 217 flora taxa were collected, including 213 native and 4 introduced taxa (Table 5.3). One Declared Rare Flora and 10 Priority Flora taxa were recorded (Gibson and Lyons, 1997a). In the Hunt Range area a total of 285 taxa were collected including six Priority Flora taxa and one Declared Rare Flora taxon (Gibson and Lyons, 1997b). A total of 248 flora taxa were recorded from the Highclere Hills of which 223 were native and 25 were introduced (Gibson and Lyons, 1997c). Five Priority taxa were recorded from the area.

Table 5.3: Summary of previous flora studies in the general Koolyanobbing region

Authors	Area researched	No. Quadrats	Total No. flora taxa found
Gibson et al., 1997	Helena and Aurora Range	55	324 -303 native -21 introduced
Gibson and Lyons, 1997a	Mt Manning Range	54	217 - 213 native - 4 introduced
Gibson and Lyons, 1997b	Hunt Range, Yendilberin and Watt Hills	53	285 - 271 native - 14 introduced
Gibson and Lyons, 1997c	Highclere Hills	45	248 - 223 native - 25 introduced
Biological Surveys Committee, 1985	'Jackson-Kalgoorlie' study area	166	816

5.7.3 Survey Methodology

As part of the environmental assessment for the current proposal, a range of botanical studies have been undertaken on the proposed ore bodies at the Jackson and Windarling Ranges and along the transport corridor from Koolyanobbing. Mattiske (2001a) summarizes the flora values of the area in a local and regional context and compares these values with previous studies undertaken in the region by Gibson et al. (1997) and Gibson and Lyons (1997a, 1997b, 1997c) (Table 5.4).

Vegetation and Flora Surveys

The report on the vegetation and flora of the project area (Mattiske, 2001a,c) was based on a variety of studies and sources of information:

- Beard vegetation mapping on a local and regional scale (Beard, 1972, 1990);
- CALM WAHERB records;
- CALM Florabase records;
- Survey of the Die Hardy, Windarling, Jackson, Helena and Aurora Ranges (Mattiske, 2001) (Mattiske, 2001a,c);
- Survey of the transport corridor (Mattiske, 2001a,c);
- Additional survey work on proposed mining areas at Windarling and Jackson Ranges including 20m x 20m gridding of the main outcrop areas on these ranges in 2001 (Mattiske, 2001b);
- Survey of the Koolyanobbing and Highclere Hills (Mattiske, 2001a,c)
- Additional survey work on outcrop areas of Mt Manning, Die Hardy, Mt Elvire and Ranges north of Lake Barlee as a result of helicopter surveys undertaken by P Collings.
- Butcher et al. (2001) and Butcher (2001) on the morphological and DNA sequence variation in the Declared Rare Flora species of *Tetratheca*.
- Flora and Vegetation of the Helena and Aurora Range (Gibson *et al.*, 1997).
- Floristic Surveys of the Mt Manning Range, Highclere Hills and the Hunt Range, Yendilberin and Watt Hills (Gibson and Lyons, 1997a, 1997b, 1997c).

The objectives of the flora and vegetation survey undertaken by Mattiske (2001a,c) were to describe and define the botanical values of the project area. Specific objectives of the survey were to:

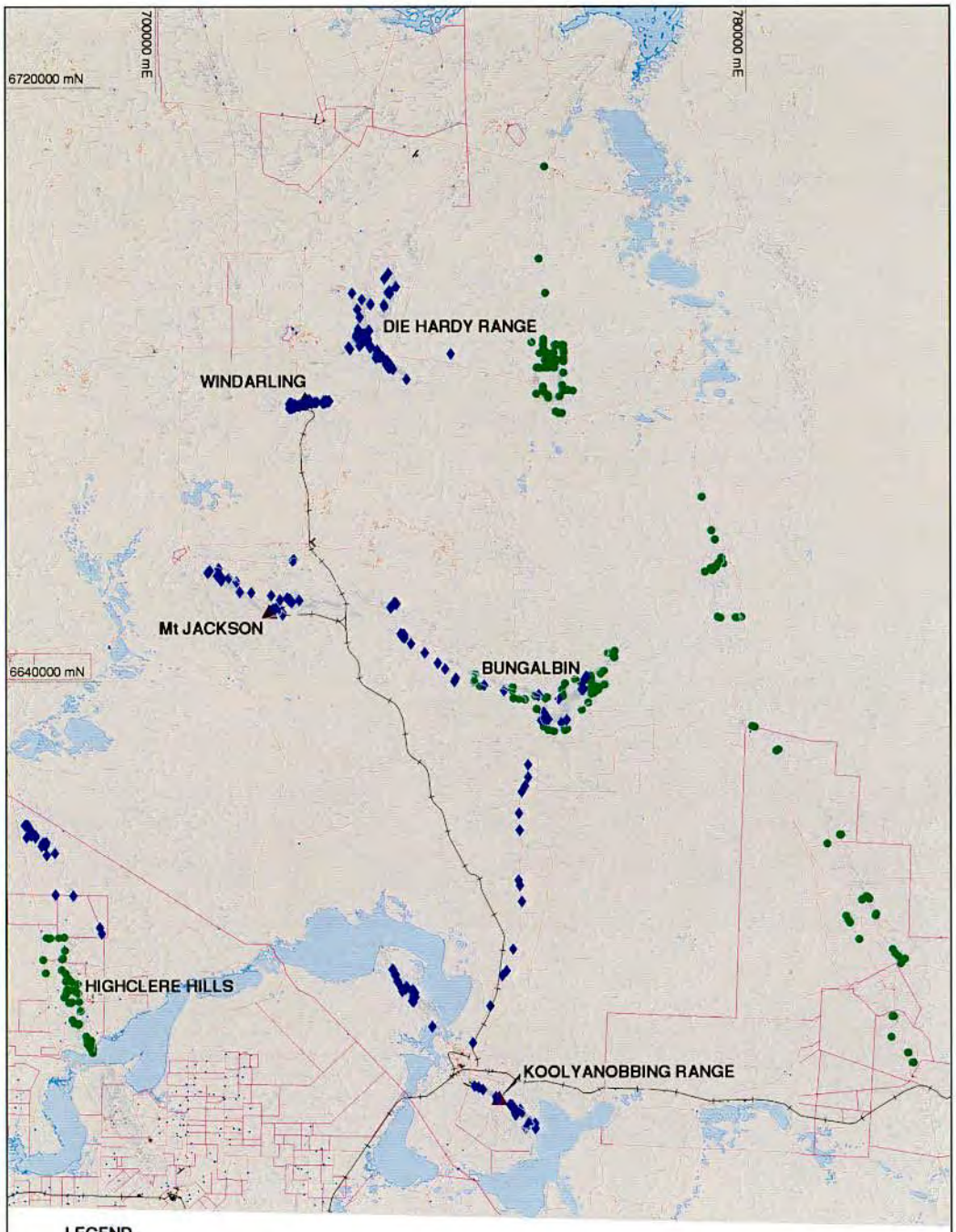
- Collect and identify the vascular plant species present in the project area;
- Search for any rare, endangered or significant flora species'
- Review the conservation status of the vascular plant species by reference to current literature and current CALM listings and plant collections held at the WA State Herbarium and current listings associated with the EPBC Act, 1999;
- Identify any weed species present; and
- Integrate the data sets with previous data sets collected in the area (WAHERB; Gibson *et al.* 1997; Gibson and Lyons, 1997a, b, c).

A total of 212 person field days were spent undertaking the botanical studies from July 2000 to September 2001. The concentrated plot work was largely undertaken in October and November 2000 although specific collecting time was allocated in the survey areas throughout the period.

Ecologia and Mattiske recorded 258 20 x 20m sites as compared with 207 sites recorded by Gibson *et al* (1997) and Gibson and Lyons (1997a, b, c, d). Locations of the survey sites are depicted in Figure 5.6. A total of 465 sites has therefore been examined in the project area and surrounds as a result of previous surveys and surveys undertaken specifically for the Koolyanobbing Expansion Project (Table 5.4, Figure 5.6).

Table 5.4: Summary of Flora and Vegetation Survey effort in the Region

Survey Area	Source of Data	No. of Sites
Transportation Corridor	Mattiske (2001a)	45
Die Hardy Ranges	Mattiske (2001a)	54
Helena and Aurora Ranges	Gibson (1997) and Mattiske (2001a)	75
Highclere Hills	Gibson (1997c) and Mattiske (2001a)	65
Hunt Range, Yendilberin and Watt Hills	Gibson (1997b)	53
Koolyanobbing Range	Mattiske (2001a)	40
Mt Jackson Range	Mattiske (2001a)	29
Mt Manning Range	Gibson (1997a)	54
Windarling Area	Mattiske (2001a)	50
	TOTAL	465



REGIONAL FLORA SURVEY SITES

Figure 5.6

Survey Limitations

Due to its location the project area can be subjected to both winter and summer rains, which vary from one season to the next. This variability in rainfall influences the range of annual species that can be surveyed in any one year. During the surveys the majority of unidentified taxa were largely annuals. This appears to relate to seasonal conditions in specific areas rather than all the survey areas. Flowering times of the annual species are short and sensitive to rainfall events. Due to the time constraints of fieldwork and the unpredictability of rainfall events in the Southwestern Interzone (Beard, 1990), it is not always possible to survey when the annuals are flowering. Many of the annual species were unidentifiable during surveys. However, a significant effort was made during the work to ensure opportunistic collections were made from all local niches to capture as many taxa as possible.

Rare and Priority Flora Survey

A variety of methods were used by Mattiske (2001b) to identify Declared Rare Flora (DRF) and Priority Flora taxa that potentially occur within the project area. Detailed searches of portions of the project area were undertaken where previous information or flora surveys suggested the possible existence of Rare DRF and Priority species. A system of 20 x 20 m grids was devised covering some of the deposits and surrounding areas where rare species were known to occur. These areas were traversed on foot and an accurate count per species was recorded for quadrats either side of the transect.

5.8 VEGETATION COMMUNITIES

5.8.1 Regional Mapping

In a regional context Beard (1972, 1990) mapped a total of 10 supergroups containing 25 vegetation associations (Figure 5.7). As this mapping was undertaken on a regional scale of 1:100,000 and published at a scale of 1:250,000 many local communities were not delineated in the mapping. However, the results allow the vegetation in the local areas to be placed in a regional context.

In defining the vegetation associations at a regional scale Beard recognised broad patterns of vegetation on the varying landforms and soil types. The extensive eucalypt woodlands (York Gum, Salmon Gum and Gimlet species names here?) dominate the broad flats between the Helena and Aurora Ranges, Jackson Range and Lake Deborah to the south while extensive shrublands predominate on upland areas and sandplains. Beard (1972) separated the banded iron formations on the Jackson Ranges by delineating *Acacia* thickets of *Acacia quadrimarginea* on ironstone ridges, as distinct from the surrounding eucalypt woodlands.

5.8.2 Vegetation Communities of the Koolyanobbing Area

Analysis of floristic data from all plots in the general Koolyanobbing area (Mattiske, 2001c) differentiated six Supergroups and 35 Groupings of species (Table 5.5). The six Supergroups can be generally subdivided into shrublands on ridges (Supergroups 1 & 2), shrublands and *Acacia* shrublands on outcrops and slopes (Supergroup 3), eucalypt woodlands on flats and lower slopes (Supergroup 4) and *Acacia* and eucalypt woodlands on slopes (Supergroups 5 & 6). The Supergroups are summarised in Table 5.5 and can be distinguished as follows:

Supergroup 1 – includes Groups 1A, 1B and 1C

The separation of Groups 1A, 1B and 1C from the remainder of the plots on the basis of differences in species composition is indicative of the distinctiveness of the Windarling ridges and outcrop areas and is significant in

a regional context. The majority of the Windarling plots (35 out of a total of 50 for the area) were separated out into Groups 1A to 1C. This includes plots on the ridges and outcrop areas.

Supergroup 2 – includes Groups 2A to 2F

Supergroup 2 includes a variety of shrublands on outcrops, ridges and upper slopes of the various ranges. The distinctiveness of the communities supporting the two nationally listed species *Tetratheca aphylla* and *Tetratheca harperi* is significant, although the plots supporting *Tetratheca* aff. *paynterae* (Die Hardy Ranges) were most similar to those sites on Muddarning Hill (Mt Jackson Range) that supported *Tetratheca harperi*, some 30km away to the south.

Supergroup 3 – includes Groups 3A to 3M

Supergroup 3 includes a mixture of shrublands, *Acacia* and eucalypt woodlands on hill and range slopes. Some of the Groups occur at more than one locality and are well differentiated but less so than Supergroups 1 and 2.

Supergroup 4 – includes Groups 4A to 4E

Supergroup 4 encompasses mostly eucalypt woodlands either on extensive flats between the ranges or on lower hill slopes. Due to the similarity of the dominant species many of the Groups consistently occur at more than one locality and are less differentiated than Supergroups 1 and 2. In particular Groups 4B, 4C and 4D include a mixture of plots from various areas.

Supergroup 5 – includes Groups 5A to 5E

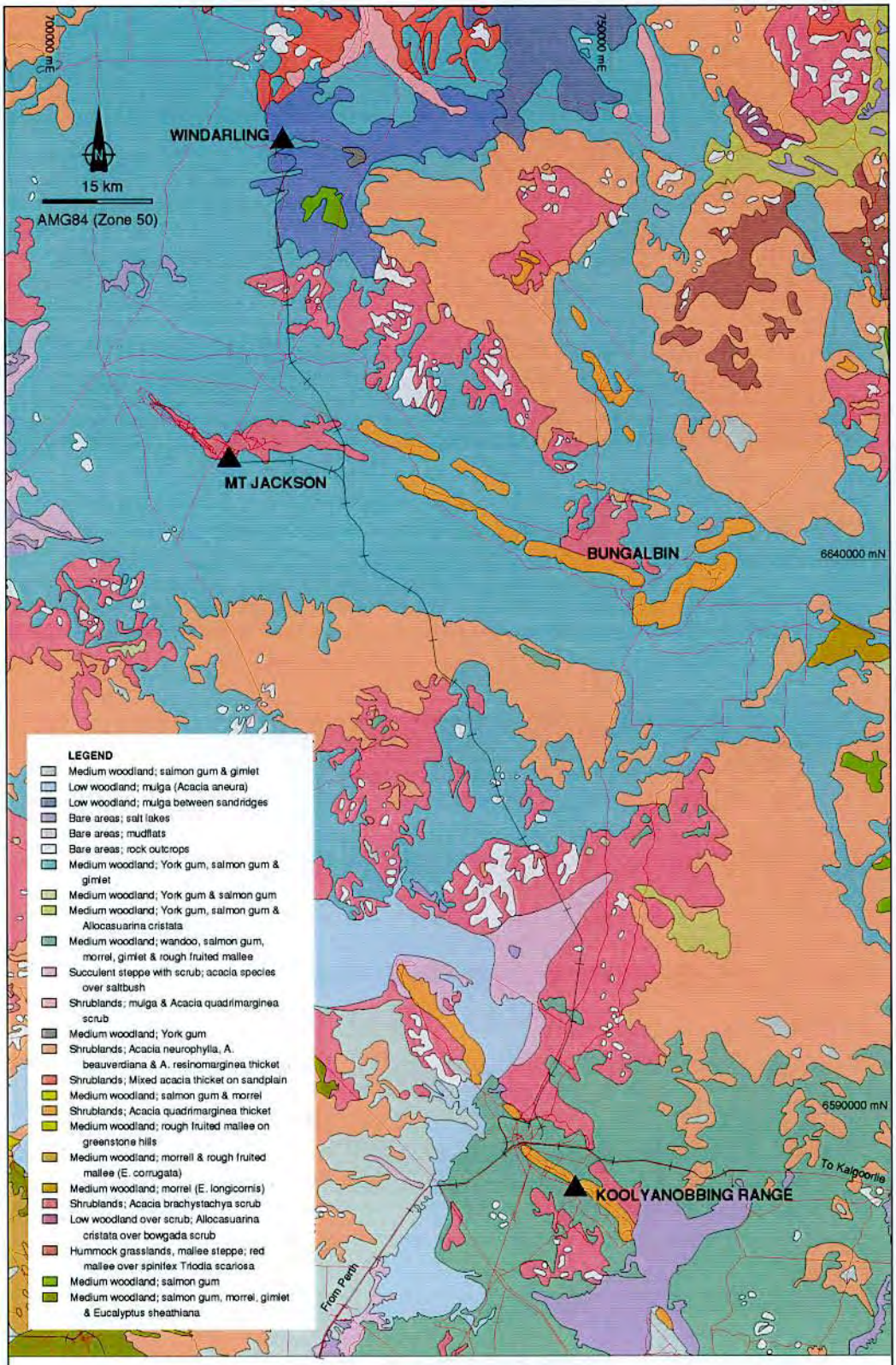
Supergroup 5 is mostly *Acacia* or eucalypt woodlands either on the extensive flats between the ranges or on the hill slopes. Due to the similarity of the dominant species many of the Groups occur on more than one locality and are less differentiated than Supergroups 1 and 2.

Supergroup 6 – includes Groups 6A to 6C

Supergroup 6 contains mixed shrublands, and *Acacia* or eucalypt woodlands on hill slopes. The similarity of the dominant species means that many of the groups occur at more than one locality and are not as well differentiated as Supergroups 1 and 2, with the exception of 6B which is confined to the Windarling slopes. This again reinforces the differences of the Windarling area from the rest of the sites.

The overall delineation of Supergroups is suggestive of a separation by locality, with the majority of plots within a Supergroup tending to be from a particular range or area, e.g. Windarling, Bungalbin or Highclere Hills. Also there is significant separation on the basis of situation within the landscape, so that there are mixed shrublands on outcrop areas, ridges and upland slopes, trending to eucalypt woodland dominated communities on lower slopes and flats.

In general this analysis shows a fairly clear separation with only a few Groups having a mixture of sites from various locations, and with many Groups having plots either solely from the one area, or with only one or a few plots from other locations. This is most obvious in relation to the Windarling plots (e.g. Supergroup 1C) and other groupings on the range (Supergroups 2A to F). However there is a gradual breakdown of this orderly pattern particularly in relation to Supergoup 4 that includes lowland sites that support eucalypt woodlands.



VEGETATION ASSOCIATIONS

Figure 5.7

These results suggest that many of the specific localities, particularly in upland areas along the ranges, support communities that are limited to these areas. This trend is particularly evident in the communities on the ridges and shallow soils of the ranges, and is less obvious in relation to the eucalypt woodland communities on the lower slopes and flats. In these lowland areas the discrimination of communities is less obvious and sites may occur across the wider project area. These findings are commensurate with the hypothesised derivation of the vegetation communities, in that those communities that occur on the ranges are relatively restricted in occurrence, and are isolated from other rangeland communities by the surrounding lowland areas.

Eucalypt woodlands occur widely throughout the project area, giving way in the northern parts to *Acacia* woodlands (principally Mulga, *Acacia aneura*). Within these broad areas of relatively homogeneous vegetation lie 'islands' of distinctive vegetation associated with the ranges, commonly containing species specifically adapted to skeletal soils and exposed situations. Where these ranges are isolated from one another there has been little interchange between the areas over time, resulting in the development of characteristic and occasionally distinct communities. This is likely to be due to the mixture of relictual components that have survived on the ranges over time combined with the wide-ranging species that are able to disperse to the slopes and other available landscapes of the ranges over time.

5.8.3 Vegetation Mapping of the Mine Areas

Vegetation mapping of the project area identified a total of 12 vegetation communities belonging to 3 main vegetation types;

- Eucalypt Woodlands (two communities; E1 and E2)
- Acacia Woodlands (one community; A1)
- Mixed Shrublands (nine communities; S1 to S9).

Vegetation community mapping of the whole project area is provided in Appendix C.

Mt Jackson

On the Jackson Ranges and adjacent slopes four main groupings were recorded which could be further subdivided into 8 vegetation communities (Appendix C). The groups and vegetation communities are related primarily to the underlying landforms and soils, and include:

Group 1 - Vegetation dominated by Shrublands and Tall Shrublands on the main ridges and outcrops on J2 and J3 deposits (communities S3 and S5).

Group 2 - Vegetation on the ridges, outcrops and slopes of the western Jackson Ranges (communities S1, S3 and S7).

Group 3 - Vegetation on the surrounding slopes and flats (communities E1 and E2).

Group 4 - Vegetation on the slopes, outcrops and flats of the Jackson area (and those areas east of J3) (communities E1, E2, S8, A1).

Table 5.5: Regional Vegetation Supergroups and Groups

Group	Principal location of plots	Vegetation	Landscape
1A	Windarling	Mixed Shrublands	Outcrops and ridges
1B	Windarling & Jackson Range	Mixed Shrublands	Slopes and outcrops
1C	Windarling	Mixed Shrublands	Slopes and outcrops
2A	Helena and Aurora & Jackson Range	Mixed Shrublands	Upper slopes
2B	Jackson Range	Mixed Shrublands	Outcrops and upland slopes
2C	Helena and Aurora	Mixed Shrublands	Outcrops and upland slopes
2D	Koolyanobbing Range	Mixed Shrublands	Upland slopes
2E	Koolyanobbing Range	Mixed Shrublands	Upland slopes
2F	Die Hardy & Muddarning Hill	Mixed Shrublands	Ridges
3A	Helena and Aurora	Acacia & Eucalypt Woodlands	Range slopes, includes breakaways and massive tops
3B	Hunt Range, Yendilberin & Watt Hills	Mixed Shrublands Acacia & Eucalypt Woodlands	Range slopes
3C	Highclere Hills	Mixed Shrublands	Range slopes
3D	Highclere Hills	Mixed Shrublands	Range slopes, includes quadrats from BIS ridges and slopes
3E	Highclere Hills	Mixed Shrublands	Range slopes
3F	Mixture	Mixed Shrublands Eucalypt Woodlands	Range slopes includes quadrats form braekaways
3G	Die Hardy Ranges	Mixed Shrublands Acacia & Eucalypt Woodlands	Range slopes
3H	Die Hardy Ranges	Mixed Shrublands Acacia Shrublands	Range slopes
3I	Die Hardy Ranges	Mixed Shrublands Acacia Shrublands	Range slopes
3J	Rail Corridor	Mixed Shrublands Acacia Shrublands	Range slopes
3K	Mt Manning Range	Mixed Shrublands Acacia & Eucalypt Woodlands	Range slopes
3L	Hunt Range, Yendilberin & Watt Hills	Mixed Shrublands Acacia Shrublands	Range slopes
3M	Mt Manning Range	Mixed Shrublands Acacia & Eucalypt Woodlands	Range slopes
4A	Rail Corridor	Eucalypt Woodlands	Flats and lower slopes
4B	Mixture	Eucalypt Woodlands	Flats and lower slopes
4C	Mixture	Eucalypt Woodlands	Flats and lower slopes
4D	Mixture	Eucalypt Woodlands	Slopes and non-clay soils
4E	Helena and Aurora	Eucalypt Woodlands	Range slopes, includes ridgetops and breakaways
5A	Mixture	Acacia & Eucalypt Woodlands	Range slopes
5B	Rail Corridor	Acacia & Eucalypt Woodlands	Range slopes
5C	Hunt Range et al.	Eucalypt Woodlands	Flats
5D	Hunt Range et al. Mt Manning Range	Eucalypt Woodlands	Range slopes
5E	Mt Manning Range	Eucalypt Woodlands	Range slopes
6A	Mixture	Acacia & Eucalypt Woodlands	Range slopes
6B	Windarling	Mixed Shrublands Acacia Shrublands	Outcrops and slopes
6C	Die Hardy Ranges	Acacia & Eucalypt Woodlands	Range slopes

The vegetation of the Jackson Range has been mapped into 8 vegetation mapping units (communities) as follows:

Eucalyptus Woodlands

E1: Open Woodland to Tall Open Woodland of *Eucalyptus salmonophloia* and *E. salubris* over *Acacia burkittii, A. tetragonophylla, Eremophila scoparia* and *Olearia muelleri* on flats and lower slopes.

E2: Open Woodland of mixed eucalypts (5 taxa) over *Acacia spp., Eremophila scoparia* and *Olearia muellerion* flats and slopes.

Acacia Woodlands

A1: Open Woodland of *Acacia aneura* and other *Acacia* shrubs over mixed *Eremophila* and chenopods on broad flats and gently undulating slopes.

Mixed Shrublands

S1: Open Heath to Tall Shrubland of *Acacia quadrimarginea, A. ramulosa, A. tetragonophylla, Scaevola spinescens, Eremophila clarkei* and *E. oldfieldii* on mid slopes on shallow soils.

S3: Tall Shrubland of *Dryandra arborea, Acacia quadrimarginea, Allocasuarina acutivalvis* and *Calycopeplus paucifolius* with emergent *Eucalyptus ewartiana* on upper slopes and outcrops on ranges.

S5: Shrubland of *Dryandra arborea, Acacia quadrimarginea, Allocasuarina acutivalvis, Jacksonia jackson, Tetratheca harperi* and *Acacia andrewsii* on upper slopes and outcrop areas on ranges.

S7: Low Shrubland of mixed *Acacia, Ptilotus, Senna* and *Eremophila* spp. on exposed calcrete areas on low rises and slopes.

S8: Open Shrubland of *Acacia aneura, A. burkittii, Dodonaea bursariifolia, Hibbertia exasperata* over *Amphipogon caricinus* and *Lepidosperma* sp. (LM/180/373) on low undulating flats.

The results of the vegetation analysis indicate that the vegetation communities of the Jackson Range are distinct from other outcrops, ridges and upland areas in the region. The one exception was Muddarning Hill, located in the eastern section of the Jackson Ranges, which showed some affinities with the Die Hardy Range, some 35km to the north. The ecological significance of this similarity has yet to be determined however.

There were also differences within the Jackson Range. The western end of the Jackson Range was separated from the J2 and J3 deposits, which in turn were separated from the associated ranges to the east (eg. Muddarning Hill.

In reviewing the species in common with other locations in the region, multivariate analysis suggests that the Jackson Ranges are closer to some of the Transportation Corridor sites (particular range slope sites) ahead of the Die Hardy ranges and the Windarling ranges. This is supported by the dendrograms (in Mattiske, 2001a) and is expected from a biogeographic point of view due to the near geographic proximity of the Corridor to the Jackson Range.

Windarling

On the Windarling Range and adjacent slopes a total of 5 main groupings were recorded, which were further subdivided into 8 vegetation communities (Appendix C). The groups and vegetation communities are related primarily to the underlying landforms and soils, and are as follows:

Group 1 - Vegetation dominated by Shrublands and Tall Shrublands (community S6) on the main ridges on W3, W4 and W5 deposits.

Group 2 - Mixture of Tall Shrublands (communities S2, A1, S9 and S4) on the upper slopes and outcrops on the W2, W3 and W5 deposits.

Group 3 - Vegetation dominated by Shrublands on the outcrops and slopes mainly on W1 and W3 and to a lesser extent the W2 and W5 deposits (communities S2, S4 and A1).

Group 4 - Vegetation on the slopes of the Windarling ranges (communities E2 and S2).

Group 5 - Vegetation on the ridges of W2 deposit (community S4).

Utilising aerial photographs and the analysis above, the vegetation of the Windarling area was mapped into 8 vegetation units (ie. communities), as follows:

Eucalypt Woodlands

E1: Open Woodland to Tall Open Woodland of *Eucalyptus salmonophloia* and *E. salubris* over *Acacia burkittii, A. tetragonophylla, Eremophila scoparia* and *Olearia muelleri* on flats and lower slopes.

E2: Open Woodland of mixed eucalypts (5 taxa) over *Acacia spp., Eremophila scoparia* and *Olearia muelleri* on flats and slopes.

Acacia Woodlands

A1: Open Woodland of *Acacia aneura* and other *Acacia* shrubs over mixed *Eremophila* and chenopods on broad flats and gently undulating slopes.

Mixed Shrublands

S2: Open Heath to Tall Shrubland of *Acacia quadrimarginea, A. ramulosa, A. tetragonophylla, Dodonaea lobulata, Scaevola spinescens, Eremophila clarkei* and *E. oldfieldii* on mid to upper slopes on shallow soils.

S4: Tall Shrubland of *Dodonaea viscosa, Acacia quadrimarginea, Allocasuarina acutivalvis* and *Eremophila* spp. on upper slopes and outcrops on ranges.

S6: Shrubland to Tall Shrubland of *Dryandra arborea, Dodonaea viscosa, Melaleuca leiocarpa, Ricinocarpos brevis, Tetratheca paynterae* and *Acacia andrewsii* on upper slopes and outcrop areas on ranges.

S7: Low Shrubland of mixed *Acacia, Ptilotus, Senna* and *Eremophila* spp. on exposed calcrete areas on low rises and slopes.

S9: Open Heath to Low Shrubland of *Ptilotus obovatus, Scaevola spinescens* and *Olearia muelleri* on exposed and shallow soils on slopes of ranges.

Results from an analysis of the vegetation indicate that the vegetation communities on the uplands and ridges of the Windarling areas are distinct from those on other ranges in the project area and in the region generally. These findings support the earlier reported findings on the species from the area, which occur on the respective outcrop and ridge areas (including the nationally listed species – *Tetratheca paynterae* which is largely confined to the S6 community as mapped on Appendix C: Figure 2).

5.8.4 Transportation Corridor

Based on the mapping of Beard (1972) for the Jackson sheet, the proposed Transportation Corridor crosses a series of vegetation types. This includes eucalypt woodlands (principally York Gum *Eucalyptus salubris* and Salmon Gum *E. salmonophloia*), Acacia shrublands, chenopod (saltbush) steppe (associated with saltlakes), sandplain vegetation and

patches of localised vegetation associated with granite outcrops. The corridor also traverses limited areas of York Gum woodland in the southern section and Mulga *Acacia aneura* woodland in the northern section.

Within the project area the areas of sandplain vegetation, granite exposures and chenopod steppe only occur along the Transportation Corridor, however, these vegetation types are relatively widespread in the region. A more detailed appraisal of vegetation communities along thecorridor will be required in order to assess adequate representation of vegetation communitites and identify any significant areas for conservation once the final alignment has been selected.

5.8.5 Conservation Value

Representation

There seems to be considerable variation in representation of vegetation communities within the project area. Some communities are well represented in the project area, whilst others are poorly represented. This may not necessarily be of significance as those communities may in some cases have an extensive distribution outside of the proposed project area.

Eucalypt Woodlands:

These communities consist of Tall Open Woodland (E1) and Open Eucalyptus Woodland (E2), which equates to Salmon Gum woodland and mallee (Eucalyptus) dominated woodland respectively. Both communities are very widely distributed in areas surrounding the ranges, and generally occur in relation to soil type. The E1 community tends to occur on soils with a high clay content and in relatively low lying positions in the landscape, and E2 is located more on stony substrates including the lower slopes of the ranges. These vegetation communities will be subject to limited impact, which will primarily come from the Transportation Corridor as it traverses a variety of lowland areas. Due to the wide distribution of these vegetation types (in the project area and surrounding region) there are not in any way threatened by the proposed development.

Acacia Woodlands:

This community (A1) equates to Mulga woodland, which whilst not frequently encountered in the project area, is widely distributed in areas to the north and east of the project area in the arid zone proper. This trend can be observed even at the local scale where Mulga woodland is poorly represented around the Jackson Range but is quite common at Windarling, which is 30km north. These patterns are indicative of the transitional zone between the eucalypt woodlands of the southwest and the arid *Acacia* dominated shrublands of the interior.

Mixed Shrublands:

There are a variety (nine types) of mixed shrubland communities. They occur principally on the ranges, including outcrop and ridge areas in addition to the lower slopes. These communities are essentially restricted to the ranges but show variation in the extent of their distribution. Communities S1 and S2 are relatively widespread over the Jackson and Windarling Ranges respectively, and occupy the major portion of the ranges in these areas. They are the most widespread of the shrubland type communities but are exclusive to each of the ranges and do not overlap. Two community types in each area, S3 and S5 in the Jackson Range and S4 and S9 at Windarling are moderately widespread and unevenly distributed along the ranges.

A few vegetation communities are limited in their distribution. Type S7 is a community that is characterised by low shrubland situated on calcrete deposits, which have a patchy distribution around the ranges. S7 occurs sporadically

throughout the area and region but is usually confined to small isolated patches of limited extent, usually less than one hectare in area (Appendix C: Figures 1 and 2). This vegetation type is represented both on the Jackson and Windarling Ranges but also occurs outside the proposed development areas.

At Windarling, community type S6 occurs on rocky outcrops and upper slopes, and is quite restricted. It represents an example of ironstone communities, with typical species such as *Dryandra arborea, Ricinocarpos brevis* and *Tetratheca paynterae* existing in crevices along the exposed rocks and ridges of the range. Community type S6 occurs principally in the area of the W3 deposit, but is also represented on nearby W4 and W5 deposits.

The ecologically equivalent community in the Jackson Range is S5, which contains species occupying similar niches but having a slightly different floristic composition. *Dryandra arborea, Jacksonia jackson* and a different species of *Tetratheca, T. harperi*, are prevalent on the rocky outcrops of the central and eastern sections of the Jackson Range (over J3). *T. harperi*, a closely related species to *T. paynterae* at Windarling (Butcher *et al.*, 2001) occupies a matching ecological niche to *T. paynterae* in that it only grows in exposed situations on the ironstone cliffs. It exhibits a similar habit to *T. paynterae*, and is a characteristic component of the S5 community. The S5 community on the Jackson Range is more widely distributed than the corresponding S6 community at Windarling due to the greater size of the Jackson Range and the consequently larger area of suitable habitat.

The most restricted community type is S8 and it occurs at a single location south of Mt Jackson itself. This is a lowland shrub community with sedge components *(Lepidosperma aff. angustatum* and *Lepidosperma* sp. (LM/180/373)) and possibly represents a relictual drainage channel. This community type has not been found elsewhere in the project area, although a number of unidentified *Lepidosperma* and Cyperaceae species have been found at a number of localities in the surrounding region (eg. Helena and Aurora Range and Die Hardy Range) (Appendix B, page B6, in Mattiske, 2001a). Further research may indicate the presence of this vegetation type elsewhere, however impact to this area will not occur in order to ensure its survival.

5.8.6 Significant Ecological Communities

No vegetation communities are currently listed as threatened ecological communities under the EPBC Act 1999. As a result of previous studies in the area by Gibson and Lyons (1997a, b, c), Gibson et al. (1997) and recent studies by Mattiske Consulting (2001c), a range of vegetation communities have been highlighted as significant. This significance is attributed to the occurrence of Nationally Listed flora species, geographically restricted species or locally restricted species within the vegetation community (ie. on ridges and other specific habitats).

For the purposes of this report, vegetation communities have been broadly separated into 4 distributional categories and a summary is shown in Table 5.6.

Table 5.6: Vegetation Community Categories of Distribution within the Proposed Project Areas.

Category of Distribution	Vegetation Community	
	Jackson Range	Windarling Range
Widespread in region	E1, E2, A1	E1, E2, A1
Widespread over range but geographically restricted	S1	S2
Restricted over range and geographically limited	S3, S5	S4, S6, S9
Isolated pockets not apparently associated with the range	S7, S8	S7

Potentially significant vegetation communities in the project area are as follows;

Windarling

The vegetation analyses and subsequent mapping support the separation of communities S4, S6, S9 and perhaps S2 in a local and regional context. The ridges of W3 and W5 support the restricted community S6 with the Declared Rare Flora (DRF) and Nationally Listed species *Tetratheca paynterae*. This species is only known from these ranges and although it primarily occurs in community S6, it does also occur to a lesser extent in communities S9 and S4.

S4 and S9 community types primarily dominate the lower banded ironstone ridges and scree slopes of the Windarling Range. These communities appear to be locally and regionally significant as they appear to be limited in distribution to the Windarling Range only. They also support the sole Priority Flora species, *Ricinocarpos brevis* P1, which seems to be geographically restricted to the ranges and may contribute to the distinctiveness of these communities.

The S2 community type appears geographically limited to the Windarling Ranges, but is of larger area than the ironstone communities that occur on or near the ridge tops (see Figure veg types). It is comprised of an open heath of *Acacia* and *Eremophila* spp. and is of local and regional significance because it is confined to the upper and mid slopes of the Windarling Range only.

Mt Jackson (J3)

There are two potentially significant communities occurring in the Jackson Range project area. The exposed ridges and outcrops of Mt Jackson (J3) and nearby Muddarning Hill support the restricted community S5. This seems to be the most significant vegetation community, partly due to the presence of the DRF and Nationally Listed species *Tetratheca harperi*. The S3 community also appears to be limited to the ridgetops and upper slopes of the Jackson Range, however it is more widespread than S5 and occurs consistently along the entire length of the range. The presence of geographically restricted species such as *Tetratheca harperi* and *Jacksonia jackson* are likely to contribute to vegetation communities S3 and S5 being significant in a local and regional context.

The S1 community type is confined to the lower slopes and flatter areas of the Jackson Range. It seems highly associated with the range itself as it generally does not occur more than a kilometre from the main ridge. However, S1 is much larger in area than either the S3 or S5 communities, and can be interpreted as extending outside the mapping area depicted in Figures ? It is a mixed shrubland containing a variety of *Acacia* spp., and only a minor percentage of it is contained within the project area. (Table5.6).

The lower slopes of Mt Jackson (J3) supports a restricted community (S8) (refer to Appendix C) which includes a mixture of shrub and sedge species (*Lepidosperma* aff. *angustatum* and *Lepidosperma* sp. (LM/180/373)). This community has yet to be located elsewhere in the study region and is therefore considered extremely restricted and should be avoided in any infrastructure development.

General Area of the Jackson Range

In the wider area a range of calcrete soils support both mallee woodlands and also open heath and low shrublands (community S7). The mallee communities occurring on this substrate are uncommon, patchily distributed and small in area, however they are unlikely to be impacted by the proposd development. The Transportation Corridor may be a potential source of impact, but it has not been mapped in detail, and the route has not been finalised. Therefore, the location of the Corridor can be altered if this community type appears under threat from construction.

5.9 FLORA

5.9.1 Flora of the Region

A total of 73 families, 333 genera, 1077 species and taxa have been recorded within the wider Koolyanobbing area by Gibson *et al.* (1997), Gibson and Lyons (1997a, b, c,) and Mattiske (2001a,b,c). The total number of taxa does not include the unknown taxa, which have only been identified to family level (e.g. Asteraceae sp.). The majority of these unknown taxa are short-lived annual species which, depending on the seasonal conditions, pose difficulties in the identification phase.

Specific surveys of the general area have been conducted on the Die Hardy Ranges, Highclere Hills, Koolyanobbing, Helena and Aurora Ranges, Mt Manning Ranges as well as the project area. The best represented families, including only those taxa identified to species level, were the Poaceae (29 native and 11 weed taxa), Chenopodiaceae (45 taxa), Mimosaceae (41 taxa), Myrtaceae (64 taxa), Myoporaceae (35 taxa) and Asteraceae (80 native taxa and 6 weeds). The most speciose genera were Acacia (41 taxa), Eucalyptus (35 taxa) and Eremophila (33 taxa).

If a comparison is made of the respective locations where floristic surveys have been carried out in the region (Table 5.7) it appears that the total number of taxa found at each locality are similar. However where additional studies have been undertaken over several trips, the number of taxa found appears to increase slightly (eg. Highclere Hills and Helena and Aurora Ranges). This may indicate that with an increase in survey effort there is a greater coverage of the flora and hence more species are revealed.

Table 5.7: Flora taxa and Recording sites in specific localities within the wider Koolyanobbing area (adapted from Mattiske, 2001a).

Survey Area	Data Source	No. of Recording Sites	No. of Taxa*
Jackson Range	Mattiske (2001a)	29^	219
Windarling	Mattiske (2001a)	50	131
Transportation Corridors	Mattiske (2001a)	45^	182
Helena and Aurora Range	Gibson *et al.* (1997) Mattiske (2001a)	75	287
Koolyanobbing	Mattiske (2001a)	40	174
Die Hardy Ranges	Mattiske (2001a)	54	145
Highclere Hills	Gibson (1997c)	65	322
Hunt Range, Yendilberin and Watt Hills	Gibson (1997b)	53	265
Mt Manning Ranges	Gibson (1997a)	54	211

* excluding unidentified annual taxa (Mattiske, 2001a).

^ some of Corridor sites occurred on the lower slopes of the Jackson Range area.

These data illustrate the differences between the ranges and localities, a pattern that is also repeated in other interpretations on the vegetation and the endangered species. The distinctive nature of the outcrops and ranges is reinforced by this data, although the low values on Windarling and Mt Jackson illustrate a different trend to the Helena and Aurora Ranges and Highclere Hills.

Figure 5.8 further illustrates the degree of variation between localities, with most plant taxa occurring in less than four of the localities studied by Gibson *et al.* (1997a, b, c) and Mattiske (2001c). In addition, almost 25% of all plant taxa that have been surveyed in the region occur in only one specific locality, therefore indicating a high degree of local endemism (Figure 5.9).

Figure 5.8: Comparison of Number of Taxa restricted to each Specific Locality

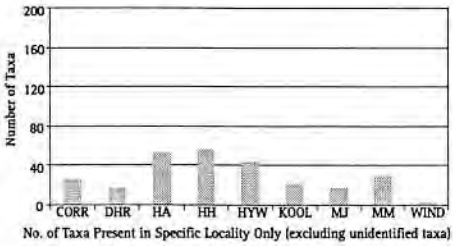
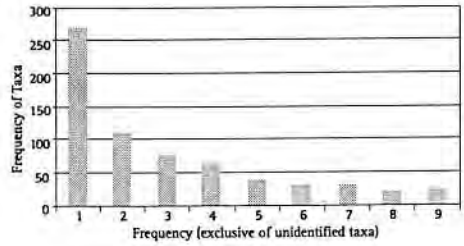


Figure 5.9: Comparison of Frequency of Taxa with Frequency of Occurrence in Respective Localities



The results in Table 5.8 illustrates both the degree of similarity between the localities in terms of flora species present and indicates again the complexity of the issues at hand in addressing the specific areas in a local and regional context. For example, 64.2% of species along the Transportation Corridor also occur on the Mt Jackson sites, whilst only 21.8% of species that were recorded in the Highclere Hills have been recorded on the Windarling sites.

There seems to be a relationship with regards to distance between localities. That is, the further the distance between ranges, the fewer species they have in common. Comparing localities both in terms of species in common and their distance from each other supports this. For example, the Transportation Corridor, Die Hardy Range and Windarling Range are all relatively near to the Jackson Range, and correspondingly have many species in common (from 64.2% to 41.4%), while localities further afield (such as the Highclere Hills and Koolyanobbing Range) have less species in common with the Jackson Range. Similarly, the Transportation Corridor, Die Hardy Range and the Jackson Range are all geographically near to the Windarling Range and also have more species in common than localities further away from Windarling.

Table 5.8: Species in Common between Localities (% Similarity).

(note: This data is based on only the plot data and not additional observations and gridding data) (Mattiske, 2001a)

Locality	MJ	CORR	HA	HH	HYW	KOOL	MM	DHR
CORR	64.2							
HA	39.8	54.4						
HH	29.7	52.3	55.7					
HYW	38.5	47.7	51	39.6				
KOOL	32.5	46.1	32.5	31.1	31.7			
MM	36.3	40.9	39.8	33	52.5	22.2		
DHR	55.1	39.4	47.8	47.2	39.9	42.1	36	
WIND	41.4	39.4	26.8	21.8	24.5	24.6	29.9	42.7

Key

CORR:	Transportation Corridor	KOOL:	Koolyanobbing Range
DHR:	Die Hardy Range	MJ:	Mt Jackson and Jackson Range
HA:	Helena and Aurora Range	MM:	Mt Manning Range
HH:	Highclere Hills	WIND:	Windarling Range
HYW:	Hunt Range, Yendilberin and Watt Hills		

5.9.2 Flora in the Project Area

A total of 353 species from 51 families have been recorded for the project area, which includes the Jackson Ranges, Windarling, and Transportation Corridor study areas (Mattiske, 2001a) (Appendix D). The Jackson Range was more speciose (255 species) than either the Windarling Range (142 species) or Transportation Corridor areas (191 species) (Table 5.9). Species most frequently encountered were *Austrostipa elegantissima, Ptilotus obovatus, Acacia quadrimarginea, Scaevola spinescens* and *Olearia muelleri,* all which occupy upland habitat types. The best-represented families were, in decreasing order, Asteraceae, Poaceae, Myoporaceae, Myrtaceae, Chenopodiaceae and Mimosaceae.

Table 5.9: Number of taxa in the Project Areas (Windarling, Jackson Range, Transportation Corridor)

	Project Area			
Flora Group	Windarling	Jackson Range	Transportation Corridor	TOTAL
Families	38	49	39	51
Genera	82	110	97	144
Species	142	255	191	353
Introduced species	7	11	5	12

5.9.3 Mine Areas

A total of 255 taxa including 244 native and 11 introduced flora taxa were recorded during the survey of the Jackson Range study area (Table 5.9).142 taxa including 135 native and seven introduced flora taxa were recorded during the survey of the Windarling study area. Although more quadrats were sampled at Windarling, more taxa were found over the Jackson Range. The relatively small number of taxa recorded at Windarling compared with the Jackson Range may be related to the size and topographical variety of the respective ranges. The Jackson Range is geographically larger (approximately 46 sq km) than the Windarling Range (approximately 18 sq km) and it has significantly more elevated areas over a wider area than the Windarling Range. It appears to contain more microhabitats where local endemic species can survive.

5.9.4 Transportation Corridor

A total of 191 taxa including 186 native and five introduced flora taxa were recorded during the survey of the Transportation Corridor. Well-represented families included the Poaceae (grasses), Chenopodiaceae (saltbushes) and Myrtaceae (myrtles). The most frequently recorded species were *Austrostipa elegantissima, Ptilotus exaltatus, Ptilotus obovatus* and *Zygophyllum fructiculosum.* Many of the characteristic species of upland stony areas (e.g. *Dryandra arborea, Acacia quadrimarginea, Tetratheca* spp.) were not recorded or were infrequently observed along the Corridor.

5.9.5 Introduced Flora

A total of 38 introduced species were recorded for the broader Koolyanobbing area, and 12 species were recorded in the project area (Table 5.9), including ten species at Mt Jackson, seven at Windarling and five along the Transport Corridor. Of these introduced species several are potentially aggressive weeds and will require control and hygiene measures in the future. These aggressive species include *Eragrostis curvula* (African Love Grass), *Acetosa vesicaria* (Ruby Dock), *Brassica tournefortii* (Wild Turnip), *Centaurea melitensis* (Maltese Cockspur), *Sonchus asper* (Prickly Sowthistle) and *Sonchus oleraceus* (Sowthistle). Many of these species rely on wind blown seed or seed carried in vehicle tyres and therefore any disturbance of native vegetation areas should be minimized and a strict weed hygiene

plan will need to be implemented. Most of the weeds occur near Koolyanobbing and extend along the fringes of current agricultural areas and tracks. *Eragrostis curvula, Acetosa vesicaria* and *Brassica tournefortii* have not been recorded from the project area but have the potential to invade if the area is disturbed, and hygiene not managed.

5.10 RARE AND PRIORITY FLORA

5.10.1 Environment Protection and Biodiversity Conservation Act

At a National level, flora are protected under the Commonwealth Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act). The Act contains a list of species that are considered Critically Endangered, Endangered, Vulnerable, Conservation Dependent, Extinct or Extinct in the Wild. Categories relevant to flora that occur or potentially occur in the project area are:

- Endangered (E): The species is likely to become extinct unless the circumstances and factors threatening its abundance, survival or evolutionary development cease to operate; or its numbers have been reduced to such a critical level, or its habitats have been so drastically reduced, that it is in immediate danger of extinction.
- Vulnerable (V): Within the next 25 years, the species is likely to become endangered unless the circumstances and factors threatening its abundance, survival or evolutionary development cease to operate.

5.10.2 Wildlife Conservation Act

Rare Flora are also protected under the *Western Australian Wildlife Conservation (Rare Flora) Notice 2001* of the *Wildlife Conservation Act 1950*. The notice lists protected flora taxa that are extant and considered likely to become extinct or rare. Generally speaking, species of flora are considered as being of Declared Rare Flora (DRF) or Priority conservation status where their populations are restricted geographically or threatened by local processes.

CALM maintains a list of all DRF and Priority Flora taxa within Western Australia (Atkins, 2001). Definitions of categories of DRF and Priority Flora are provided in Table 5.10. Priority Flora are either poorly known, believed to be uncommon, rare or under threat but have not been designated as DRF and thereby legally protected because the detailed survey work to justify this has not been carried out. Priority species are maintained on a "Reserve List" and assigned to one of four Priority categories (Atkins, 2001).

Table 5.10: Definition of Declared Rare and Priority Flora Categories

Code	Category	Definition
R	DRF	Declared Rare Flora - Extant Taxa. Taxa which have been adequately searched for and are deemed to be in the wild either rare, in danger of extinction, or otherwise in need of special protection.
X	DRF	Declared Rare Flora - Presumed Extinct Flora. Taxa which have not been collected, or otherwise verified, over the past 50 years despite thorough searching, or of which all known wild populations have been destroyed more recently, and have been gazetted as such.
P1	Priority One	Poorly Known Taxa. Taxa which are known from one or a few (generally <5) populations which are under threat.
P2	Priority Two	Poorly Known Taxa. Taxa which are known from one or a few (generally <5) populations, at least some of which are not believed to be under immediate threat.
P3	Priority Three	Poorly Known Taxa. Taxa which are known from several populations, at least some of which are not believed to be under immediate threat.
P4	Priority Four	Rare Taxa. Taxa which are considered to have been adequately surveyed and which whilst being rare, are not currently threatened by any identifiable factors.

5.10.3 Potential Rare and Priority Flora in a Regional Context

On the basis of a search of Rare and Priority Flora for the wider Koolyanobbing area there are 13 DRF species and some 73 Priority taxa (Table 5.10). A total of two Nationally Listed, two DRF, and 12 Priority Flora species were recorded from the project area during the current surveys (Table 5.10). Rare and Priority Flora taxa for the wider Koolyanobbing area are listed alphabetically in Appendix G, and locations of Rare and Priority Flora are depicted in Figures 5.10 to 5.12.

5.10.4 Rare and Priority Flora in a Local Context

5.10.4.1 Declared Rare Flora (DRF)

Two species of endemic *Tetratheca* recorded within the project area have been classified as DRF. Both *T. paynterae* and *T. harperi* are examples of a number of endemic species restricted or associated with the ironstone ridges of the local and regional area (Gibson and Lyons, 1997a, b, c; Gibson et al., 1997). *T. paynterae* appears to be restricted to the topmost areas of the Windarling Range ridges and *T. harperi* appears to be confined to similar habitats on the Jackson Range ridges. These species are also nationally listed under the EPBC Act as Endangered and Vulnerable respectively. Specific surveys over a 12 month period were conducted within the broader project region in order to determine if additional populations of these species occurred. This met with little success. (Mattiske, 2001a,b,; ecologia dataset, 2001).

An intensive search of the Windarling area located a total of 2852 individual plants of *Tetratheca paynterae*, with 2747 plants at W3, 123 at W5 and two plants at W4 (Mattiske, 2001b; Ecologia dataset, 2001).

A total of 1529 specimens of *Tetratheca harperi* were located during a 20m x 20m grid survey at Mt Jackson (J3) and a further 180 specimens were located on the slopes of nearby Muddarning Hill. This is highly likely to under represent the total population of *T. harperi* as the survey on Muddarning Hill was not as exhaustive as those completed at Windarling. Estimates based on the density of plants found there and the potential habitat elsewhere on the Ranges (Mattiske, 2001a) increases this figure to more than 20 000 (see Section 6.2.2).

The two *Tetratheca* species are the only flora species under the EPBC Act that may be potentially affected by the proposed operations on the Jackson and Windarling Ranges.

5.10.4.2 Priority Flora

During the current surveys 12 Priority Flora species were recorded from the project area and immediate surrounds (Table 5.11). Of these, three occur in the Windarling area. *Ricinocarpos brevis* occurs on the banded iron formations and therefore is the most critical Priority species for operational planning. Nine Priority species occur in the Jackson Range area (Table 5.12) and of these, *Jacksonia jackson* (which is restricted to Mt Jackson and the Jackson Ranges only) and *Ricinocarpos brevis* are present within the proposed impact area.

The range of Priority Flora species is similar to that recorded by Gibson *et al.* (1997) and Gibson and Lyons (1997 a, b, c), although it is recognized that two of these areas overlapped with survey areas investigated by ecologia and Mattiske Consulting.

Table 5.11: Numbers of Declared Rare Flora and Priority Flora that potentially occur in the wider Koolyanobbing area and Project Area

(As summarised by WAHERB, Gibson *et al* (1997a,b,c), Gibson and Lyons (1997), and Mattiske (2001a))

Category	Wider Koolyanobbing Area			Project area*
	Code	No. of taxa (potential)	No. of taxa (recorded)#	No. of taxa
Endangered (EPBC Act)	E	9	2	1
Vulnerable (EPBC Act)	V	4	2	1
TOTAL Nationally Listed		13	4	2
DECLARED RARE FLORA	R	13	4	2
Priority 1	P1	22	12	3
Priority 2	P2	19	5	3
Priority 3	P3	20	4	1
Priority 4	P4	12	6	5
TOTAL PRIORITY FLORA		73	27	12
TOTAL DRF and Priority Flora		86	31	14

Recorded in specific localities in the wider Koolyanobbing region (eg. Highclere Hills)

* Project area is defined by the three areas of impact, ie. the Jackson and Windarling Ranges, and the Transportation Corridor.

Table 5.12: Priority Flora recorded in the Respective Localities

(As summarised by WAHERB, Gibson *et al* (1997a,b,c), Gibson and Lyons (1997), and Mattiske (2001a))

SCC State Conservation Code (based on Wildlife Conservation Act 1950 and listings by Department of Conservation and Land Management 2001)
MJ Mt Jackson and Jackson Ranges
WIND Windarling
CORR Transportation Corridor
DHR Die Hardy Ranges
HA Helena and Aurora Ranges
HH Highclere Hills
HYW Hunt Range, Yendilberin and Watt Hills
KOOL Koolyanobbing
MM Mt Manning Ranges

Species	SCC	MJ	WIND	CORR	DHR	HA	HH	HYW	KOOL	MM
Acacia adinophylla	P1					+				
Calytrix creswellii	P1									+
Chamelaucium paynterae	P1					+				
Gnephosis intonsa	P1					+				
Gnephosis sp. Norseman (KRN 8096) 'gold'	P1							+		
Homalocalyx grandiflorus	P1					+				
Leptospermum macgillivrayi	P1	+								
Leucopogon sp. Helena and Aurora Range	P1					+				
Mirbelia densiflora	P1							+		
Persoonia leucopogon	P1					+				
Ricinocarpos brevis	P1	+	+							
Stenanthemum newbeyi	P1				+	+	+		+	
Elachanthus pusillus	P2							+		
Jacksonia jackson	P2	+								
Lepidium genistoides	P2			+		+	+			
Melaleuca filifolia	P2							+		+
Phlegmatospermum eremaeum	P2					+				
Spartothamnella puberula	P2	+				+				
Stylidium choreanthum	P2					+				
Acacia acanthoclada subsp. *glaucescens*	P3	+					+	+		
Acacia cylindrica	P3					+				
Astartea sp. Bungalbin Hill (K.R. Newbey 8989)	P3					+				
Austrostipa blackii	P3							+		
Grevillea eriobotrya	P3				+					
Grevillea georgeana	P3				+	+	+	+		+
Verticordia mitodes	P3					+				
Daviesia purpurascens	P4	+		+		+				+
Eremophila caerulea subsp. *merrallii* ms	P4							+		
Eremophila racemosa	P4		+							
Eucalyptus formanii	P4	+	+		+	+	+			+
Grevillea erectiloba	P4	+				+		+		+
Sowerbaea muliticaulis	P4			+						

5.10.5 Rare and Priority Flora within the Deposit Areas

Mt Jackson (J2, J3):

No DRF species are present within the two proposed mine areas, however two Priority Flora species are present. *Jacksonia jackson* (P2) was found on both the mine footprint areas of J2 and J3 while *Ricinocarpus brevis* (P1) was located on J2 (Mattiske, 2001a). *Jacksonia jackson* will be minimally impacted by the proposed operations.

Both species have an extensive distribution throughout the ranges as indicated by the survey data (Figure 5.11; Table 5.13) but more surveys on *R. brevis* need to be conducted in order to confirm the abundance and distribution of this species on the Jackson Range as a whole. Mattiske (2001a) located it scattered throughout the range.

Tetratheca harperi, although present and quite common on Mt Jackson and Muddarning Hill (general estimate of about 20000 individuals on the range), is not going to be impacted either directly or indirectly by the development of J3 deposit.

Windarling Range:

Mattiske (2001b) undertook an intensive search (April 2001) for previously recorded DRFand Priority species at the proposed Windarling deposits W3, W4 and W5. Particular attention was placed on locating individuals of *Tetratheca paynterae*, and a total of 2428 individual plants were discovered during the survey. During subsequent surveys by Mattiske and ecologia, this number has increased to 2852 individuals. Of these, 2727 plants were located on Windarling W3, 123 on W5 and two on W4, which cover a total population area of 4 hectares (Mattiske, 2001a,b; ecologia dataset, 2001).

The Priority Flora species, *Ricinocarpos brevis* (P1) was located and mapped during the survey at the proposed W3 and W4 mining areas (Mattiske, 2001b). *R. brevis* (P1) was also observed on deposits W1 and W2, although these areas were not formally gridded for rare flora surveys. Ecologia conducted a wider search for populations of *R. brevis* in November 2001. It was confirmed that *R. brevis* occurred on the entire main ridges and associated upper slopes as surveyed previously (ie. W1, W2, W3, W4,W5), and extra populations were also located along the western end of W5 and a smaller hilltop between W1 and W2. From the available data, it was calculated that *R. brevis* occupies an area of 40.8 ha throughout the range (Table 5.13). This approximates to over 8000 individuals (derived from field observations of plant density (ecologia dataset, 2001), most of which occur on the upper ridge slopes but sometimes extending lower into the rocky scree valleys.

Table : Population and Area Estimates for DRF and Priority Flora in the Deposit Areas

DRF or Priority Species	Status	Site Location	Total number of Plants #	Estimated Area of Population* (ha)
Tetratheca harperi	DRF	Jackson Range	25836	111.7
Tetratheca paynterae	DRF	Windarling Range	2852	4
Ricinocarpus brevis	P1	Windarling Range	8128	40.8
Jacksonia jackson	P2	Jackson Range	48680	202.6

estimated from density measurements, counts in the field, and quadrat data from Mattiske (2001a,b)
* calculated areas were derived from species distribution maps provided by Mattiske and ecologia.

5.10.6 Transportation Corridor

No DRF and ony three Priority Flora were recorded along the Transportation Corridor; *Lepidium genistoides* (P2), *Sowerbaea multicaulis* (P4) and *Daviesia purpurascens* (P4).

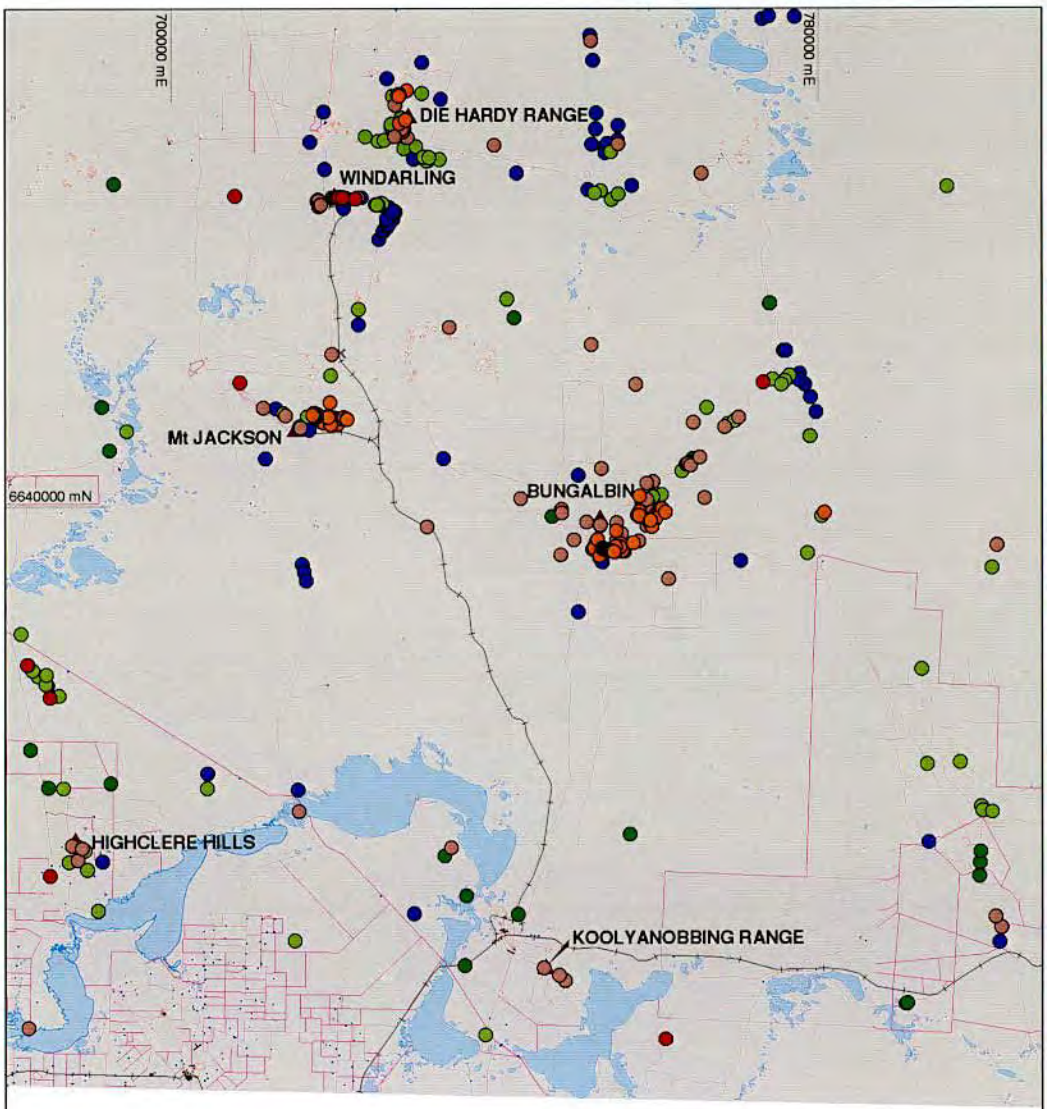
5.10.7 Other Species of Conservation Interest

There are two other flora taxa which have the potential to be added to the rare and endangered species lists in the near future as a result of their restricted occurrence.

The following two taxa are potentially significant as they occur as either range restrictions or are restricted to specific habitats (see community S8 at Mt Jackson). Based on current information, many other species listed as geographically restricted may be considered potentially significant as they are usually confined to local ranges or specific locations.

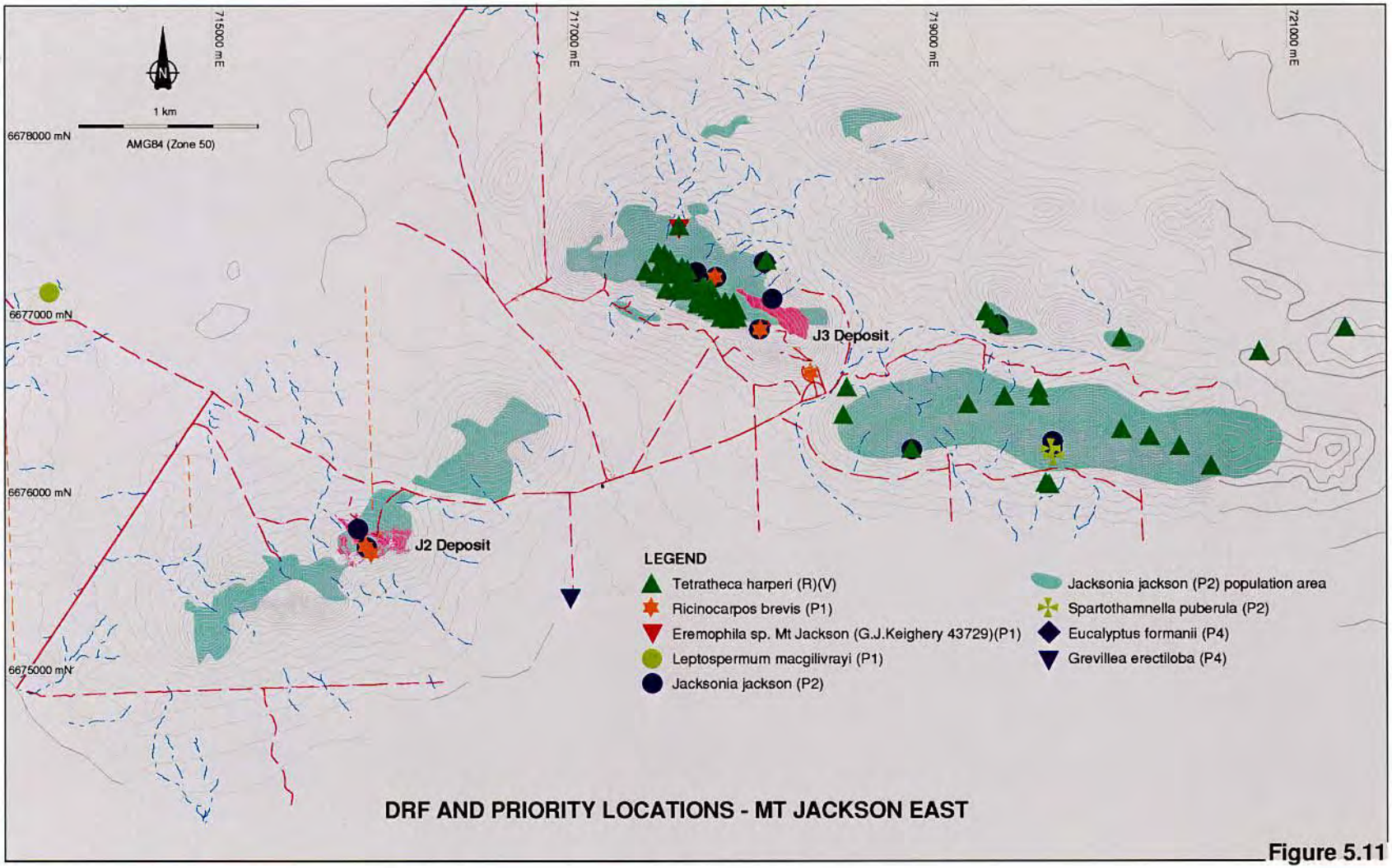
- *Lepidosperma* aff. *angustatum* from Jackson ranges appears to be similar to the *Lepidosperma* aff. *angustatum* scps as collected by Gibson *et al.* (1997a and d) and Helena Aurora and Hunt Range, Yendilberin and Watt Hills. This taxon requires taxonomic work.
- *Lepidosperma* sp. (LM/180/373) have been recorded on mid slopes and flats around Mt Jackson and the Jackson ranges. These species require taxonomic work.

Neither of these two species will be impacted by the proposed development.



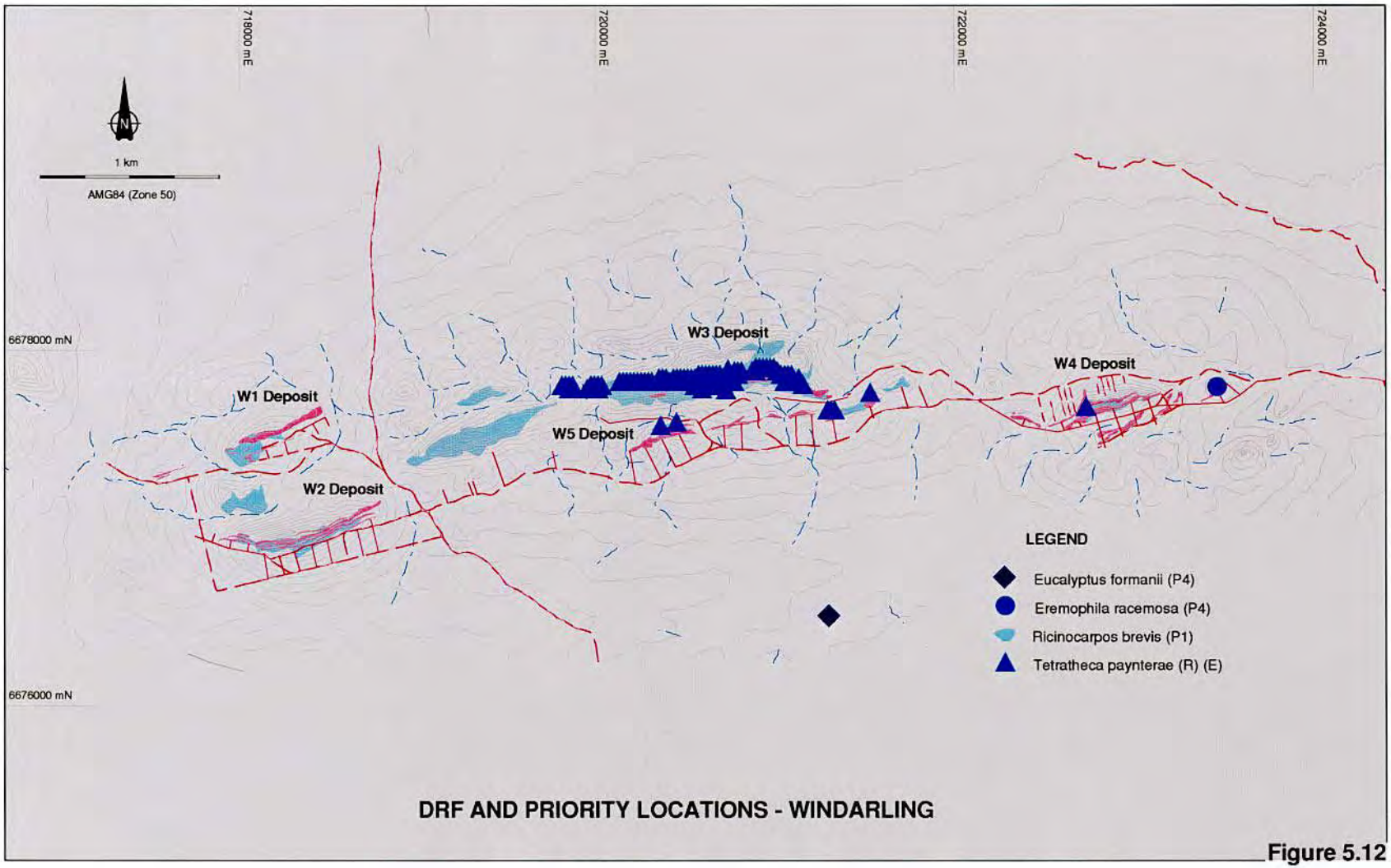
REGIONAL RARE AND PRIORITY FLORA

Figure 5.10



DRF AND PRIORITY LOCATIONS - MT JACKSON EAST

Figure 5.11



DRF AND PRIORITY LOCATIONS - WINDARLING

Figure 5.12

5.11 FAUNA

The fauna assessment provided within this PER has drawn upon a significant literature database, including both published and unpublished information, and recent focused intensive sampling of the project area (ecologia, 2001).

From a fauna perspective the area lies within the Eyrean zoogeographic region, i.e. within the Australian arid zone (Serventy and Whittell, 1976). However, due to its location near to the margin of the southern Bassian zoogeographical sub-region the area contains fauna having biogeographic affinities with this zone in addition to the more typical arid zone component.

5.11.1 Previous Fauna Studies

The Biological Survey of the Eastern Goldfields of Western Australia, conducted by the WA Museum and CALM, commenced in 1978. During that survey all major vegetation formations within 15km of Mt Jackson and 10km of Bungalbin Hill were extensively examined. A total of 42 days were spent in the field at the two areas (Newby et al., 1985).

The survey recorded 2 amphibian and 55 reptile species. Neither amphibian species and only 31 (56%) of the reptiles were common to both areas. The paucity of amphibians is probably due to the lack of claypans, large granite exposures and streams within the survey areas, which are their important habitats in other semi-arid regions. A total of 89 species of bird were recorded during the surveys of Mt Jackson and Bungalbin. These comprised 29 non-passerines and 60 passerines of which 18 and 42 species, respectively, were common to both areas. The mammal fauna in the area is one of the richest recorded in the Eastern Goldfields with 30 native and feral species documented. Of the 30 species recorded only 57% were common to both the Mt Jackson and Bungalbin survey areas (Biological Surveys Committee, 1985).

Between 1989 and 1993, researchers from the University of Western Australia have conducted numerous field trips to the same sites at Bungalbin as those surveyed during the Eastern Goldfields expeditions. A total of 45 reptile species (16 skinks, 7 agamids, 11 geckos, 1 goanna, 4 legless lizards, 1 blind snake and 6 elapid snakes), two frogs, 92 birds (31 non-passerines and 61 passerines), and 17 mammals (15 native and two introduced) have been recorded from the hills and surrounds.

More recently CALM researchers carried out an extensive survey to investigate the biological components of the Helena and Aurora Ranges (Chapman and Thomas, 1996). This investigation had the specific objective of identifying potential areas with high conservation values. During the survey eight species of native mammal, 52 bird species, 28 reptiles and one amphibian were recorded from the range. However, there was little to suggest that the banded ironstone landform offers a unique habitat for vertebrate fauna, though there are indications that locally it is particularly well suited to and utilized by some species. The invertebrate fauna survey of the area recorded 142 species of insects and 84 spiders leading to the conclusion that the area is extremely rich in arthropod species.

Henry-Hall (1990) has summarised all existing biological and landform information in an effort to identify potential conservation boundaries.

5.11.2 Survey Methodology

An extensive vertebrate and targeted invertebrate fauna assessment survey of the project area was carried out by ecologia Environmental Consultants during November and December 2000. A total of 132 person field days were expended during the survey period.

Following a preliminary reconnaissance, detailed survey sites within the Koolyanobbing Expansion Project area were chosen as being:

(i) representative of major fauna habitats and vegetation associations;

(ii) areas of potential conservation value or ecological sensitivity; and/or

(iii) areas of potential environmental impact arising from proposed mining activities.

Assessment of the fauna was carried out using a variety of sampling techniques, including systematic and opportunistic sampling:

- Systematic sampling refers to data methodically collected over a fixed time period in a discrete vegetation community type, using an equal or standardised sampling effort. The resulting information can be analysed statistically facilitating comparisons within and among sites and between seasons.
- Opportunistic sampling includes data collected non-systematically within and outside fixed sampling sites.

The number of sites and habitat types surveyed for the proposed rail corridor and mine areas are summarised in Table 5.14. Fauna survey sites were distributed throughout the three study areas to encompass a broad cross section of each area and to sample all available fauna habitat types (Figure 5.13). Within the rail corridor, survey sites were established along the length of the corridor and were placed so as to sample the majority of habitats present. In some instances where trapping was not feasible, fauna surveys were limited to avifauna transects and microhabitat searching to gain an appreciation of the fauna present and to survey for fauna species not encountered elsewhere at trapping sites or recorded opportunistically.

Table 5.14: Fauna Survey Regime

Study Area	No. of Survey Sites	No. of Habitats
Mt Jackson	9	3
Windarling	6	3
Bungalbin	10	4
Transportation Corridor	8	4

Fauna trapping was achieved using standardised trapping formats based on the CALM trapping regime utilized during the Biological Survey of the Helena and Aurora Range Survey (Chapman and Thomas, 1996). At all systematic survey sites a comprehensive regime of trapping, opportunistic searching and bird censusing was conducted, including Pit and Elliott trapping, microhabitat searching and set time avifauna transects. Mistnetting was also undertaken where appropriate.

Within the 33 systematic fauna survey sites a total of 2254 pit trap, 4640 Elliott trap and 323 Cage trap nights were undertaken (Table 5.15) A total of 128 person hours were spent microhabitat searching and 108 hours were spent undertaking avifauna surveys.

To supplement the systematic sampling, the presence of species in all vertebrate groups was assessed via secondary evidence and opportunistic sightings. Tracks, diggings, scats, burrows and nests were recorded where possible for the species responsible. The presence of species was noted while searching, travelling and during trap establishment within the project area during the day or night.

Table 5.15: Fauna Survey Effort

Study Area	Pit trap nights	Elliott trap nights	Cage trap nights	Avifauna Transects	Microhabitat Searching
Mt Jackson	670	1440	139	36 hrs	40 hrs
Windarling	310	820	65	18 hrs	20 hrs
Bungalbin	714	1260	63	30 hrs	36 hrs
Rail Corridor	560	1120	56	24 hrs	32 hrs
TOTAL	2254	4640	323	108 hrs	128 hrs

In addition to sampling of vertebrate fauna, terrestrial gastropod snails were collected when observed in both systematic and opportunistic collection sites.

5.11.3 Fauna Habitats

The system of habitat classification used in this study is based on the landform classification system used in the Biological Survey of the Eastern Goldfields (Newbey *et al.*, 1985), with modifications in relation to vegetation associations. On the basis of the landform units and vegetation associations present in the project area, a system of five major and 10 minor habitat types was developed. Although these fauna habitats are closely aligned with landform - vegetation associations, they are in some cases a composite of several vegetation associations. Habitat types and their survey site representation are summarised in Table 5.16.

5.11.4 The Fauna Community

Systematic sampling and opportunistic collecting within the Koolyanobbing Expansion Project Area yielded 158 vertebrate species including 85 birds, 51 reptiles and 22 mammals including 16 native and six introduced species (Appendix E). No amphibians were recorded during the survey. The greatest number of species was recorded from the Mt Jackson study area, due in part to the greater number of bird species recorded. The highest numbers of reptile species were recorded from the Bungalbin and Rail Corridor Study Areas.

Table 5.16 Survey sites and habitat types.

Major Habitat	Minor Habitat	No. of Sites	Study Area*
Hill/Ridge	Hilltop	9	MJ, WI, BU
	Gully/Cliff	5	MJ, BU
Woodlands	Salmon Gum	4	MJ, WI, RC
	Mallee	6	MJ, WI, BU, RC
	Mixed Eucalypt	1	BU, RC
	Casuarina	1	MJ
	Mulga	1	WI
	Callitris	1	RC
Shrubland		2	BU, RC
Cracking Clay		1	RC
Sandplain	Burnt	1	RC
	Unburnt	1	RC
	Total sites:	33	

* Study Areas: MJ = Mt Jackson, WI = Windarling, BU = Bungalbin, RC = Rail Corridor

Species lists have been prepared for the project area based on a search of the available literature, information obtained from the WA Museum fauna database, unpublished information relevant to the area and knowledge of known habitat preferences. On this basis an estimated 275 vertebrate fauna species may potentially occur comprising 29 native and eight introduced mammals, 134 birds, 97 reptiles and seven frog species. It is unlikely that all potentially occurring vertebrate fauna species would be detected within the project area during the course of a single fauna survey due to temporal and spatial variations in fauna population numbers, however, of the species that potentially occur in the project area a relatively high proportion (57%) were recorded during the fauna survey.

Mammals:

Amongst the 22 mammal species (16 native and six introduced) captured or observed several representatives of major family groups were recorded including the monotremes (Echidna), marsupials including dasyurids (3 species), kangaroos (3 species) and the Western Pygmy-possum, and placental mammals including rodents (3 native and 1 introduced species) and bats (4 species).

Woolley's Pseudantechinus *Pseudantechinus woolleyae* is the largest of the dasyurid species recorded during the survey. Four individuals were recorded in rocky habitats in the Mt Jackson and Bungalbin study areas, representing the species' southern most record and a range extension.

Avifauna:

Eighty five bird species from 34 families were recorded throughout the project area, including 27 non-passerines from 16 families and 58 passerines from 18 families. Amongst the passerine birds some of the most speciose families were the Meliphagidae (honeyeaters; 11 species from eight genera), Pardalotidae (thornbills, pardalotes and allies; 11 species from seven genera) and Artamidae (woodswallows and allies; seven species from four genera).

Fauna survey sites

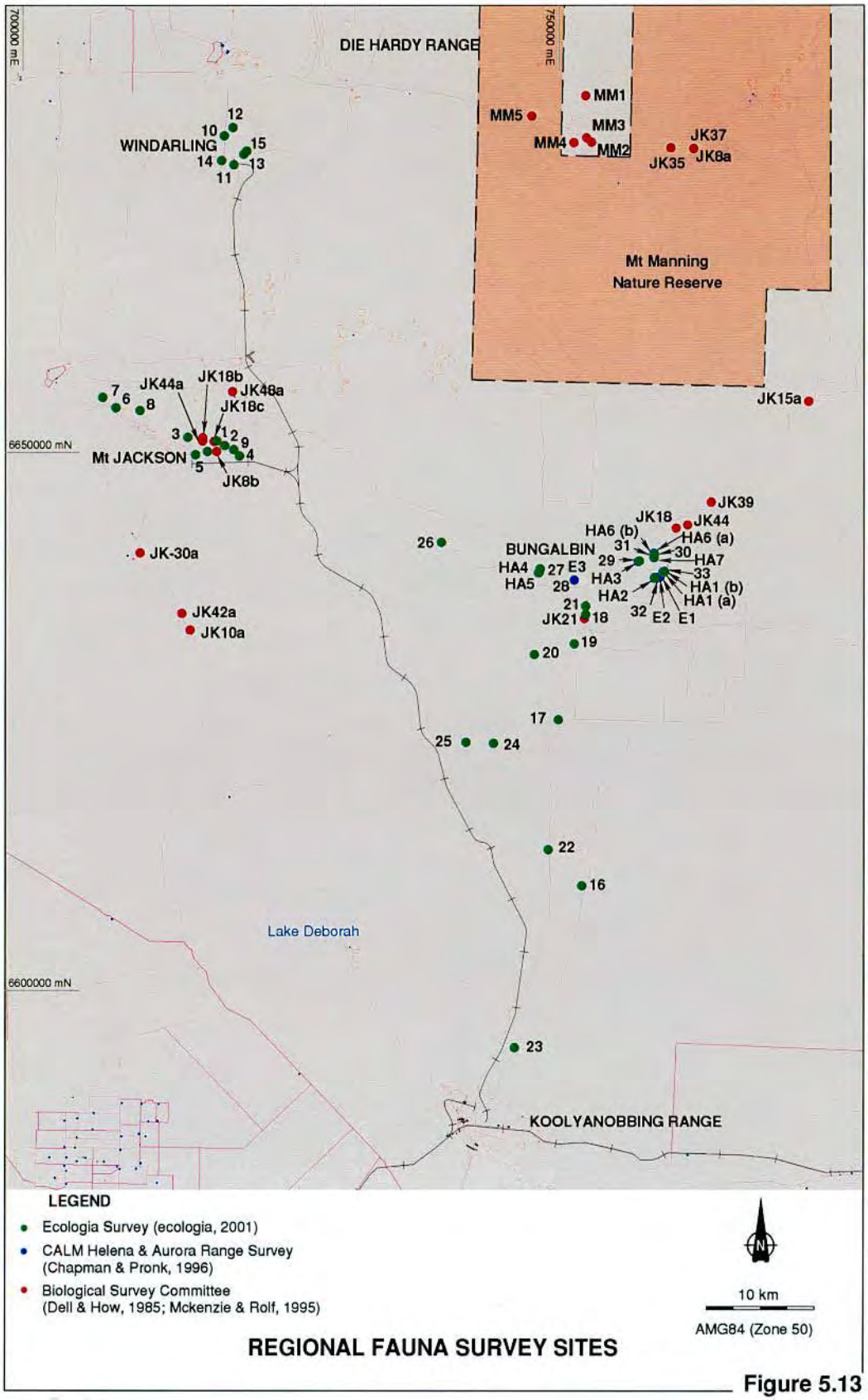


Figure 5.13

Species of interest recorded during the survey include Malleefowl *Leipoa ocellata*, Pink Cockatoo *Cacatua leadbeateri*, Australian Bustard *Ardeotis australis*, Barn Owl *Tyto alba*, Red-tailed Black Cockatoo *Calyptorhynchus banksii*, Southern Scrub Robin *Drymodes brunneopygia*, White-browed Treecreeper *Climacteris affinis* and Peregrine Falcon *Falco peregrinus*.

Herpetofauna:

A total of 51 reptile species were recorded including six agamid lizards, 10 geckos, three pygopods, 18 skinks, four varanids, seven elapid snakes and three blind snakes. No frogs were recorded during the survey although at least two species are known to occur in the area.

Of the reptile species recorded, three of the potential six species of pygopod, all four varanids and three of the four blind snakes that may occur were recorded. The diverse range of geckos and skinks recorded are fairly typical of the semi-arid zone, and are a result of the extensive nature of the survey and the timing of the survey in a warmer season of the year when reptiles are active. Of interest amongst the reptiles are the infrequently recorded species *Tympanocryptis cephalus*, *Lerista gerrardii* and *Ramphotyphlops hamatus*, and the Perentie *Varanus giganteus* which is at the southern limit of its range in the project area.

Feral Fauna:

Six species of feral fauna were recorded in the project area during the course of the field survey; House Mouse *Mus musculus*, Fox *Vulpes vulpes*, Feral Cat *Felis catus*, Goat *Capra hircus*, Cattle *Bos taurus* and Rabbit *Oryctolagus cuniculus*. The House Mouse was the most common species, however, several feral fauna species were widespread and recorded in a variety of different habitats.

Invertebrate Fauna:

Three species of terrestrial snail from two families (Camaelidae and Bulimulidae) were collected during the field survey; *Sinumelon kalgum*, *Bothriembryon* sp. and *Pleuroxia* sp.

Mt Jackson

Within the Mt Jackson area a total of nine sites were systematically surveyed, representing two major and five minor habitat types (Table 5.16). Within the areas surveyed a total of 12 native mammals, five introduced mammals, 24 reptiles and 52 bird species were recorded. A further 10 bird species were recorded opportunistically at sites around this area. The highest species richness was recorded from the Hilltop - Hill/Ridge habitat, with a total of eight mammals (five native and three introduced), 37 bird species and 14 herpetofauna species.

Mammals:

17 species; 12 native and five introduced. The most abundant mammal species was the introduced House Mouse *Mus musculus*, followed by the Feral Goat *Capra hircus* and the Little Long-tailed Dunnart *Sminthopsis dolichura*. Woolley's Pseudantechinus *Pseudantechinus woolleyae* was recorded from Gully/Cliff habitat.

Avifauna:

62 species; 19 non-passerines and 43 passerines were recorded. Abundant species included Inland Thornbill *Acanthiza apicalis*, Chestnut-rumped Thornbill *Acanthiza uropygialis*, Weebill *Smicrornis brevirostris*, Singing Honeyeater *Lichenostomus virescens* and Grey Shrike-thrush *Collurincla harmonica*. Australian Bustard *Ardeotis australis*, Red-tailed Black Cockatoo *Calyptorynchus banksii*, White-winged Fairy-wren *Malurus leucopterus*, Grey-fronted

Honeyeater *Lichenostomus plumulus* and Zebra Finch *Taenopygia guttata* were not recorded elsewhere in the project area. An individual of the threatened species Malleefowl *Leipoa ocellata* was recorded in the Mt Jackson study area.

Herpetofauna:

24 species; 21 lizards and three snakes were recorded here. Two species, the Southern Shovel-nosed Snake *Brachyurophis semifaciata* and Hooded Snake *Parasuta monachus*, were not recorded elsewhere in the project area.

Windarling

Within the Windarling study area, two major and four minor habitats were surveyed. A total of 82 species were recorded, including six native mammals, three introduced mammals, 53 birds and 20 reptile species. The highest species richness within the study area was recorded from Salmon Gum Woodland Habitat, with a total of 50 species, including one native mammal, three introduced mammals, 33 birds and 13 herpetofauna species.

Mammals:

Nine species; six native and three introduced mammals were recorded at Windarling. The introduced House Mouse *Mus musculus* was the most widespread mammal species. The most abundant species was the Inland Forest Bat *Vespadelus baverstocki.*

Avifauna:

53 species; 15 non-passerines and 38 passerines. Widespread species included Chestnut-rumped Thornbill *Acanthiza uropygialis*, Red-capped Robin *Petroica goodenovii*, Crested Bellbird *Oreoica gutturalis*, Rufous Whistler *Pachycephala rufiventris* and Grey Butcherbird *Cracticus torquatus*. Peregrine Falcon *Falco peregrinus*, Little Button-quail *Turnix velox*, Mulga Parrot *Psephotus varius* and Striated Fieldwren *Calamanthus fuliginosus* were not recorded elsewhere in the project area.

Herpetofauna:

20 species; 19 lizards and one snake. Highest species richness occurred in Salmon Gum Woodland habitat. The most abundant and widespread species, Bynoe's Gecko *Heteronotia binoei* Spiny-tailed Skink *Egernia depressa*, Striped-tailed Monitor *Varanus caudolineatus* and the blind snake *Rhampotyphlops hamatus* were not recorded from any other study area.

Transportation Corridor

The proposed Transportation Corridor contained four major and five minor habitats (Table 5.16). From this study area, 11 native mammals, one introduced mammal, 49 bird species and 30 reptile species were recorded. The highest species richness was recorded from Salmon Gum Woodland habitat, with a total of 46 species, including two native mammals, one introduced mammal, 28 birds and 15 reptiles.

Mammals:

Eight species; seven native and one introduced. Five species including Echidna *Tachyglossus aculeatus*, Pygmy Possum *Cercartetus concinnus*, Sandy Inland Mouse *Pseudomys hermannsburgensis*, Ash Grey Mouse *Pseudomys albocinereus* and Dingo *Canis familiaris dingo* were only recorded from a single habitat within the study area. Relatively few mammals were trapped in comparison to the other study areas. The Ash Grey Mouse was not recorded from any other study area.

Avifauna:

60 species; 19 non-passerines and 41 passerines were found, including the threatened Malleefowl *Leipoa ocellata*. Five species, Little Eagle *Hieraaetus morphnoides*, Tawny Frogmouth *Podargus strigoides*, Crimson Chat *Epthianura tricolor*, Black-faced Woodswallow *Artamus cinereus* and Richards Pipit *Anthus novaeseelandiae*, were not recorded from any other study areas within the project area.

Herpetofauna:

33 species; 30 lizards and three snakes. The most abundant and widespread species was the Tree Dtella *Gehyra variegata*. Twelve species were not recorded from any other study areas; Thorny Devil *Moloch horridus, Diplodactylus maini, Ctenotus atlas, C. mimetes, C. schomburgkii, Egernia formosa, E. inornata, Lerista gerrardii*, Shingleback Lizard *Tiliqua rugosa*, Mulga Snake *Pseudechis australis*, Dugite *Pseudonaja affinis* and Gwardar *Pseudonaja nuchalis*. Frogs are expected to occur in the area due to the presence of suitable lowland habitats.

5.12 RARE AND SPECIALLY PROTECTED FAUNA

Fauna species that have been formally recognised as rare, threatened with extinction or as having high conservation value are protected by law under Commonwealth and State legislation. At a national level, fauna are protected under the *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act). Within Western Australia rare fauna are listed under the *WA Wildlife Conservation Act 1950*, incorporating the Japan-Australia Migratory Bird Agreement (JAMBA). The China-Australia Migratory Bird Agreement (CAMBA) covers migratory species of avifauna, particularly transequatorial waders.

During the fauna survey one species listed under international agreements, one nationally threatened species, two species listed under Schedule 4 of the Wildlife Conservation Act and one priority fauna species were recorded (Table 5.17). These fauna species and others that potentially occur in the area are described in the following sections.

Table 5.17: Rare and Priority Fauna recorded from the project area

Species	Mt Jackson	Windarling	Transportation Corridor	Previous Surveys
International Agreements (JAMBA and CAMBA)				
Rainbow Bee-eater *Merops ornatus*	X	X	X	X
EPBC Act				
Malleefowl *Leipoa ocellata**	X		X	X
WA Wildlife Conservation Act *Schedule 4*				
Peregrine Falcon *Falco peregrinus*		X		X
Carpet Python *Morelia spilota imbricata*		X		
Pink Cockatoo Cacatua leadbeateri			X	X
Priority Fauna (P4)				
Australian Bustard *Ardeotis australis*	X			

* Also listed under Schedule 1 of the WA Wildlife Conservation Act

5.12.1 Species Protected by International Agreements

Three international agreements encompass Australian fauna, with a focus on protecting migratory species. These three agreements include the Japan-Australia Migratory Bird Agreement (JAMBA), the China-Australia Migratory Bird

Agreement (CAMBA) and the Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention).

Of the species listed under these agreements, five potentially occur in the project area and one was recorded, Rainbow Bee-eater *Merops ornatus*. The Rainbow Bee-eater was observed on a variety of occasions in the project area. It is a common and widespread species in the region, albeit on a seasonal basis in southern Australia.

Migratory species that potentially occur in the area include Fork-tailed Swift *Apus pacificus*, an aerial species that tends to occur in close association with seasonal thunderstorm systems. The Fork-tailed Swift is more commonly observed in northern Australia but does occur sporadically in the south.

Four species of migratory waders (shorebirds) may potentially pass through the area whilst on seasonal migration; Common Sandpiper *Actitis hypoleucos*, Sharp-tailed Sandpiper *Calidris acuminata*, Wood Sandpiper *Tringa glareola* and Greenshank *Tringa nebularia*. These species occupy shoreline habitats in saline or freshwater and may utilise seasonally inundated Cracking clay habitat or salt lakes in the area such as those that occur in the Lake Hamersley and Lake Deborah systems.

5.12.2 Environment Protection and Biodiversity Conservation Act

The Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* contains a list of species that are considered Critically Endangered, Endangered, Vulnerable, Conservation Dependent, Extinct or Extinct in the Wild. Categories relevant to fauna that occur or potentially occur in the project area are defined in Table 5.18.

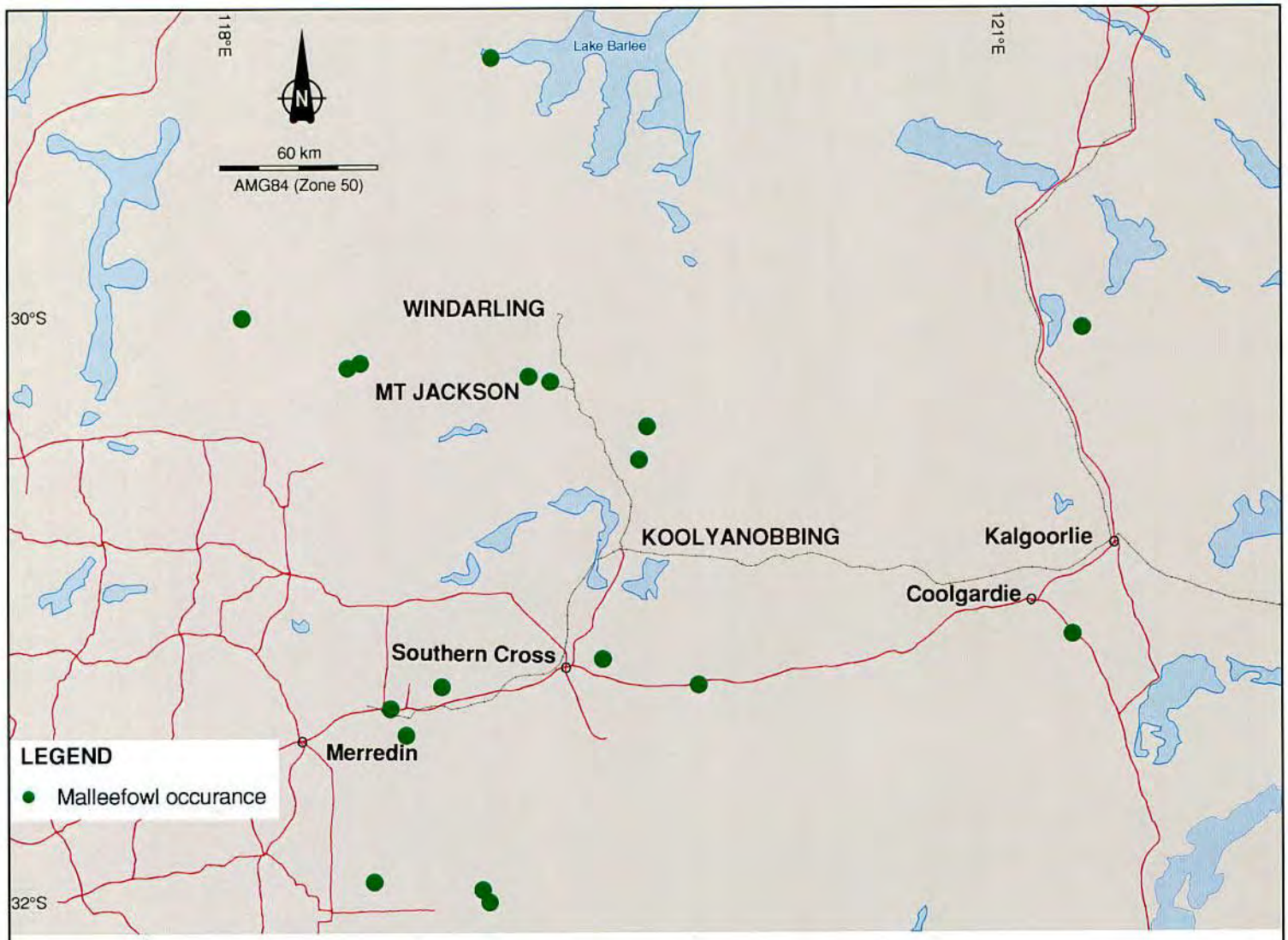
Table 5.18: EPBC Act Categories

Category	Definition
Vulnerable	A species is considered vulnerable if it is not critically endangered or endangered, and it is facing a high risk of extinction in the wild in the medium-term future, as determined in accordance with prescribed criteria.

The Malleefowl *Leipoa ocellata* is currently listed under the EPBC Act as Vulnerable. This species was observed on two occasions, once in the Mt Jackson area and once along the proposed Transport Corridor. An inactive mound was also discovered near Mt Jackson.

Much of the habitat for Malleefowl has been lost due to clearing for agriculture. Within Western Australia it has disappeared from much of the Wheatbelt, but does persist beyond the agricultural zone in parts of the Goldfields and Murchison districts. Within the general Koolyanobbing region Malleefowl have been recorded sporadically in recent years (Figure 5.14).

Because of its status as a rare species, a National Recovery Plan has been prepared that details aspects of the species biology, distribution and abundance, threatening processes, and a recovery strategy (Benshemesh, 2001). To manage the species in the project area, a Malleefowl Conservation Plan has been prepared (Section 6.4).



MALLEEFOWL OCCURRENCE IN THE REGION

Figure 5.14

5.12.3 WA Wildlife Conservation Act

Classification of rare and endangered fauna under the Western Australian Wildlife Conservation (Specially Protected Fauna) Notice 2001 of the Wildlife Conservation Act 1950, recognises four distinct schedules for fauna that are 'in need of special protection' (Table 5.19).

Table 5.19: Classification of species under the WA Wildlife Conservation Act.

Classification	Definition
Schedule 1	Fauna that is rare or likely to become extinct.
Schedule 2	Fauna that is presumed to be extinct.
Schedule 3	Birds that are subject to an agreement between the governments of Australia and Japan relating to the protection of migratory birds and birds in danger of extinction.
Schedule 4	Other fauna that is in need of special protection.

Scheduled species recorded or which potentially occur in the project area are detailed below.

Schedule 1

Malleefowl *Leipoa ocellata*

This species is decribed in detail in Section 5.12.2.

Schedule 2

Lesser Stick-nest Rat *Leporillus apicalis*

Evidence of old nests of this species were found in the project area in Gorge and Hill habitat. This species is considered extinct in Australia.

Schedule 3

Fork-tailed Swift *Apus pacificus*

This and other migratory species listed under JAMBA (Greenshank *Tringa nebularia*, Wood Sandpiper *Tringa glareola*, Common Sandpiper *Tringa hypoleucos* and Sharp-tailed Sandpiper *Calidris acuminata*) are discussed in relation to international agreements in section 5.12.1.

Schedule 4

Peregrine Falcon *Falco peregrinus*

Two individuals of this species, an adult and an immature bird, were observed in the Windarling area during the survey. The presence of an immature bird may indicate that the birds breed in the area, although they are known to range widely. Peregrines generally breed along cliff faces in inaccessible situations, hence the Windarling area does provide potentially suitable breeding habitat. This species is protected due to its poor conservation status worldwide. Within Australia it is widespread, and though not common the Australian population appears secure. Regardless of this status, however, breeding sites for this species are uncommon and consequently should not be disturbed.

Pink or Major Mitchell's Cockatoo *Cacatua leadbeateri*

This species was observed whilst travelling between the Mt Jackson and Windarling study areas, and was observed on several separate occasions, including during avifauna transects, along the Transportation Corridor. The Pink Cockatoo requires Woodland habitat for nesting, and is patchily distributed throughout Western Australia south of the Tropic.

The Schedule 4 taxa Woma *Aspidites ramsayi* and Carpet Python *Morelia spilota imbricata* potentially occur in the project area. The Carpet Python occurs in the south-west and is near the inland limit of its distribution within the project area, but there is suitable habitat in the area and there is a recent record for this species north of Kalgoorlie. A Carpet Python was observed in the Windarling area in September 2001. The Woma is nowadays uncommon is the Goldfields and may have become extinct in the Wheatbelt. It is more commonly encountered in the inland sandy deserts and is now very rare in the southern interior of the state.

5.12.4 CALM Priority Fauna

Species on the CALM Priority Fauna list include those removed from the scheduled fauna list and other species known from only a few populations or in need of monitoring. Four Priority Codes are recognised as defined in Table 5.20.

Table 5.20: CALM Priority Fauna Categories

Category	Definition
P1	Taxa with few, poorly known populations on threatened lands.
P2	Taxa with few, poorly known populations on conservation lands.
P3	Taxa with several, poorly known populations, some on conservation lands.
P4	Taxa in need of monitoring.

A single Priority fauna species was recorded from the project area. The Priority 4 Australian Bustard *Ardeotis australis* was recorded opportunistically in the Mt Jackson area. It is a large bird that is slow to take wing, and is hunted in some areas. The Australian Bustard, whilst not abundant, occurs regularly in parts of the arid zone.

The Priority 4 species Central Long-eared Bat *Nyctophilus timoriensis* 'central form' has been recorded in ranges just north of 30∞ latitude and as a mobile species it has the potential to occur in the project area.

5.12.5 Conservation Significance

The significance of the fauna of the Koolyanobbing Expansion Project area has been assessed at four spatial scales; international / national, state, regional and local. Relevant species are identified in Table 5.21. The project area encompasses distinct landform and fauna habitats, which are generally representative of the Coolgardie Bioregion. Most features have at least some representation within conservation areas, principally Mt Manning Nature Reserve.

International/ National Significance

Fauna species whose conservation is dependent, because of their migration patterns, on the action of other nations as well as Australia's, are of international significance. National significance refers to those features of the environment, which is recognised under legislation as being of importance to the Australian community.

Species listed under international agreements or the EPBC Act recorded from the project area are the Malleefowl *Leipoa ocellata* and Rainbow Bee-eater. Five other migratory species potentially occur in the area (Table 5.21). Suitable habitats in the Mt Jackson and Transportation Corridor areas support populations of the Malleefowl.

State Significance

State significance refers to those features of the environment that are recognised under State legislation as of importance to the Western Australian community. Fauna that are regarded as "rare and/or endangered" or habitats

that are site or type specific and possess high ecological value are of State significance. Habitats, which exhibit such a level of significance, will contain specific, habitat dependent fauna or high biodiversity and are poorly represented elsewhere. If a species or habitat is poorly represented in conservation reserves its conservation significance is increased.

Species recorded from the project area that are of State significance include the Malleefowl *Leipoa ocellata*, Peregrine Falcon *Falco peregrinus* and Pink Cockatoo *Cactua leadbeateri*. The Peregrine Falcon was recorded at Windarling and the Pink Cockatoo was observed on several occasions along the Transportation Corridor.

Regional Significance

Regional significance addresses the representation of species and habitats at a biogeographic regional level, i.e. within the Coolgardie Bioregion. Species or habitat types that are endemic to the Goldfields and whose known distributions are limited or unknown are considered regionally significant.

The project area generally encompasses habitats and vegetation associations that are widespread throughout the region, however, the ironstone range habitats are more specific to the area and less well represented elsewhere, and are not currently protected within conservation reserves. Although the flora of these ranges shows a greater degree of localised endemism, there are limited indications that upland areas are important for certain fauna taxa in the area. The expectation being Woolley's Pseudantechinus *Pseudantechinus woolleyae* which is restricted to Gorge and Cliff habitats within the project area. The presence of this species in the area represents a southern range extension and it is therefore considered to be of regional significance.

Species listed on the CALM Priority list are considered regionally significant because of limited knowledge about their distribution, restricted distribution and/or poor representation within existing conservation reserves.

Local Significance

Species are of local significance when their presence is confined to a specialised habitat type which is not common within the local area and whose disturbance or removal may lead to local extinction, where there are very few records for the species, or where there is uncertainty about their taxonomic status or they are endemic to the area.

No particular fauna species or habitat is of local significance.

Table 5.21: Conservation Significance of Fauna within the Project Area.

Conservation Significance	Relevant Legislation	Species Recorded Species Potentially Occurring
International/ National	CAMBA, JAMBA, EPBC Act, IUCN	*Malleefowl, Rainbow Bee-eater* Fork-tailed Swift, Greenshank, Wood Sandpiper, Common Sandpiper, Sharp-tailed Sandpiper
State	WCA	*Malleefowl, Peregrine Falcon, Pink Cockatoo, Carpet Python* Woma
Regional		*Australian Bustard* Central Long-eared Bat 'central form'
Local Significance		none

Abbreviations: *WCA - West Australian Wildlife Conservation Act 1999*
IUCN - International Union for the Conservation of Nature
EPBC - Environment Protection and Biodiversity Conservation Act 1999
CAMBA - China-Australia Migratory Bird Agreement
JAMBA - Japan-Australia Migratory Bird Agreement

5.13 BIODIVERSITY OVERVIEW

5.13.1 Introduction

Biodiversity conservation is a critical component of the environmental impact assessment process. There is an increasing community expectation that protection of the State's biological diversity of plants and animals be given greater importance through the EPA assessment process (EPA, 2000).

With the adoption of the National Strategy for Ecologically Sustainable Development (ESD), ESD principles are to be incorporated into government planning and initiatives at a national, state and regional level. The states have also reached agreement on the subsequent National Strategy for the Conservation of Australia's Biological Diversity. Western Australia has committed to an agreed framework, principles and objectives for the protection of biodiversity.

As a consequence of these actions, assessment of proposals must ensure that processes relating to the protection of biodiversity are undertaken to agreed National and Commonwealth standards and agreements. A greater level of detailed information is required to facilitate satisfactory assessment of factors that impinge on the biotic components of the environment.

5.13.2 Elements of Biodiversity

Biodiversity may be considered at two principal levels; its intrinsic value at the individual species, species assemblage and genetic level, and its functional value at the ecosystem level.

Environmental impact assessment in Western Australia principally considers biodiversity at the species and taxa levels. Flora has generally been considered at the species and species assemblage (vegetation community) level, while fauna has mainly been interpreted at the species level in relation to habitat, and, in terrestrial studies, invariably focusses on vertebrate fauna. Where possible or relevant, efforts are also made to identify subspecies or varieties, thereby enhancing taxonomic definition of the biota.

Diversity at the ecosystem level can and usually is regarded in terms of species composition and abundance, but should also incorporate knowledge of functional relationships within an ecosystem. In the majority of situations the level of information available is insufficient to assess the nature of functional relationships and interactions.

Australia has adopted a bioregional approach (Thackway and Cresswell, 1995) in order to assess biodiversity conservation and representation at a national level, with 26 bioregions represented in Western Australia. The Coolgardie Bioregion is one of two interzones in Western Australia, lying near the boundary between the mesic south west and the arid zone and including elements of both.

5.13.3 Components of Biodiversity Associated with the Project

The Koolyanobbing Expansion Project area includes a variety of landscapes that support a range of vegetation communities and fauna habitats, and their associated flora and fauna components (Table 5.22). These include Rare flora and fauna taxa, as well as Priority species and other species of conservation significance. Assessment of biodiversity in the area is almost entirely limited to species and taxa levels of biodiversity; the only investigation of genetic diversity is in relation to genetic differentiation of some locally endemic, restricted and rare taxa of the genus *Tetratheca* (Butcher et *al*, 2001).

5.13.4 Conservation Significance

The relative importance of areas impacted by the proposed development, including landscapes, vegetation and fauna is partially determined by the ecological integrity of the area to be impacted and the role it plays as part of a regional environment. The size of conservation reserves within the region and the representation of vegetation communities and fauna habitats within these reserves should be taken into account when assessing the potential impact of the proposed development.

At a local scale the proposed Koolyanobbing Expansion is not expected to be of major significance to the biota of the Goldfields' Region, resulting in the loss or partial removal of localised populations of plants and animals. However, banded ironstone ranges in the Coolgardie Bioregion are under-represented in the overall landscape, emphasising the need to conserve representative areas of this landscape.

Fauna habitats are closely related to landform/ vegetation communities. Eucalypt woodlands on lowland areas are widespread in the bioregion and are not likely to be significantly impacted by the proposal. There is currently representation of these vegetation communities in conservation reserves such as Mt Manning Nature Reserve. A similar circumstance exists for Mulga woodland (*Acacia aneura*) associations that are widepsread particularly in areas to the north of the project area.

On the ironstone ranges, including ridges, upper slopes and lower slopes, a variety of communities occur. These are predominantly mixed shrublands dominated by *Acacia*. These shrublands occur only along the ranges, and in some cases are restricted to particular areas, i.e. the Mt Jackson and Windarling Ranges. The vegetation community S6 (see Section 5.8.1) at Windarling is particularly restricted, occurring along the ridge where ironstone rocks are exposed. Communities S4 and S9 at Windarling and S3 and S5 at Mt Jackson are also restricted to ridges and steep upper slopes, and are not apparent elsewhere in the region. Within the general Koolyanobbing area there is currently no representation of these ironstone vegetation communities within conservation reserves.

Table 5.22:Biodiversity Attributes Summary Table

Biodiversity Attribute	Project Area Characteristics	Regional Area Characteristics
Flora	365 flora species from 51 families	73 families, 333 genera, 1077 species and 1127 taxa (38 introduced) in the general Koolyanobbing area
Fauna	148 vertebrate species recorded: 81 birds, 46 reptiles, 21 mammals (15 native and 6 introduced) 3 terrestrial snails	Potentially in wider area: 275 vertebrate species: 133 birds, 104 reptiles, 38 mammals (31 native and 7 introduced)
Rare Flora (DRF)	*Tetratheca harperi* (Mt Jackson) *Tetratheca paynterae* (Windarling)	Also includes; *Tetratheca aphylla* (Helena and Aurora Range) *Eremophila viscida* (Highclere Hills)
Priority Flora	12 species recorded Potentially impacted by proposal: *Ricinocarpos brevis*, P1 (Jackson Range & Windarling). *Jacksonia jackson*, P2 (Jackson Range)	73 species potentially occurring in the wider Koolyanobbing area 35 species recorded at specific localities in the region
Rare Fauna	Malleefowl *Leipoa ocellata* (S1)(JAMBA) (Jackson Range, Transportation Corridor) Rainbow Bee-eater *Merops ornatus* (JAMBA) Pink Cockatoo *Cacatua leadbeateri* (S4) (Jackson Range and Transportation Corridor) Peregrine Falcon *Falco peregrinus* (S4) () Windarling Carpet Python *Morelia spilota imbricata* (S4) (Windarling)	Potentially; Fork-tailed Swift *Apus pacificus* (S3)(JAMBA) Woma *Aspidites ramsayi* (S4) Greenshank *Tringa nebularia* (S3) (JAMBA) Wood Sandpiper *Tringa glareola* (S3) (JAMBA) Common Sandpiper *Tringa hypoleucos* (S3) (JAMBA) Sharp-tailed Sandpiper *Calidris acuminata* (S3) (JAMBA)
Priority Fauna	Australian Bustard (*Ardeotis australis*) (P4) (Jackson Range)	Potentially: Central Long-eared Bat *Nyctophilus timoriensis* (P4)
Other taxa of conservation significance	15 flora taxa (6 at Jackson Range, 6 at Windarling, 9 at Transportation Corridor)	50 flora taxa recorded Principally range extensions, but some geographically restricted and/or in need of further taxonomic work

Biodiversity Attribute	Project Area Characteristics	Regional Area Characteristics
Vegetation communities	Six supergroups and 35 groupings of vegetation with differentiation by locality and position in the landscape Project area: 12 vegetation communities; Eucalypt Woodlands (E1, E2), Acacia Woodlands (A1) and Mixed Shrublands (S1 – S9) Mt Jackson: 8 vegetation communities; Windarling: 8 vegetation communities Restricted communities – S2, S4, S6, S9 at Windarling S1, S3, S5, S8 at Mt Jackson.	Bungalbin, Die Hardy (ranges) and Jackson (lowlands) Systems (Beard, 1972;1978)
Fauna Habitats	5 major and 10 minor habitat types	
Significant Ecosystems	Mixed Shrublands (S6) on ironstone ridges at Windarling	
Bioregion	Coolgardie (COO)	

In terms of the flora of the project area there are a variety of DRF and Priority taxa that occur principally on the ranges. The most significant in the context of the proposal are *Tetratheca paynterae* (DRF) and *Ricinocarpos brevis* (P1) at Windarling and *Tetratheca harperi* (DRF) at Mt Jackson. The only known existing population of *Tetratheca*

paynterae occurs at Windarling. *Ricinocarpos brevis* (P1) and *Jacksonia jackson* (P2) occur over the Mt Jackson deposits, J2 and J3.

The principal species of Rare Fauna that may be affected by the proposal is the Malleefowl *Leipoa ocellata*. This species is now rarely recorded in the Wheatbelt but viable populations still exist in the lower rainfall zones of the southwest. There is limited representation of Malleefowl habitat in conservation reserves in the Coolgardie bioregion.

5.14 LANDUSE AND TENURE

5.14.1 Region

The first European exploration in this area occurred in 1846 at which time the three Gregory brothers named Mt Jackson. The area remained relatively unexplored due to unfavourable reports following initial exploration and the obvious lack of water. Ed Payne discovered gold in the nearby Yilgarn Hills in 1887 and the Yilgarn Goldfield was declared in 1888. Two gold mines were instigated near Mt Jackson in 1894 and wood collection for those mines has significantly altered the structure of the nearby woodland areas.

Bullfinch is the closest town to the Windarling and Mt Jackson mine areas. The town was founded in 1909 following the opening of a significant gold mine, which has now closed. Other towns to the south of the project area are the mining village of Koolyanobbing, and further afield, Southern Cross. Small settlements also exist to the west of Southern Cross along the Great Eastern Highway.

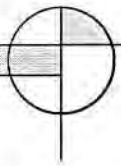
In the general area pastoralists have not fared particularly well, with extensive sheep leases often abandoned due to the marginal and infrequent rainfall (Beard, 1979). In the region to the south of the project area wheat and sheep farms are sustainable: Bullfinch marks the approximate northern boundary of the farming districts. Mount Jackson station was established in 1919 and although still active, it remains only as a reminder of previous attempts at pastoralism. Approximately 25% of the area around Mt Jackson is under pastoral lease but most of it is subleased to mines. The Brontie pastoral lease surrounds Koolyanobbing.

The history of iron ore production in the area is well documented. Originally discovered by prospectors in 1887, the Koolyanobbing deposit was first mined in 1948 by the Western Australian Government. As a result the Trans Australia rail line was deviated from its course to pass through Koolyanobbing. In 1961, BHP commenced exploration of iron ore deposits at Koolyanobbing and also at Bungalbin. From 1967 to 1983 BHP mined iron ore at Koolyanobbing which was transported to Kwinana. The Koolyanobbing operations were closed in 1983 but Portman recommenced mining operations in the area in July 1994, with ore being shipped via Esperance. Portman announced a major expansion in 1999, and acquired access to additional tenements at Mt Jackson and Windarling to provide additional resources of iron ore. In 2000 the port facilities at Esperance were upgraded to accommodate increased mining activity.

5.14.2 Project Area

The proposed expansion area of Windarling is located on the Diemels Pastoral Lease and the Mt Jackson deposits are on the Mt Jackson Pastoral Lease (Figure 5.15). To the north of Mt Jackson and east of Windarling lies the Mt Manning Nature Reserve. Proposed extensions to the 'C' class Mt Manning Nature Reserve cover the entire area of Bungalbin in the Helena and Aurora Range (PNR96) and also parts of Windarling and Mt Jackson (PNR97) (Figure 5.15).

Exploration leases curently cover the proposed mine areas:



- Mt Jackson E77/511 and E77/896
- Windarling E77/1032 and E77/993

Mining Lease No. E77/417 covers the existing Koolyanobbing mine site and three mining leases cover the Windarling area – M77/999, M77/1000 and M77/1001. The transportation corridor crosses mostly Vacant Crown Land in the southern section and portions of the Diemels and Mt Jackson Pastoral Leases in the area of the Mt Jackson and Windarling deposits.

5.14.3 Conservation Estate

Nature Reserves are areas to be managed for nature conservation and scientific study. They have important nature conservation value, either as part of a conservation reserve system, as a remnant of native vegetation or because of the occurrence of particular species of flora and fauna. In Western Australia Nature Reserves are vested in the Conservation Commission (CC) and managed by CALM.

Mt Manning Nature Reserve

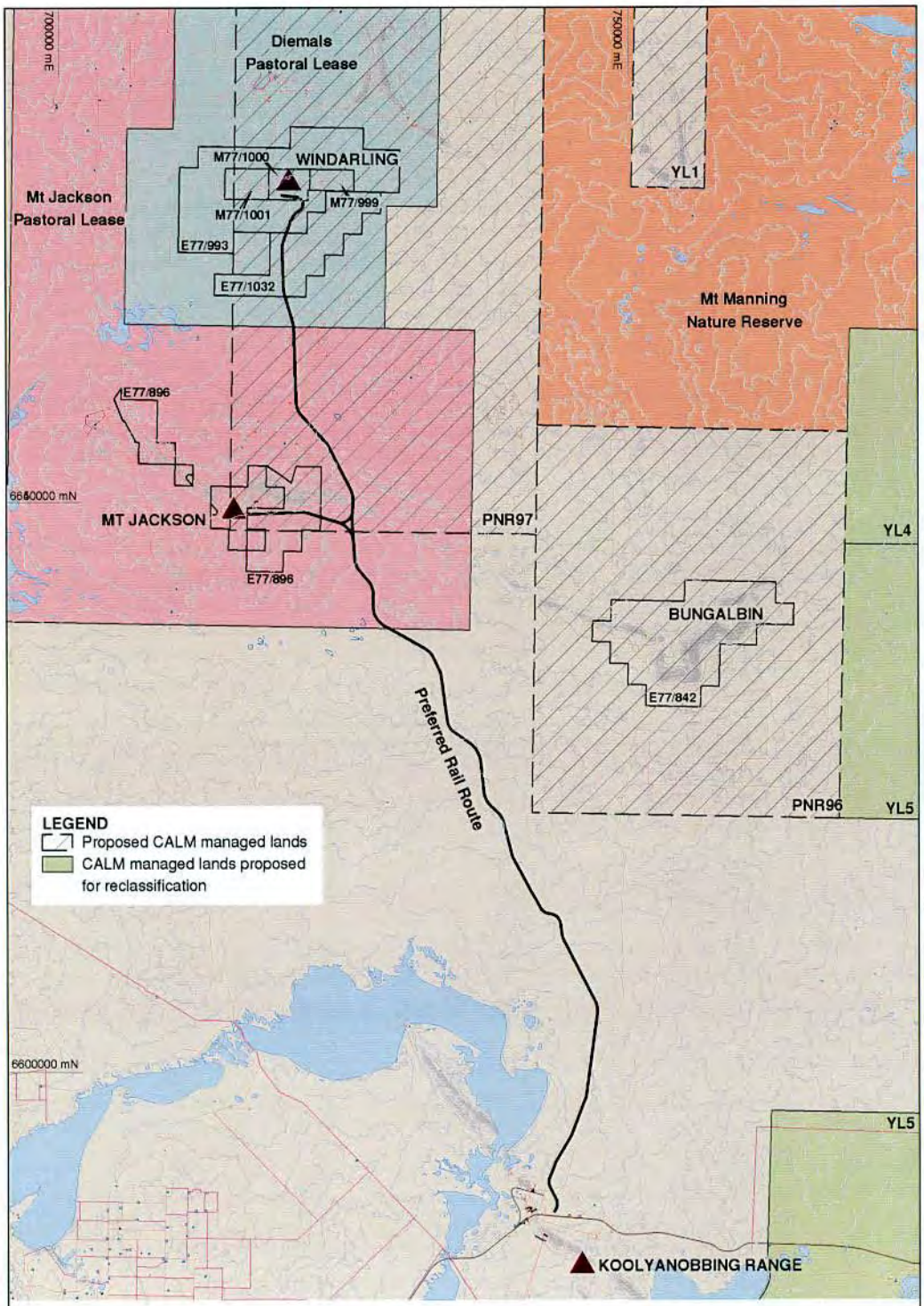
The proposed Koolyanobbing Expansion tenements are in relatively close proximity to the Mt Manning Nature Reserve. The Mt Manning area, located 90 km north of Koolyanobbing, has been declared a "C" class reserve for conservation of flora and fauna. The Mt Manning Nature Reserve covers approximately 153,290 ha. The area is particularly important for the preservation of natural mulga associations and rare and endemic plants, but as it currently exists does not include the upland banded ironstone and greenstone formations of the Mt Manning Range itself, and its associated endemic flora elements.

The Mt Manning Range area is recognized as having potential prospects for gold and iron exploration and mining. CALM (1994) have recommended that the central portion within the Nature Reserve which is currently Vacant Crown Land, including the Mt Manning Range itself, be incorporated into the reserve.

Further investigations of the flora and fauna around the Helena and Aurora Ranges, including the Bungalbin Hill area, were conducted by CALM in 1995 and 1996. The surveys were undertaken to investigate the ecological and biodiversity conservation value of the area as a proposed extension to the Mt Manning Range Nature Reserve (Refer to Section 5 for a discussion of these flora and fauna surveys). It is generally acknowledged that conservation reserves are under represented in the IBRA Coolgardie bioregion.

Recommendations have been made to extend the Mt Manning Nature Reserve southward by adding 91 650 ha of Vacant Crown land to include the Helena and Aurora Range (CALM, 1994; Henry-Hall, 1990). This follows the suggestions of Keighery (1980) and Dell *et al.* (1985) who advocated a southern extension to conserve the restricted banded ironstone flora, and the rich and diverse fauna particularly around the Bungalbin Hill area. Gibson *et al.* (1996) also supported this suggestion to protect the flora and ironstone vegetation communities.

A further recommendation has been made by CALM (1994) to extend the Mt Manning reserve to the west, incorporating Windarling Peak, the Die Hardy Range, Mt Jackson and surrounding areas, including portions from Mt Jackson and Diemals pastoral leases. The proposed nature reserves cover the entire area of Bungalbin (PNR96) and also parts of Windarling (PNR97) and Mt Jackson (PNR97) (Figure 5.15). CALM (1994) indicated that they would proceed with the first recommendation, the southern extension (PNR96), but that the recommendation to extend the reserve to the west (PNR97) would be deferred.



EXISTING LANDUSE AND TENURE

Figure 5.15

5.15 SOCIAL AND CULTURAL ENVIRONMENT

5.15.1 Aboriginal Sites and Heritage

An assessment of the relevant historical and anthropological material associated with Aboriginal cultural sites in the Koolyanobbing – Windarling area was prepared by Clarke (2001). An archaeological and ethnographic survey of the area, including proposed rail routes and the northern deposits, was undertaken by Australian Interaction Consultants (AIC, 2001). Clarke (2001) reviewed the survey report and provides additional information about the Aboriginal heritage in the area.

The indigenous people living in the Koolyanobbing – Windarling and surrounding areas were speakers of the Kalaamaya language. They resided in an intermediate zone between the southwest and western desert cultural regions. The Kalaamaya comprised a number of small groups who lived as hunters and gatherers. Tindale (1974) mapped the distribution of Australian tribes and found that the Kalaamaya people were located in an area extending south to the vicinity of Southern Cross and including the Koolyanobbing Range and associated salt lakes, north to Lake Barlee, and west to the Lake Moore area. This therefore encompasses all of the area under consideration in this PER document.

The Colonial Secretary of Western Australia published a list of Aboriginal placenames for the Southern Cross 'sub-district' in 1904. This list includes a series of terms that describe landscape forms, and others that appear to refer to specific sites. The majority of these terms are linked to water sources, since these sites were of great importance to the survival of the Kalaamaya people in this semi-arid environment. Daisy Bates (1901-14) mentioned important sites in the area including Karratjibbin (Southern Cross), Wilgauin (Mt Jackson), Kammining (NW of Southern Cross) Malyorning (unknown) and Juwardain (near Mt Jackson).

As was the situation in many parts of Australia, the indigenous population of the area suffered in the early years of European settlement from alienation from their land, death through violence, disease and reduced birth rates. The overall result was a decrease in the Aboriginal population and loss of ceremonial elements of Aboriginal life, loss or dramatic alteration to native language, and breakdown of cultural systems and beliefs. The majority of people moved into major towns or missions, and by the 1960's only a few elderly Aboriginal people possessed any memory of their traditional heritage.

The general area around Koolyanobbing is poorly known archaeologically, with little or no systematic survey over the area (AIC, 2001). As a consequence, few sites have been documented. Known archeological sites in the area include gnamma holes and artefact scatters however no synthesis of archaeological data has been undertaken previously. The archaeological and ethnographic survey (AIC, 2001; Clarke, 2001) provides a more detailed listing of sites in the area. This is based on a search of the DIA sites database, a bibliographic search of relevant documents, and an archaeological assessment of the survey area undertaken in consultation with representatives of the Ballardong and Central West people and additional people.

The heritage assessment area included the project area and an extensive area surrounding it, extending south of Koolyanobbing and north to Lake Barlee, thereby encompassing much of what is thought to have been Kalaamaya tribal land based on the maps of Tindale (1974). A search of the DIA sites database resulted in a listing of 20 sites, including three located within the project area:

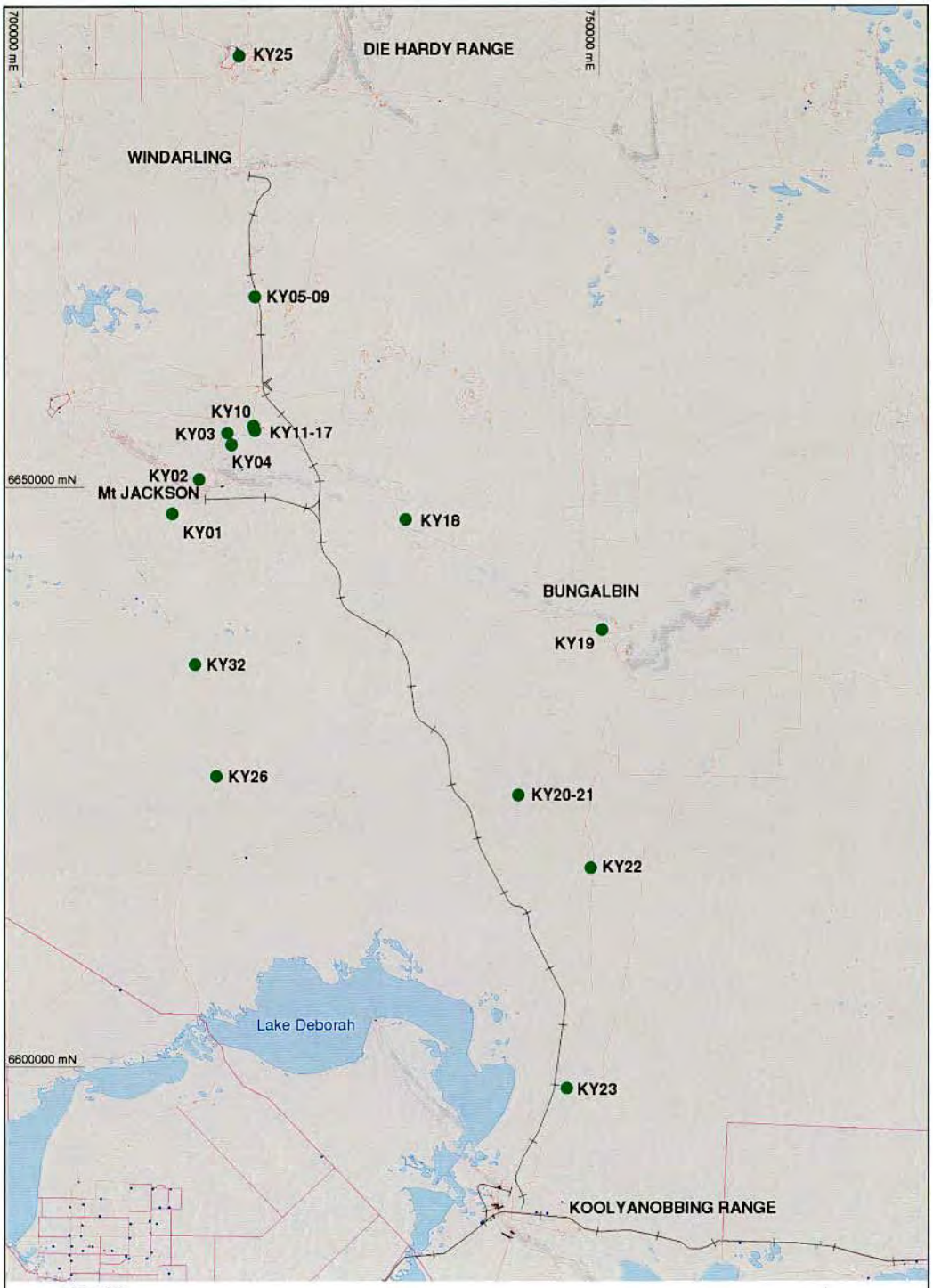
- SO0104 Mt Jackson: an unreliably located, artefactual site
- SO0105 Bungalbin: unreliably located and not given a type
- SO2875 Marda Dam: a positionally reliable, artefactual site

As a result of the archaeological and ethnographic survey undertaken by AIC (2001) a series of 15 sites and associated areas have been identified in the general area that are potentially of significance to indigenous people (Table 5.23 and Figure 5.16). Many of these sites are not in close proximity to the project area and are not likely to be impacted, however access to these sites should be restricted. The only sites in proximity are sites KY05-09 which are near the Transportation Corridor. These can be avoided by a minor realignment of the railway. Most of the sites listed in Table 5.20 should probably be registered with the DIA, but further investigations are necessary before this occurs. Sites listed in the table that are currently registered on the DIA database include Marda Dam, Pigeon Rock and Pearce Stone Arrangement.

Table 5.23: Sites of potential significance identified during the indigenous heritage survey.

Site No.	Location	Site details	Location in relation to project area
KY01	712889E 6647714N	rock hole, stone artefact scatter	8 km SW of Mt Jackson
KY02	715222E 6650646E	rock shelter	3 km SW of Mt Jackson
KY03	717690E 6654642N	rock shelter – "Prospector's Cave"	3 km N of Mt Jackson
KY04	718057E 6653615N	rock shelter	3 km N of Mt Jackson
KY05-09	720086E 6666370N	claypan and artefact scatters associated with chain of claypans	5 km S of Windarling
KY10	719962E 6655362N	artefact scatter – Marda Dam (SO02875)	4 km N of Mt Jackson
KY11-17	720086E 6654846N	rock shelters and rock hole on laterite breakaway in the vicinity of Marda Dam	4 km N of Mt Jackson
KY18	733192E 6647237N	rock hole and artefact scatter	14km ESE of Mt Jackson
KY19	750228E 6637749N	rock hole and artefact scatter	4 km NW of Bungalbin
KY20-21	742972E 6623471N	lizard traps and rock shelter	15 km SW of Bungalbin
KY22	749259E 6617225N	rockshelter, rock hole and artefact scatter	19 km S of Bungalbin
KY23	747187E 6598126N	gnamma hole and artefact scatter	35 km S of Bungalbin
KY25	718736E 6687012N	stone arrangement, lizard traps, rock holes – Pigeon Rock (SO0529)	16 km N of Windarling
KY26	716727E 6625102N	Stone arrangement, rock holes and artefact scatter – Pearce Stone Arrangement (SO0048)	25 km S of Windarling
KY32	714867E 6634756N	rock hole adjacent to Evanston Road	16 km S of Mt Jackson

Sites of potential significance identified during the indigenous heritage survey.



SITES OF POTENTIAL INDIGENOUS HERITAGE SIGNIFICANCE

Figure 5.16

5.15.2 Native Title

The registered Native Title claimant groups consulted during the ethnographic survey are:

- Ballardong; and
- Central West Goldfields.

Portman have been engaged in talks with the Ballardong (Nyaki Nyaki) and Central West Goldfields native title claimants over a proposed Indigenous Land Use Agreement that covers the study region. As discussed by Clarke (2001), available information suggests that these are the groups that are likely to have the greatest affiliation with the study region, through cultural and genealogical connections and their proximity.

The proposed Land Use Agreement refers to the requirement for the parties involved to enter into the agreement with a strong spirit of reconciliation and cooperation for the purposes of establishing a long term and harmonious relationship. The agreement recognises that the Ballardong and Central West Goldfields people have aspirations which include being able to access and live on their traditional lands and identify and protect Aboriginal sites. Portman will provide compensation for recognition as traditional owners in order that consent will be allowed for the exploration and mining process without further objection or opposition. As part of the Land Use Agreement Portman will use its best endeavours to promote the direct employment of Ballardong and Central West people at its operations in the agreement area. Portmans will make available trainee positions for suitably qualified people, however these opportunities will be limited due to the small size of the workforce. The Aboriginal parties may enter the project area but must allow Portman to conduct mining operations without interference or interruption and in the interests of security, health or safety.

The negotiation process with the native title claimants has been ongoing for a period of 12 months and significant progress has been made towards the development of a Land Use Agreement.

5.15.3 Non-indigenous Heritage

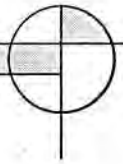
A search has been conducted through the following sources in order to identify any sites of non-indigenous heritage that may be contained within the project area:

- Register of the National Estate Database – Australia's national inventory of natural and cultural heritage places compiled by the Australian Heritage Commission, the Commonwealth Government adviser on the National Estate.
- Register of Heritage Places - Heritage Council of Western Australia. This focuses on places, buildings and sites and is a list of places considered worth conserving. The Heritage of Western Australia Act 1990 is official recognition by the community of its cultural heritage significance to Western Australia.
- Shire of Yilgarn Municipal Inventory List – The Heritage Inventory process focuses on events and developments in Western Australian history since the arrival of European settlers. The inventory also includes buildings and sites associated with present day activities in the area.

The search yielded the following results:

- Register of the National Estate Database

Mt Manning Nature Reserve (C 36208). A 'C' class reserve which lies to the northeast of the proposed Koolyanobbing Expansion Area, the Reserve covers approximately 153,290 ha and lies 70 km north of Koolyanobbing. The site is particularly concerned with the preservation of natural mulga associations and many rare plants. It will not be



disturbed by the proposed development since it is some 20 kilometres from the project area at its nearest point. There are no other features included in the Register of the National Estate Database in the vicinity of the project area.

- Register of Heritage Places WA. Three sites were identified in the general vicinity but outside the immediate project area:
  1. Koolyanobbing Fire Station (Historic Site). Located on Fitzgerald Street, Koolyanobbing.
  2. Mt Jackson Graves and Cemetery – a burial place for about seven people. Located on Mt Jackson station, the cemetery is in an open space near the homestead. The area lies approximately 15 km to the west of Mt Jackson.
  3. Mt Jackson Homestead. The explorer Gregory named Mt Jackson in 1846. A development started after gold was found in the area. Two hotels, the homestead and station were developed around this time (c.1895). The site lies approximately 15 km west of Mt Jackson itself and the nearest mine area.
- Shire of Yilgarn Municipal Inventory List. This is not a statutory list although the local government (Shire of Yilgarn) has recommended management Categories (A-D) based on the level of significance with A having the highest level of protection. Several sites were identified but none are within the limits of the project area, as follows:
  1. Golden Valley Five Stamp Battery – Approximately 8 km from Bullfinch, near Golden Valley (Site # 13, Management Category B);
  2. Golden Valley Mine Site – Approximately 8 km from Bullfinch near Golden Valley (Site # 14, Management Category B);
  3. Mt Jackson Graves & Cemetery – Mt Jackson Station (Site # 37, Management Category D);
  4. Mt Jackson Homestead - Mt Jackson Station (Site # 38, Management Category D); Water Supply Places (Management Category D).
  5. Site #59.7 Eenuin Well/Tank - Near Golden Valley, adjacent to the Mt Jackson Road. Located to the southwest of the project area; and
  6. Site #59.10 Marda Dam – Located between Mt Jackson and Windarling, just off the Bullfinch-Evanston Road.

Category D sites are considered 'significant but not essential to an understanding of the history of the district'.

5.15.4 Demography

The Koolyanobbing Expansion area lies within the Shire of Yilgarn. The Shire encompasses an area of approximately 30 000 square kilometres and caters for a population of approximately 3 000 people. The Shire is centred on the town of Southern Cross, situated 370 km east of Perth and 52 km south-south-west of Koolyanobbing. Towns within the Shire of Yilgarn are Southern Cross (the administrative centre), Bodallin, Bullfinch, Koolyanobbing, Marvel Loch and Moorine Rock.

The township of Koolyanobbing was established following interest in iron ore at the Koolyanobbing Range in the 1950s. A rail link was laid down that passed through Koolyanobbing and ore was transported to Kwinana by the then owners, BHP, who operated the mine from the mid 60's. As mining fell away the town was abandoned in 1983 with the closure of the mine, until being reactivated by Portman in 1994/95. The population of the town has fluctuated with the fortunes of the mine over the years, but currently includes 60 to 70 people in the mine camp with the great majority in single quarters. Some workers on the mine also commute from Southern Cross.

6.0 BIOPHYSICAL

Environmental issues relating to the Koolyanobbing Expansion Project have been developed by the EPA based on experience of similar projects in Western Australia. In addition, the Guidelines which detail the factors, environmental objectives and work required have been subject to comment by relevant Government agencies and were released for a 14 day public review period.

This Section discusses each environmental factor as it applies to the mining and transportation corridor components of the overall proposal. Each factor includes reference to the EPA objective, the policy and technical framework which applies to that factor, predicted and potential environmental impacts and management of the proposal to achieve the EPA objective and concludes with a statement of the predicted outcome and Portmans' Commitments to that objective.

An Environmental Management Plan (EMP) will be the main operational tool through which effective and consistent management of environmental issues will be achieved. The EMP is the principal supporting document for the PER and includes environmental management of all issues discussed in this PER document, as addressed in Part 3 under the following headings:

BIOPHYSICAL

- Vegetation Communities
- Rare and Priority Flora
- Terrestrial Fauna
- Specially Protected (Threatened) Fauna
- Watercourses
- Groundwater
- Landscape Values

POLLUTION MANAGEMENT

- Surface Water Quality
- Groundwater Quality
- Solid Waste
- Dust/Particulates
- Noise

SOCIAL SURROUNDINGS

- Aboriginal Culture and Heritage
- Non-indigenous Heritage

DECOMMISSIONING AND REHABILITATION

6.1 VEGETATION COMMUNITIES

6.1.1 EPA Objectives

- *Maintain the general abundance and diversity of species.*
- *Maintain the geographic distribution and productivity of vegetation communities.*

The State and Federal Government has endorsed the National Strategy for Conservation of Australia's Biological Diversity and the National Strategy for Ecologically Sustainable Development which require the protection and preservation of biological diversity. In particular one of the core Ecologically Sustainable Development objectives is to "...protect biological diversity and maintain essential ecological processes and life support systems."

6.1.2 Potential Impacts

The Koolyanobbing Expansion project will require the clearing of land for pit areas, the construction of mining associated infrastructure (e.g. waste dumps, plant, access roads, accommodation villages and mine site buildings) and the transportation corridor (rail line and acess road). This clearing will result in the loss of vegetation and a corresponding area of fauna habitat.

During the construction period the main impact of the Project on vegetation communities will be as a result of land clearing for mining infrastructure and pits.

Indirect impacts on vegetation could include the following:

- the risk of weed introduction or spread; and
- dust generation.

With regard to the transportation corridor, potential impacts may also include alteration to surface drainage patterns and increase in fire frequency within the study area.

6.1.3 Predicted Impacts

6.1.3.1 Proposed Mine Areas

Impacts from Clearing

The total area of clearing required for the proposed mine areas and associated infrastructure is approximately 93 ha at Mt Jackson and 480 ha at Windarling. The estimated area of vegetation that would be cleared for the mine pits and associated waste dumps is detailed below:

Tenement	Deposit (estimated area of clearing in hectares)			
Mt Jackson	J2 pit (14)	J2 dump (37)	J3 pit (4)	J3 dump (4)
Windarling	W1 pit (52)	W2 pit (56)	W3 pit (93)	W4 pit (7)
	W1/W2 dump (137)	W3/W5 dump (81)		

As discussed in Section 5.8 both the Mt Jackson and Windarling areas contain site specific vegetation that is restricted to these areas in addition to widespread vegetation types. The geographic distribution of vegetation at Mt Jackson and Windarling will only be maintained if restricted vegetation communities are not significantly impacted or where representative examples are left intact.

Impacts to vegetation communities at Mt Jackson and Windarling based on the current proposed locations of mine areas are shown in Tables 6.1, 6.2, 6.3 and Figure 6.1.

Table 6.1: Summary of Predicted Outcome – Vegetation

Component	Proposal	Area to be cleared	Vegetation Communities to be affected #
Mt Jackson	Excavation of pits	18 ha	Widespread in region – E1, E2
	Waste dumps	41 ha	Widespread over range – S1
	Associated infrastructure	34 ha	Restricted – S3, S5
	Accommodation Village	25 ha	Widespread in region – A1, E2
Windarling	Excavation of pits	210 ha	Widespread in region – E2, A1
	Waste dumps	219 ha	Widespread over range – S2
	Associated infrastructure	60 ha	Restricted – S4, S6, S9
TransportationCorridor	Railway construction	500 ha	Eucalypt Woodlands, Acacia Shrublands, Sandplain communities

Categories of distribution are;
- Widespread in region
- Widespread over ranges and geographically restricted
- Restricted over ranges and geographically restricted

Impacts from weeds

The spreading of weeds can arise as a result of earthmoving activities and vehicle movements. Weeds can be a major cause of disturbance to native vegetation because they compete with native species for space, nutrients and water, and alter the composition and structure of vegetation communities. These problems may be particularly acute in the ground layer where introduced grasses and herbs invade and then preclude other species. In some cases weeds may carpet the ground, thereby minimising opportunities for seedlings to establish.

Within the project area weed invasion has not previously been significant because of the relative isolation of the area, hence although not considered 'pristine', the area has been relatively unaffected by weed introductions. Gibson *et al.* (1997) recorded only 21 introduced species (303 natives) in the Helena and Aurora Range and Gibson and Lyons (1997) recorded only four weeds (213 natives) from the Mt Manning range area. These introduced species are principally daisies (Asteraceae), grasses (Poaceae) and herbaceous plants. Weeds may have been introduced to the area previously as a result of pastoral activity, exploration by mining companies and general passage of people through the area.

Ruby Dock (*Acetosa vesicaria*) invades a variety of habitats, and in some habitats has a serious impact on the lower stratum of the vegetation, especially loamy sites lower in the landscape. In drier areas it has less impact but would still displace populations of annual flora species. As it is quite visually prominent, even in low numbers, control and eradication of this weed is possible but would have to be carried out before populations became large to be practical. Ruby Dock is currently distributed in areas around Koolyanobbing, including along roads, but was not recorded elsewhere in the project area. It is important to ensure that this species is not spread into areas disturbed by the proposed development.

Species that are not spread by general mining operations (i.e. from the movement of vehicles and earthmoving equipment) are not considered within the scope of Portman's proposed Weed Management Plan. The Management Plan will include a number of methods to reduce the invasion and spread of environmental weeds into the project

area and to ensure that declared weeds are not introduced into the area. Impacts from weeds are therefore expected to be minimal.

Impacts from Dust

The main sources of dust will be from earthmoving activities, vehicle traffic on access roads and haul roads and from blasting and ore handling during mining of the ore. The generation of dust would pose a risk to nearby vegetation because it accumulates on the leaf surfaces of plants, thereby reducing the ability of the plant to photosynthesise. This is expected to be a limited localised impact in that it may affect vegetation along access roads and particularly along haul roads, but only impinges on plants within a few metres of the road.

6.1.3.2 Transportation Corridor

Impacts from Clearing

The Transportation Corridor as currently planned crosses a series of vegetation types which includes Eucalypt Woodlands (principally York Gum and Salmon Gum), Acacia Shrublands, Chenopod steppe (associated with saltlakes), Sandplain vegetation and patches of localised vegetation associated with granite outcrops.

The corridor will generally be 50 metres wide and will consequently occupy an area of approximately 600 hectares that will need to be cleared. Principal vegetation communities that will be affected are the Eucalypt Woodlands and Sandplain vegetation.

No restricted or significant vegetation communities will be disturbed.

Linear Utilities – powerlines, tracks, roads, pipelines

Linear utilities will traverse country along existing alignments such as roads or will follow the proposed Transportation corridor

Impacts predicted include alteration to drainage resulting from the making of tracks which may influence stream and sheet flow patterns. Generally the impact when streams are crossed is very localised, however, when tracks are made across gentle slopes which have Mulga (Acacia aneura and related taxa) stands on them the impact can potentially be significant. This impact will be limited by careful selection of the layout of the tracks. Stands of Mulga exist in the northern part of the project area near Windarling but are relatively limited in extent and are not expected to be susceptible due to topography and the patchily distributed nature of this vegetation type in the area.

6.1.4 Management

6.1.4.1 Proposed Mine Areas

Management and monitoring of vegetation impacts are addressed in detail in the mining Environmental Management Plan (EMP) for the project. Strategies to be employed in the management of impacts associated with vegetation in the mine areas will include:

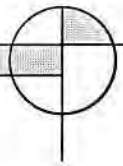
- Baseline botanical surveys for all disturbance areas to delineate the extent and distribution of vegetation communities;
- Botanical surveys to document locations of any significant vegetation communities;

- Damage to vegetation will be minimised by a 'minimum clearing' policy, with areas to be cleared only when required and necessary;
- Clearing boundaries to be well defined in the field;
- Personnel will be educated as to the importance of adhering to clearing limits to minimise disturbance to existing vegetation;
- Site disturbance will be minimised, with vegetation retained between facilities;
- Vehicles will only use designated tracks and park in allocated areas;
- Stripping and stockpiling of top soil, vegetation debris, logs and leaf litter for later reuse;
- Disturbed areas to be recovered with topsoil to a depth of 100 mm, where practicable;
- Identification of environmentally/ecologically sensitive areas e.g. creekline vegetation, or vegetation identified of moderate to high conservation value;
- Local provenance seed material to be used for seeding during rehabilitation;
- Implemention of a Weed Management Plan for the Project incorporating information from botanical surveys, and involving monitoring for weeds/introduced plants and periodic spraying or other means undertaken to control weeds;
- Quantitative monitoring of vegetation regrowth in rehabilitated areas;
- Areas displaying inadequate regrowth will receive remedial work;
- Rehabilitation will occur progressively as soon as cleared areas (e.g. roads, construction access tracks) are no longer required;
- Topsoil and plant debris to be returned to the floor and slopes of the pit, which will be contour ripped, where practicable, to promote vegetation regrowth; and
- Dust suppression techniques will be applied to reduce the impact to adjacent vegetation from excess dust, including regular watering of haul roads and work areas.

6.1.4.2 Transportation Corridor

Portman propose the following management measures associated with the construction of a transport link between the proposed mine sites and Koolyanobbing:

- Fire prevention, reporting and procedures to follow in the event of a fire;
- Each locomotive and grinding machine will be required to carry at least two fire extinguishers, and each welding operation carries a fire extinguisher;
- Rail grinding will not be undertaken on days of extreme fire danger, and a full time watch will be kept behind the grinding machine for fires;
- Railway access roads to be built to the minimum safe width to minimise impact area;
- Incidental areas disturbed during construction and access roads no longer required will be rehabilitated promptly following construction;
- Floodways and culverts to be used where necessary to minimise changes to natural surface drainage;



- Borrow pits will be rectangular in shape with the long axis parallel to any nearby public access roads; and
- Vegetation and topsoil to be stripped from borrow pits and access tracks and used for subsequent rehabilitation. Procedures for rehabilitation are detailed in the project EMP.

6.1.4.3 Linear utilities: pipelines, powerlines, roads and tracks

Direct impacts will be minimised by applying the environmental management procedures proposed for the mine areas, as described in Section 6.1.4.1, and also undertaking the following;

- Careful selection of the layout of tracks so that alteration of drainage does not impact on vegetation and flora; and
- Fire management will primarily focus on restricting public access along private roads and maintenance tracks, and ensuring personnel do not undertake activities which could result in fires.

6.1.5 Predicted Outcome

The predicted outcome for the Koolyanobbing Expansion Project is;

- Loss of vegetation in areas of direct impact through clearing.

The predicted outcomes for particular components of the project include 93 ha and 490 ha to be cleared in the Mt Jackson and Windarling areas respectively (Table 6.1).

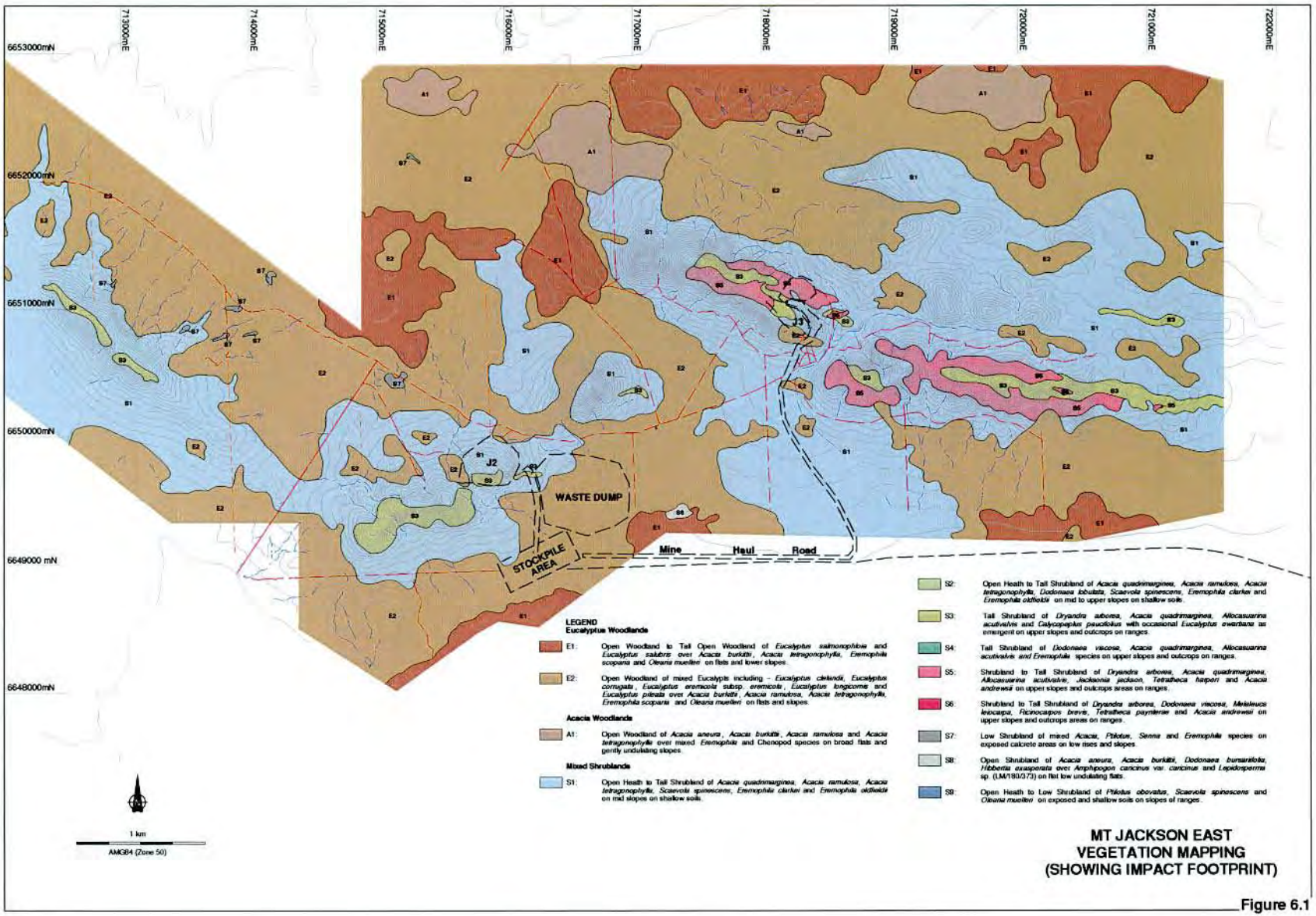
The restricted vegetation communities on Windarling will be the most severely impacted from the proposed operations. Community type S6, and to a lesser extent, S4, S9 and S2 respectively, will be significantly reduced in area due to direct clearing of the vegetation. The predicted outcome of disturbance on vegetation types is summarised in Table 6.2.

Based on the information provided in Tables 6.2 and 6.3 it can be seen that the highly restricted S8 community should not be impacted by the currently planned mine development, although the alignment of haul roads will have to take into account the location of this community.

The restricted communities S5 and S3 will have minor impact from the J3 and J2 pit and waste dumps. These communities are restricted to a limited area on the ranges and impacts will be minimised in order to retain representation of these vegetation types. Communities S3, S4 and S9 will have varying degrees of impact from the proposed operations. Although moderately widespread over the Mt Jackson range, S3 will only be minorly affected, whilst community types S4 and S9 will be affected significantly at Windarling (Figure 6.2). Widespread communities such as S1, A1, E1 and E2 will not be significantly impacted by the proposal.

Table 6.2: Predicted Impact from Specific Mine Deposits on Geographically Restricted* Vegetation Communities in the Windarling Ranges.

Vegetation Community under Potential Impact	Mine Deposit	Area of Vegetation Community over Deposit (ha)	% of Vegetation Community Impacted by by Deposit (by area)	Significance of Impact (0 – none, 0-5% - negligible 5-20% - not significant >20% - significant)
S2 community				
total area of S2 = 191.3 ha	W1	15.1	8%	not significant
	W2	8.2	4%	negligible
	W3	8.8	5%	negligible
	W4	0	0%	none
	W5	24.4	13%	not significant
	Access Road	1.9	1%	negligible
	TOTAL	58.3	30%	significant
S4 community				
total area of S4 = 36.7 ha	W1	3.1	8%	not significant
	W2	4.5	12%	not significant
	W3	9.2	25%	significant
	W4	0.0	0%	none
	W5	3.5	9%	not significant
	TOTAL	20.2	55%	significant
S6 community				
total area of S6 = 9.5 ha	W1	0.0	0%	none
	W2	0.0	0%	none
	W3	6.1	64%	significant
	W4	0.0	0%	none
	W5	1.3	14%	not significant
	TOTAL	7.4	78%	significant
S9 community				
total area of S9 = 19.9 ha	W1	0.8	4%	negligible
	W2	2.2	11%	not significant
	W3	4.3	21%	significant
	W4	0.0	0%	none
	W5	1.2	6%	not significant
	TOTAL	8.4	42%	significant



MT JACKSON EAST
VEGETATION MAPPING
(SHOWING IMPACT FOOTPRINT)

Figure 6.1

Table 6.3 : Predicted Impact from Mine Deposits on Geographically Restricted* Vegetation Communities in the Jackson Ranges.

Vegetation Community under Potential Impact	Mine Deposit	Area of Vegetation Community over Deposit (ha)	% of Vegetation Community Impacted by by Deposit (by area)	Significance of Impact (0 – none, 0-5% - negligible 5-20% - not significant >20% - significant)
S1 community				
total area of S1 = 1613.4 ha#	J2	16.2	1%	negligible
	J3	2.2	0%	none
	Haul Road	8.5	1%	negligible
	TOTAL	26.9	2%	negligible
S3 community				
total area of S3 = 81.1 ha #	J2	2.2	3%	negligible
J3	2.2	3%	negligible	
Haul Road	0.3	0%	none	
	TOTAL	4.6	6%	not significant
S5 community				
total area of S6 = 66 ha	J2	0.0	0%	none
	J3	3.4	5%	negligible
	Haul Road	0.0	0%	none
	TOTAL	3.4	5%	negligible

The S1 and S3 communities extend outside the survey area (see Appendix C) and therefore the Total Area value is an underestimate and the subsequent % Impact values is an overestimate.

Commitment 1 – Environmental Management Plan

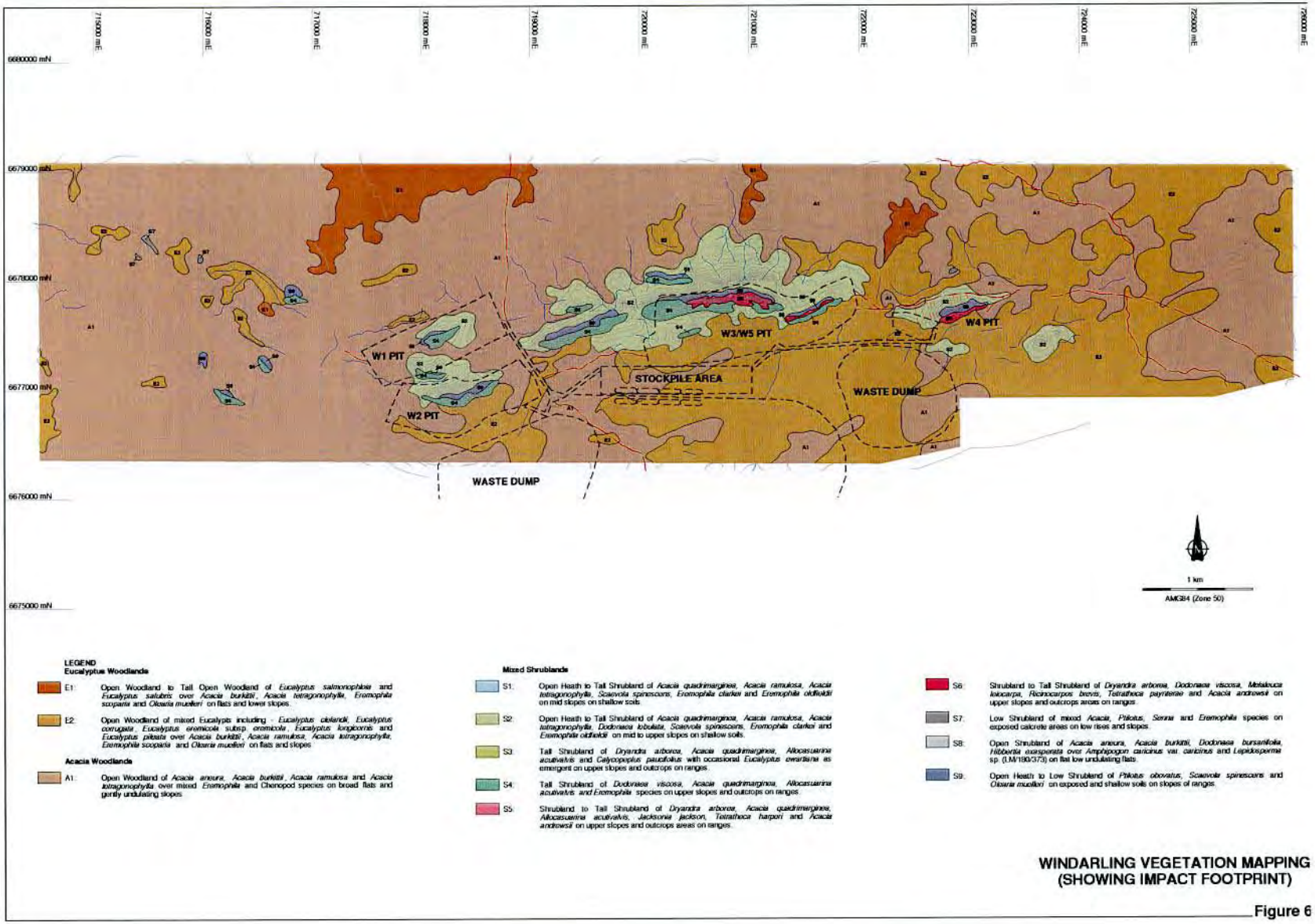
As part of the EMP for the project, areas disturbed during construction and mining will be rehabilitated and revegetated by Portman.

Commitment 4 – Flora and Vegetation Surveys

Additional flora and vegetation surveys of areas to be disturbed but not yet surveyed.

Commitment 11 – Weeds

Portman will develop and implement a Weed Management Plan, including implementation of weed hygiene procedures.



WINDARLING VEGETATION MAPPING (SHOWING IMPACT FOOTPRINT)

Figure 6

6.2 RARE AND PRIORITY FLORA

6.2.1 EPA Objectives

- *Protect Declared Rare and Priority Flora, consistent with the provisions of the Wildlife Conservation Act 1950 and the Environment Protection and Biodiversity Conservation Act 1999 .*
- *Protect other flora species of conservation significance.*

The policy framework is set by the *WA Wildlife Conservation Act 1950.* Declared Rare Flora (DRF) are protected under *the Western Australian Wildlife Conservation (Rare Flora) Notice 2001* of the *Wildlife Conservation Act 1950.* The notice lists protected flora taxa that are extant and considered likely to become extinct or rare. The Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*, lists Endangered, Vulnerable, or Extinct Species.

The flora surveys commissioned by Portman have added significantly to the existing knowledge of the status of flora species within both the project area and broader region, and a number of species of conservation interest have been identified.

6.2.2 Potential Impacts

Both direct and indirect impacts can potentially result during the construction and operation phases of the mine and can include removal of individuals and partial loss of populations of species of Declared Rare/Priority status or taxa of Conservation Significance. Direct impacts from clearing and mining operations are the principal potential impacts to Rare and Priority Flora.

6.2.3 Predicted Impacts

The predicted impacts on Rare and Priority Flora species are outlined in Table 6.4.

Table 6.4: Locations of rare flora in areas to be impacted

Species	Status	Location	Predicted impact
Tetratheca paynterae	DRF	W3, W4, W5	This species is extensively distributed along the W3 deposit, and appears to be poorly represented elsewhere. The proposed W3/W5 mine pit will directly impact a large proportion of the existing population of this DRF species.
Ricinocarpos brevis	P1	W1, W2, W3, W4, W5; J2	Individuals of this species were recorded at the J2 deposit, and at locations on each of the deposits at Windarling. These populations will be impacted by the proposal.
Jacksonia jackson	P2	J2, J3	This species has been recorded at several locations at the J2 deposit and at various locations on the edge of J3 and will be impacted.

The DRF species *Tetratheca harperi* has not been recorded on the proposed disturbance area for the J2 or J3 deposits but does exist in nearby areas along the ranges, within a few hundred metres of the J3 deposit.

Along the transportation corridor limited flora surveys have been undertaken, as the exact alignment of the railway has not yet been determined. Many of the potential species of conservation interest will not be affected by the

alignment because it will only directly impact a strip of vegetation approximately 50m wide. Final placement of the railway will depend on consideration of both engineering and environmental factors, such as the location of flora of conservation significance.

6.2.4 Management

Portman will comply with the requirements of the Wildlife Conservation Act and Environment Protection and Biodiversity Conservation Act by undertaking the following:

- Rare Flora baseline surveys will be conducted for all disturbance areas and locations of any Declared Rare and Priority Flora taxa are to be incorporated into an Environmental Geographical Information System (GIS) and plotted onto maps;
- Endeavour to avoid impact to species of Declared Rare and Priority flora or Conservation Significance by using information from flora surveys conducted in the area;
- Measures to limit the extent of vegetation clearing, e.g. marking clearing limits;
- Propagation and incorporation of Rare and Priority Flora taxa into revegetation programmes;
- Existing procedures for vegetation management listed in Section 6.1 will be applied;
- Consistent with existing vegetation management procedures, areas will be re-surveyed if information from the existing surveys does not provide sufficient information about the location of such species;
- Liase with CALM regarding the management of Rare, Priority and Significant Flora; and
- Portman will prepare and implement a Threatened Flora Management and Conservation Plan for the Project to address management of Threatened Flora impacted by the proposed development.

6.2.5 Predicted Outcome

There is one DRF and 2 Priority Flora that are likely to be affected by the proposed operations in the Jackson (J2, J3) (Figures 6.3, 6.4 and 6.5) and Windarling Ranges (W1 to W5) (Figures 6.6 and 6.7). The other Rare and Priority Flora present in the project area are located well outside the proposed mine disturbance footprint, and therefore will not be directly affected by the operations. Based on the current location of mining infrastructure and plans the following outcome is expected:

Windarling

Tetratheca paynterae (DRF)

By comparing the locations of *T. paynterae* individuals and the location of the proposed mine plans, it was possible to determine the impact of the proposed operation on the population. It was found that 2536 individuals of *T. paynterae* will be removed by the preferred mine plan (approximately 89% of the total population) (Table 6.5), with the majority of plants being from W3. The western portion of W3 (314 individuals) and the 2 plants on W4 will be left untouched. If W3 was removed from the current operational plans however, the majority of *T. paynterae* individuals will remain (96%).

Ricinocarpus brevis (P1)

As *R. brevis* is widely spread over the ironstone ridges of Windarling, there will be an impact from the proposed operations on the populations of this species. Approximately 62% of the estimated total population of 8128 individuals would be affected by the proposed operations (5047 individuals). The W3 deposit is by far the largest contributor to this impact, with 40% (3220 plants) of the total population being removed (Figure 6.7). Although W5 is targeted for mining, the smaller hills between W3 and W2 are not, and hence *R. brevis* will not be impacted by the proposed operations here.

Mt Jackson

Tetratheca harperi (DRF)

T. harperi will not be directly or indirectly affected by the proposed mine plan (Figure 6.3).

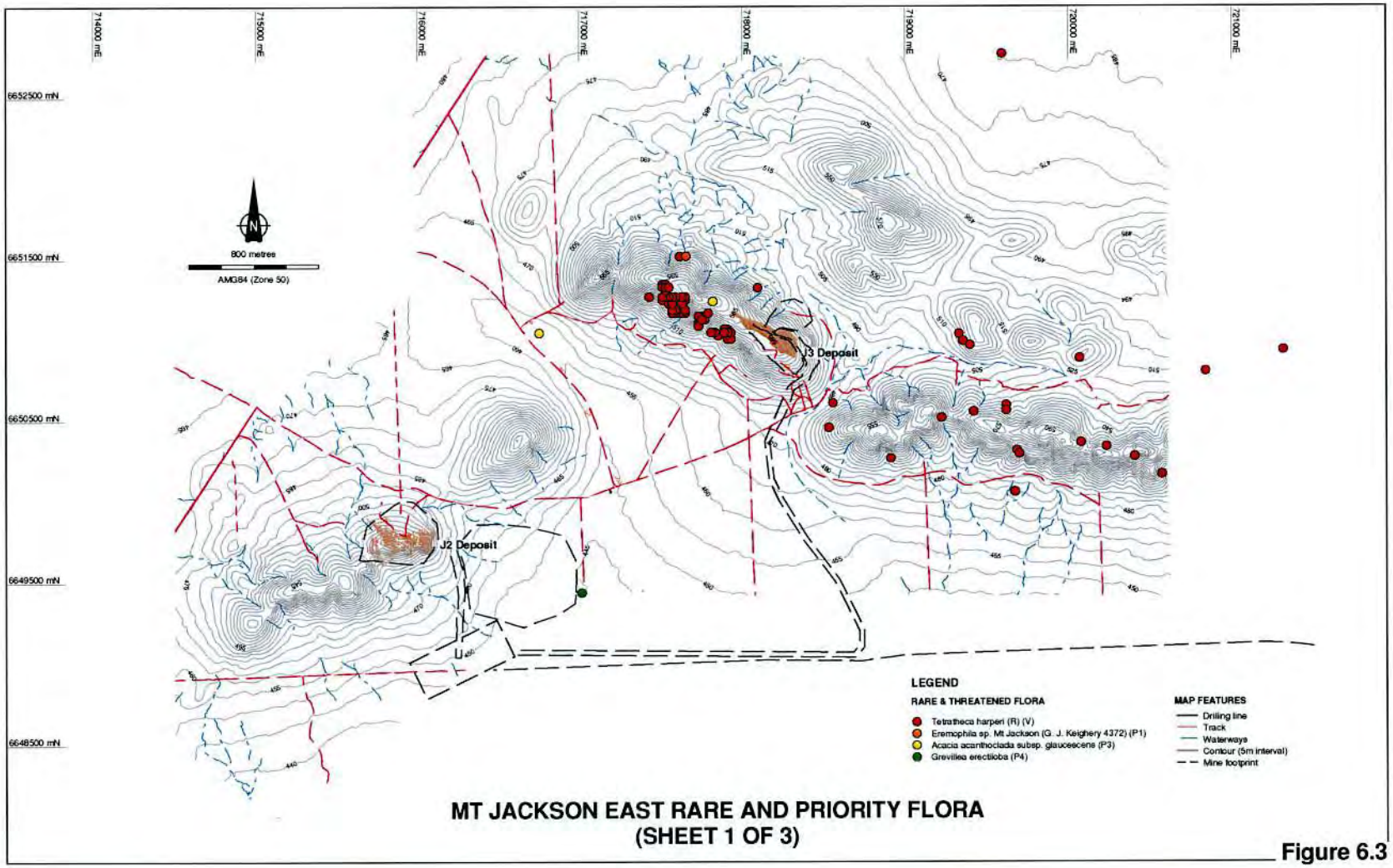
Jacksonia jackson (P2)

It is calculated that the mine plan will directly remove approximately 3600 plants of *Jacksonia jackson.* This represents 7% of the total estimated population of plants for the whole Jackson Range and 5% of the total area of the species distribution (Table 6.6). Due to the widespread nature of the species and the small area of impact from the Mt Jackson deposits, this species will receive limited impact.

Other Rare and Priority Flora taxa in the project area are unlikely to be impacted because they lie in lowland areas that are not proposed to be mined, or they lie along portions of the ranges that are not in the areas of the deposits. Taxa that occur in proximity to the proposed mine operations include *Eucalyptus formanii* (P4), *Spartothamnella puberula* (P2), *Eremophila* sp. Mt Jackson (P1), *Acacia acanthoclada* subsp. *glaucescens* (P3) and *Grevillea erectiloba* (P4) at Mt Jackson, and *Eucalyptus formanii* (P4) at Windarling (Figures 6.3 to 6.7).

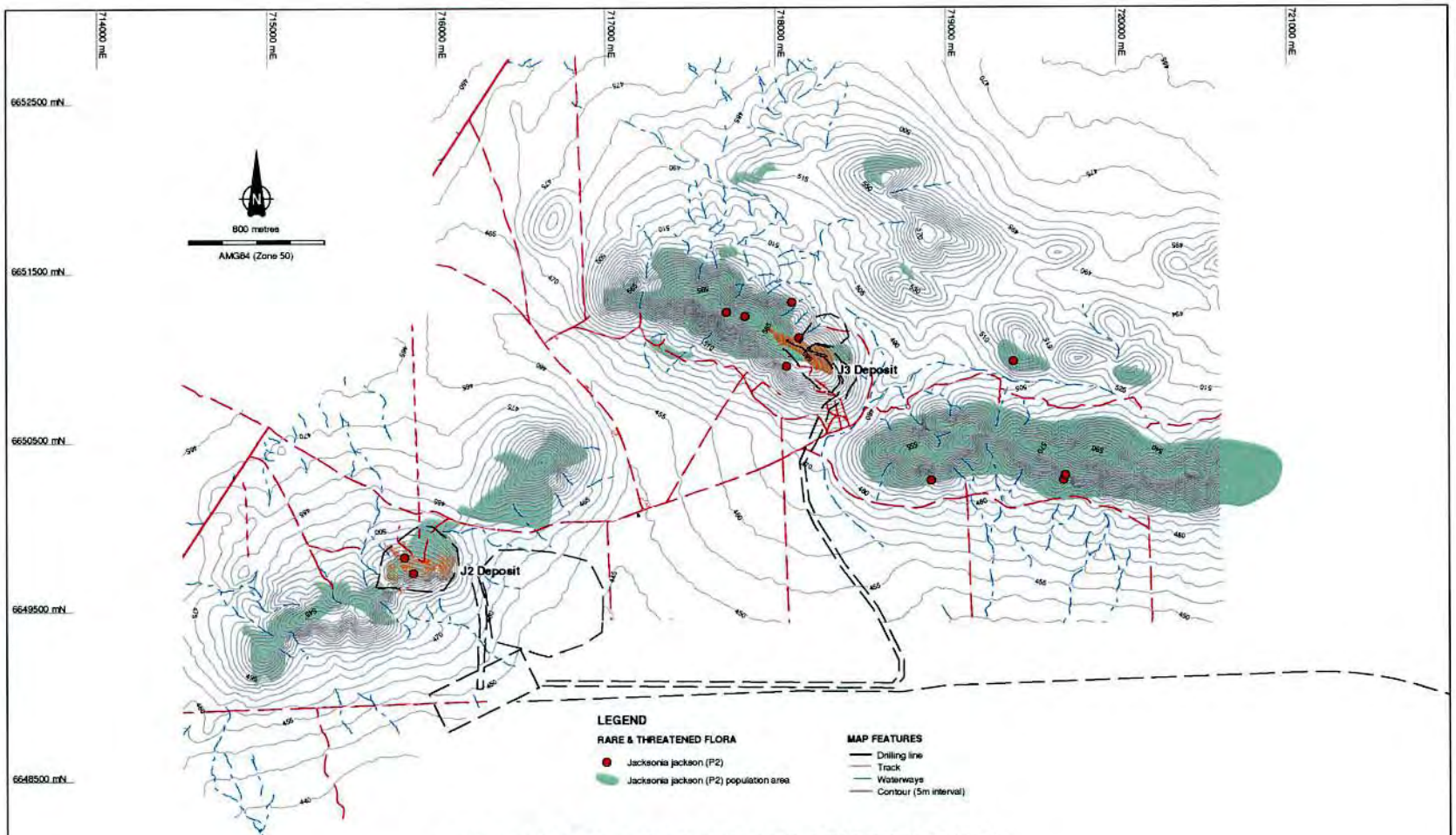
Commitment 5 – Rare and Priority Flora Surveys
Additional surveys for Rare and Priority Flora in areas to be disturbed but not yet surveyed.

Commitment 6 – Threatened Flora Conservation and Management Plan



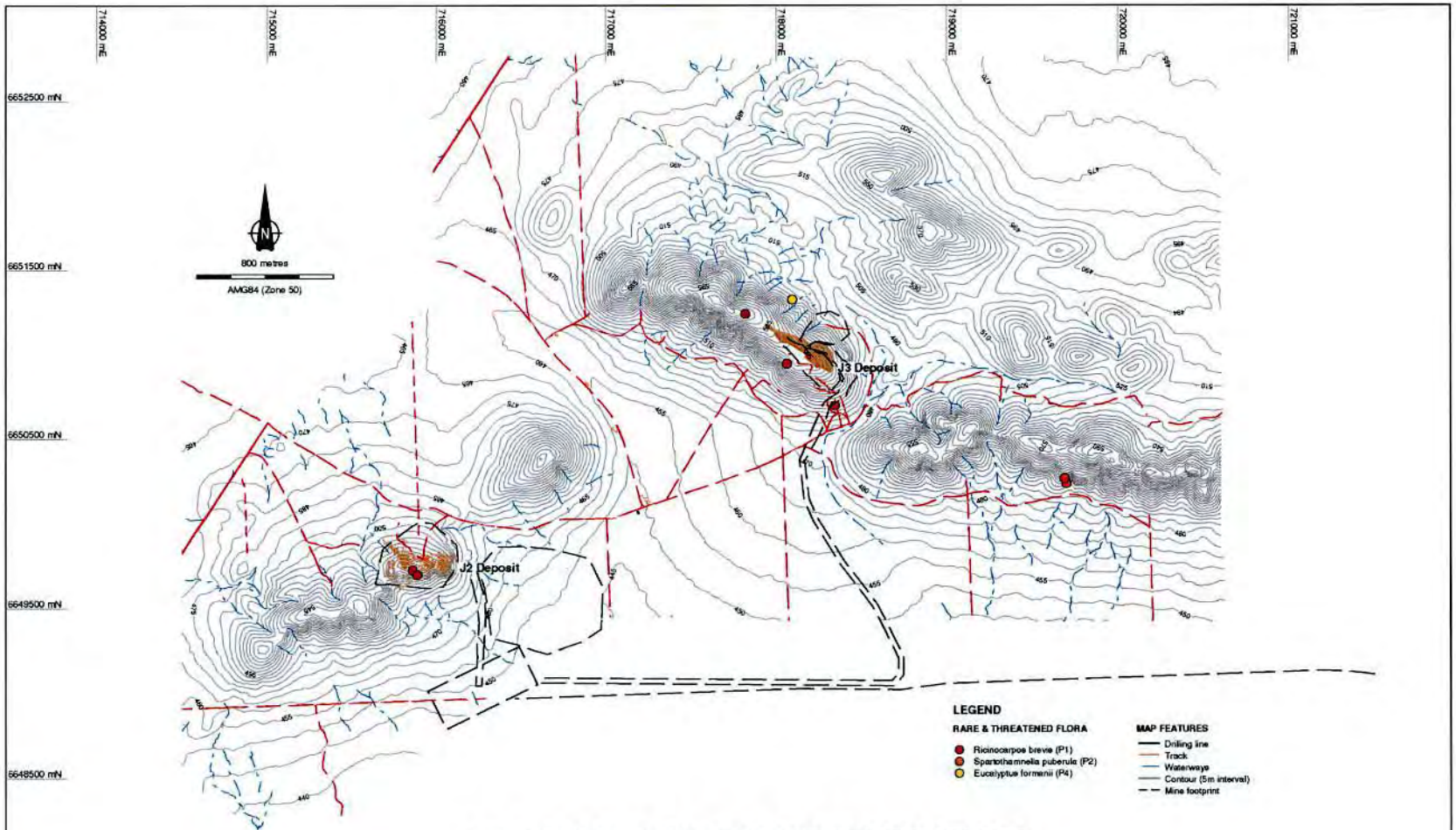
MT JACKSON EAST RARE AND PRIORITY FLORA
(SHEET 1 OF 3)

Figure 6.3



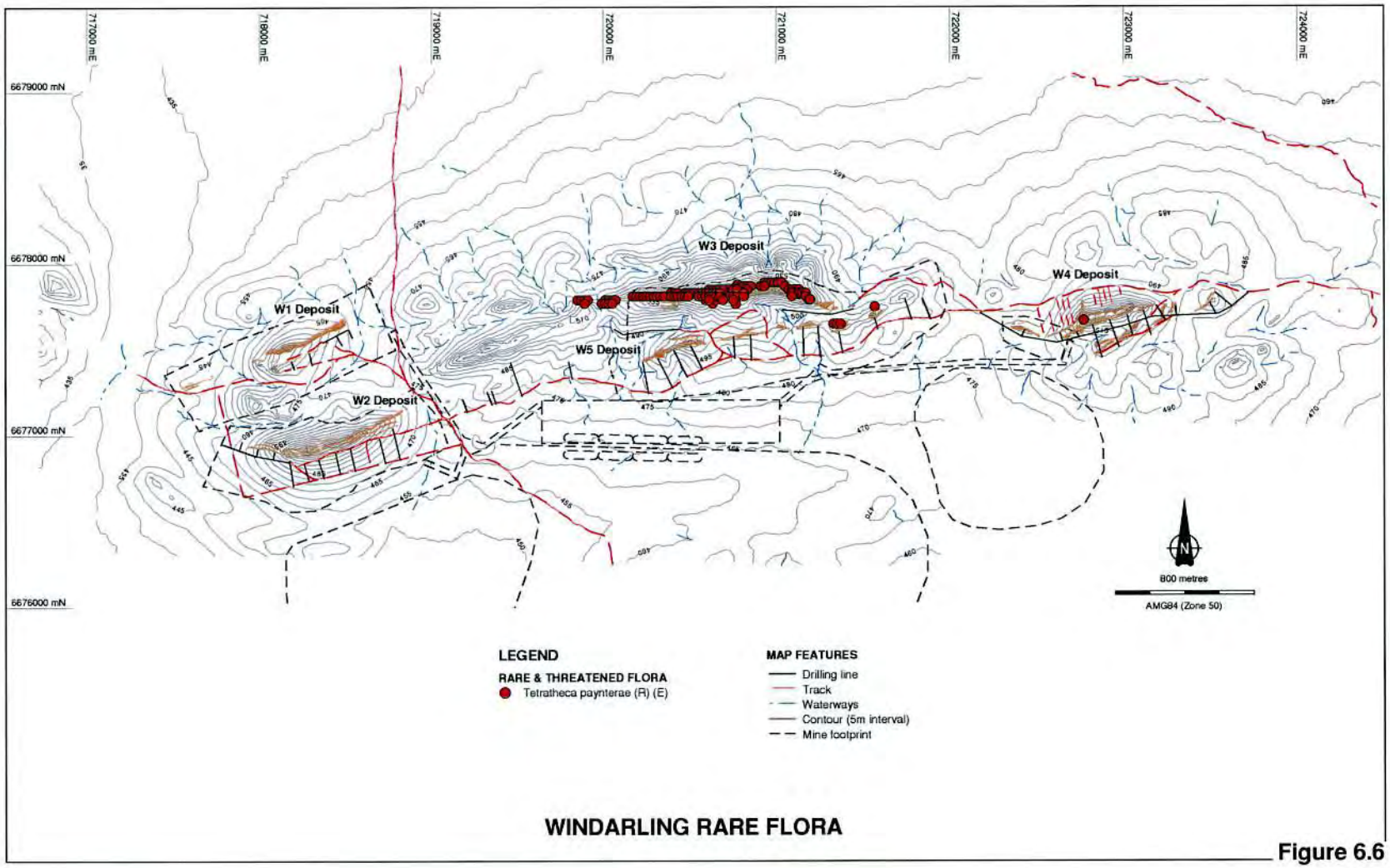
MT JACKSON EAST RARE AND PRIORITY FLORA
(SHEET 2 OF 3)

Figure 6.4



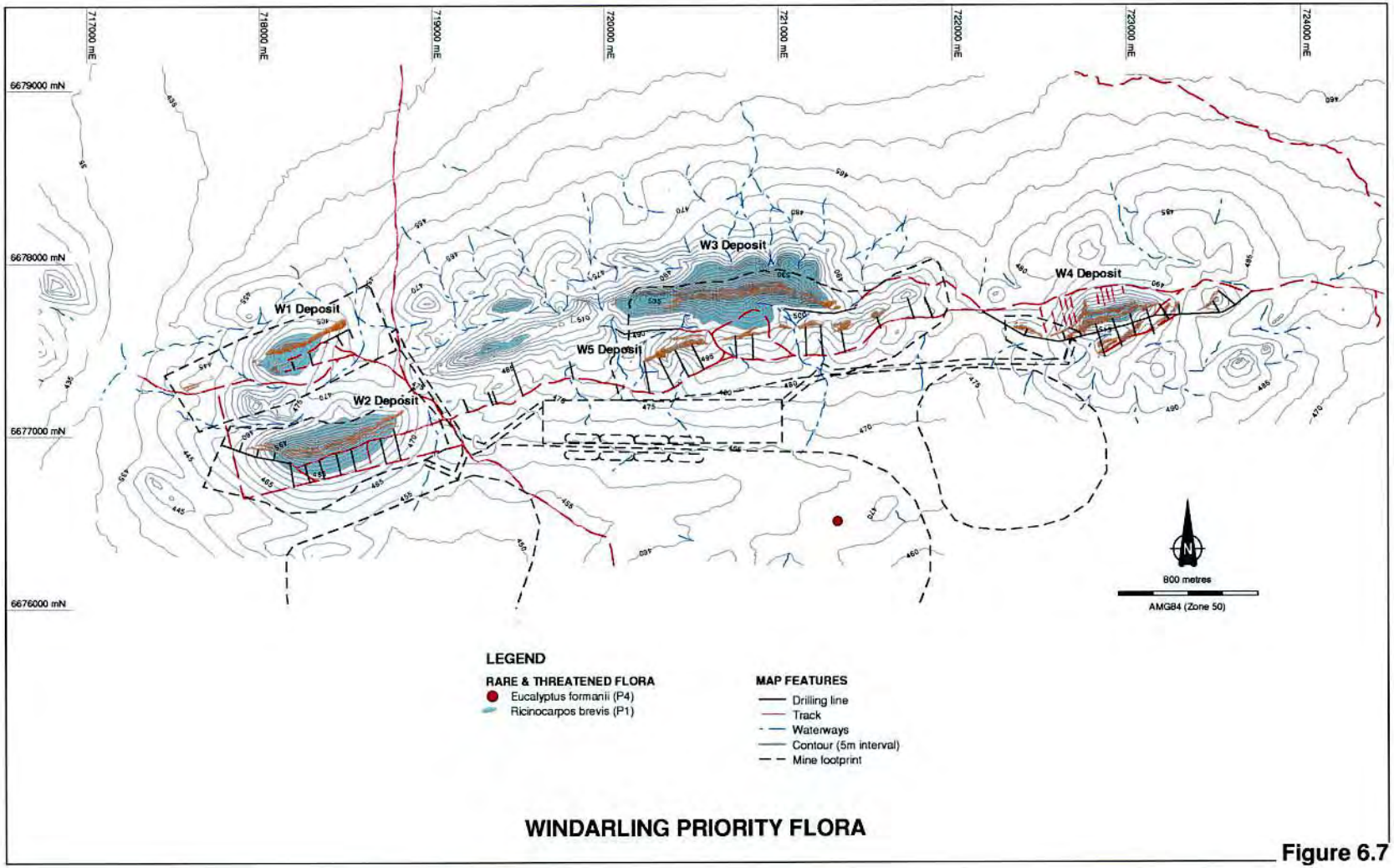
MT JACKSON EAST RARE AND PRIORITY FLORA
(SHEET 3 0F 3)

Figure 6.5



WINDARLING RARE FLORA

Figure 6.6



WINDARLING PRIORITY FLORA

Figure 6.7

Table 6.5 : Predicted Outcome for Windarling – Rare and Priority Flora

Species	Mine Deposit	Area of Plant Population over Deposit (ha)	% of Plant Population Impacted by Deposit (by area)	Estimated Number of Plants over Deposit	% of Plant Population Impacted by Deposit (by number of plants)
Tetratheca paynterae (DRF)	W1	0	0%	0	0%
	W2	0	0%	0	0%
	W3	3.2	80%	2413	85%
	W4	0	0%	0	0%
	W5	0.2	6%	123	4%
	TOTAL T. paynterae on Deposits	3.5	86%	2536	89%
	TOTAL T. paynterae Not on Deposits	0.5	14%	316	11%
	TOTAL T. paynterae	4.0	100%	2852	100%
Ricinocarpos brevis (P1)	W1	3.6	9%	546	7%
	W2	4.5	11%	670	8%
	W3	16.1	39%	3220	40%
	W4	0	0%	0	0%
	W5	4.1	10%	611	8%
	TOTAL R. brevis on Deposits	28.3	69%	5047	62%
	TOTAL R. brevis Not on Deposits	12.5	31%	3081	38%
	TOTAL *R. brevis*	40.8	100%	8128	100%

Calculated from data collected by ecologia dataset 2001 and Mattiske (2001a,b,c).
* Numbers of plants were derived from plant density data and general species distribution (ecologia, dataset 2001), plus gridded surveys (Mattiske, 2001a).

Table 6.6: Predicted Outcome for Mt Jackson – Rare and Priority Flora.

Species	Mine Deposit	Area of Plant Population over Deposit (ha)	% of Plant Population Impacted by Deposit (by area)	Estimated Number of Plants over Deposit	% of Plant Population Impacted by Deposit (by number of plants)
Tetratheca harperi (DRF)	J2	0	0%	0	0%
	J3	0	0%	0	0%
	TOTAL T. harperi on Deposits	0	0%	0	0%
	TOTAL T. harperi Not on Deposits	111.7	100%	25836	100%
Jacksonia jackson (P2)	J2	8.4	4%	2941	6%
	J3	2.4	1%	659	1%
	TOTAL J. jackson on Deposits	10.8	5%	3600	7%
	TOTAL J. jackson Not on Deposits	191.8	95%	45080	93%
	TOTAL J. jackson	202.6	100%	48680	100%

Species areas are derived from flora surveys by Mattiske (2001a) and Ecologia dataset (2001).
* Numbers of plants were derived from plant density data and general species distribution, plus gridded surveys (Mattiske, 2001a).

6.3 TERRESTRIAL FAUNA

6.3.1 EPA Objectives

- *Maintain the general abundance and diversity of species.*
- *Maintain the general abundance, species diversity and geographical distribution of terrestrial fauna.*

The State and Federal Government endorsed, 'National Strategy for Conservation of Australia's Biological Diversity', and the 'National Strategy for Ecologically Sustainable Development' require the protection and preservation of biological diversity. In particular one of the core Ecologically Sustainable Development objectives is to "...protect biological diversity and maintain essential ecological processes and life support systems."

6.3.2 Potential Impacts

As a result of mining operations and construction of infrastructure a variety of impacts to fauna are possible. These may result directly by excavation of mine pits, construction of the transportation corridor or indirectly due to the disposal of waste material or the creation of stockpile areas, all of which have the potential to destroy or adversely affect fauna and their habitats. Linear infrastructure (Transportation Corridor, pipelines or haul roads), waste dumps and pits may form barriers to some fauna and result in fragmentation and isolation of populations.

Impacts to Fauna

- Introduced Species: An increase in human activity is often associated with an increase in the abundance of introduced species such as the House Mouse *Mus musculus*, Feral Cat *Felis catus* and Fox *Vulpes vulpes*.
- Uncapped Drill Holes / Mine Pits: Uncapped drill holes within an area represent an ongoing impact to terrestrial fauna. Small animals, particularly lizards and small mammals, become trapped in the drill holes and eventually die. Drill holes that are open for periods of years or months can be particularly detrimental to small animal populations (Malnic, 1997). Mine pits can function similarly, although impacting primarily on larger animals such as kangaroos.
- Disturbance: Activity associated with the construction and operation of the mine development may affect nearby fauna. Noise and vibrations associated with blasting and drilling is most likely to cause disturbance.
- Road / Rail Deaths: An increase in road fauna deaths is likely where new roads are constructed, in particular affecting kangaroos, nocturnal birds and ground dwelling fauna. The upgrade of roads linking the three mine sites will facilitate increased traffic flow and greater travel speed with a consequent increase in the number of road fauna deaths. A railway is less likely to result in the deaths of smaller fauna species, however larger animals such as kangaroos may be impacted.

Indirect Impacts to Fauna - Loss of Habitat

Apart from the direct loss of fauna due to clearing, removal of fauna habitat reduces the availability of shelter and foraging areas, and causes displacement of local fauna populations. Loss of fauna habitat may result in reduced species diversity in an area. Loss of species from animal communities may influence ecosystem functioning.

Drainage patterns may be altered by restricting normal flow in creeks and flowlines through the construction of roads or railways or other impediments to natural flow. Alteration in drainage may influence soil moisture and consequently the distribution of flora species and vegetation communities. Though no major watercourses occur in any of the

project areas such impacts could occur to low lying areas such as Cracking Clay habitat along the Transportation Corridor. Other hydrological impacts may include the termination or reduction of run-off drainage from the banded ironstone formations once their topography is altered through mining. The reduction of this drainage has the potential to influence the fauna and vegetation on the outwash plains below these ranges. Hydrological changes would alter the existing environmental conditions and may also influence erosional processes, which are more rapid in areas denuded of vegetation.

Human presence and activity is often associated with a change in fire regimes, leading to degradation of natural ecosystems. The linear nature of the Transportation Corridor and the flammability of the area through which it travels make fire a potentially very significant impact. Fire risk will be greatest during the construction phase of the development.

Summary of potential impacts to fauna:

- Loss of fauna habitat, food and shelter resources;
- Death of non-mobile fauna;
- Reduced abundance of local fauna;
- Predation on native fauna by introduced cats and foxes;
- Competition with and potential displacement of native fauna by introduced species such as the House Mouse and Rabbit;
- Loss of fauna due to uncapped drill holes;
- Disturbance to fauna activity patterns;
- Disturbance to fauna movement patterns through barriers and habitat fragmentation;
- Death or injury to individual fauna;
- Changes to fauna populations;
- Contamination of habitat; and
- Vegetation/ habitat changes.

6.3.3 Predicted Impacts

6.3.3.1 Mine Areas

The principal impact on fauna arising from the development of the Koolyanobbing Expansion Project will be the loss and degradation of fauna habitat through the clearing of native vegetation. Clearing will occur in the mine areas for mine construction, waste dumps, processing infrastructure, workshops, offices, roads, railway and borrow pits.

The nature of iron ore mining is such that localised but complete habitat destruction is inevitable. In this instance habitat removal will specifically affect those species that inhabit the banded ironstone formations. The loss of habitat will involve the destruction of local populations, particularly of ground dwelling fauna, and relocation of individuals to adjacent areas. Species that are dependent on the ironstone areas such as Woolley's Pseudantechinus

Pseudantechinus woolleyae and those that preferentially occupy the range areas such as Little Woodswallow *Artamus minor* are potentially the most likely to be affected.

In addition to clearing, infrastructure associated with the mining development has the potential to fragment habitat. This can result in restricted movements of animals producing an impact upon the community greater than just the area cleared. Such infrastructure includes roads, waste dumps and pits. This effect is minimised when structures are located close together.

Table 6.7: Impacts and their effects and significance to fauna.

Impact	Effect (Nature of Impact)	Intensity[1]	Duration[2]	Scale[3]	Significance[4]
Clearing	1. Loss of fauna habitat, food and shelter resources	Medium	Long term	Local	Medium
	2. Death of non-mobile fauna	High	Short term	Local	High
	3. Reduced abundance of local fauna	Low	Medium term	Local	Low
Feral Fauna	4. Predation on native fauna	High	Long term	Immediate, Local	Low
	5. Competition with and potential displacement of native fauna	Low	Long term	Immediate, Local	Low
Noise	6. Disturbance to fauna activity patterns	High	Short term	Immediate, Local	Low
Vibration	7. Disturbance to fauna activity patterns	Medium	Short term	Immediate, Local	Low
Road/ Train Deaths	8. Death or injury to individual fauna	High	Long term	Immediate, Local	Low
	9. Changes to fauna populations	Low	Long term	Local	Low
Drill Hole Deaths	10. Death of ground dwelling fauna caught in drill holes	Medium	Long term	Local	Medium
Pollutants	11. Contamination of habitat	High	short to long term depending on pollutant	Immediate	Low
Fire	12. vegetation/ habitat changes to High	High	medium to long term		Local Low

[1] High, Medium, Low

[2] Short < 1yr, medium 1-5yr, long > 5yr

[3] Immediate <500m, Local < 2km, Regional < 200km

[4] High, Medium, Low

6.3.3.2 Transportation Corridor

The transportation corridor will impact upon a range of habitats. Impact will be minimised, where feasible, by avoiding sensitive and significant habitats such as Cracking Clay, samphire communities and habitats associated with granite exposures.

The Transportation Corridor, once constructed, will form a barrier to movement for some fauna species. Terrestrial animals including lizards, amphibians, and small mammals may be unable to cross the rail formation, thus diminishing the ability of these species to disperse. Habitat partitioning caused by the railway is also likely to cause disturbance to resident reptile species, small mammals, and territorial birds that live in social groups. Habitats most sensitive to this disturbance are those of small size and dependent faunal assemblages such as Cracking Clay and Mulga habitats. When the corridor is aligned next to existing barriers the impact is minimised.

6.3.4 Management

The management of fauna issues are dealt with in the project EMP and are summarised below:

- Control of clearing activities - Areas of native vegetation to be cleared will be kept to a minimum;
- Clearing will be conducted in stages to allow for the local migration of mobile fauna species into adjacent habitats. In particular, clearing of significant habitats such as Cracking Clay, Mulga, Gorge and Hilltop habitats will be minimised;
- Fragmentation of habitat will be minimised where possible, and will be achieved by grouping mine structures or aligning roads and other infrastructure;
- Vegetation debris, logs and rocks will be returned to areas which have been disturbed as they assist in rehabilitation by providing microhabitats for recolonising fauna;
- Careful consideration will be given to the best location for waste dumps and stockpile areas to minimise loss of fauna habitat;
- Rehabilitation - The primary management strategy involved in addressing clearing of native vegetation and fauna habitats in the project area will be an ongoing rehabilitation programme. The aim of the programme will be to rehabilitate disturbed areas to an array of vegetation types and fauna habitats that reflect the pre-disturbance state as closely as possible in order to create a stable long-term environment;
- All disturbed areas including waste dumps, disused access tracks and other works areas will rehabilitated. Rehabilitation will occur progressively where possible and also following the removal of all structures and equipment upon decommissioning;
- Feral fauna control - The local abundance of feral fauna within the mine area is likely to increase with disturbance of the area. Complete eradication of feral fauna populations is costly and difficult, however, simple measures such as hygienic storage and disposal of foodstuffs will help to maintain populations of these species at a minimum. An attempt will be made to reduce the numbers of feral cats observed in the area by trapping near frequented areas such as rubbish tips and camps. If ongoing monitoring demonstrates that populations of feral fauna have increased dramatically, then control measures will be considered. This may include baiting or direct culling as required.;
- In an effort to control the establishment of feral animals such as goats in the area the proponent will ensure that no unnatural permanent water sources become established that could sustain feral populations;
- No project staff will be permitted to bring pets into the project area;
- Open pits - the boundaries of pits will be fenced or bunded to deter larger animals such as kangaroos and monitors from gaining access. • Borrow pits will have slopes graded to permit safe passage of animals;
- Uncapped drill holes – All drill holes will be temporarily capped on completion of drilling and permanently capped as soonas possible. Drill holes will be regularly monitored to ensure the cap remains in place. Where drill holes are no longer required they will be completely infilled so as to remove the potential threat to vertebrate fauna;
- Vehicles will maintain safe driving speeds to minimise the chance of road fauna deaths;

- Barbed wire fences will not be used in the project area as these can impact upon local bat populations which become caught in the wire;
- The proponent will design and implement an Environmental Induction Program to educate staff and on-site visitors about the environmental management strategies associated with the project, focusing particularly on management strategies directly relevant to the personal actions of on-site staff. In particular these strategies will include the prohibition of firearms and pets within the project area and procedures to follow in the event of encountering significant flora or fauna species, or potentially dangerous fauna species;
- A bushfire contingency plan will be developed that covers the mine area and transportation corridor; and
- All vehicles will carry fire-fighting equipment and staff will be trained in its use.

6.3.5 Predicted Outcome

Based on the current planned locations of mining pits and associated infrastructure there will be a limited loss of fauna habitat and associated direct impacts to fauna individuals and populations. Some loss of larger fauna is expected from road fauna deaths, but these impacts will be minimised by appropriate management.

The localised abundance of feral fauna will be reduced through appropriate management in consultation with CALM (refer to Malleefowl Conservation Plan).

The regional impact on fauna is expected to be negligable as representation of fauna habitats and their associated communities will be maintained in the project area and surrounds.

6.4 SPECIALLY PROTECTED (THREATENED) FAUNA

6.4.1 EPA Objective

- *Protect Specially Protected (Threatened) Fauna consistent with the provisions of the Wildlife Conservation Act and the EPBC Act.*

The policy framework for this environmental factor is provided by the *Wildlife Conservation Act 1950* and the *Environment Protection and Biodiversity Conservation Act 1999.*

6.4.2 Potential Impacts

Five species of fauna recorded during the fauna survey have the potential to require special management due to their recognised conservation significance. The CALM Priority fauna species Australian Bustard *Ardeotis australis* (P4) was also recorded in the project area (Table 6.7).

Table 6.7: Potential impacts to Rare Fauna

Species	Status	Potential impact
Malleefowl *Leipoa ocellata*	Vulnerable (EPBC Act) Schedule 1 (WA)	Malleefowl are particularly vulnerable to disturbance because they require adequate leaf litter and generally sandy soils to facilitate mound construction. They are also extremely vulnerable to predation by Foxes. K nown areas supporting Malleefowl and their nest mounds include Sandplain habitat along the Transportation Corridor and several locations around the base and on the lower slopes of Jackson Range.
Peregrine Falcon *Falco peregrinus*	Schedule 4 (WA)	Two individuals of this species were recorded in the Windarling area. This species is wide ranging but utilises specific, inaccessible areas on cliff faces for breeding purposes. Sites in the project area on the exposed cliffs, gorges and outcrops may be suitable breeding sites for this species.
Carpet Python *Morelia spilota imbricata*	Schedule 4 (WA)	This subspecies of the Carpet Python occurs in the south-west of the State and is near the inland limit of its distribution within the project area. A Carpet Python was observed in the Windarling area in September 2001. Limited potential loss of habitat including refuge sites may occur. The species utilises Eucalypt Woodland habitats which are widespread and abundant in the region.
Pink Cockatoo *Cacatua leadbeateri*	Schedule 4 (WA)	This species was observed at lowland sites in the project area including between Windarling and Mt Jackson and along the Transportation Corridor. The Pink Cockatoo also utilises Eucalypt Woodland habitats which are widespread and abundant in the region.
Rainbow Bee-eater *Merops ornatus*	JAMBA & CAMBA	The migratory Rainbow Bee-eater was recorded on several occasions in the project area including near to proposed mine areas and along the Transportation Corridor. This species is seasonally common and abundant and will be impacted by the proposal.

6.4.3 Predicted Impacts

The development will impact upon a range of fauna habitats including those of limited distribution. Each of the banded iron formation ranges at Mt Jackson and Windarling represent a discrete unit of a poorly represented Goldfields habitat type.

Predicted impacts to Significant Fauna and their associated habitat include:

- *Malleefowl Leipoa ocellata:* There will be negligable loss of some habitat near mine areas, although mine pits will not directly impact Malleefowl habitat. Nesting mounds will not be impacted by the proposed development (refer to Malleefowl Conservation Plan). Possible loss of individuals from road fauna deaths although signage in Malleefowl habitat will limit vehicle speeds.

- Peregrine Falcon *Falco peregrinus:* The proposed development will alter the habitat of possibly a small number of resident individuals, including Cliff and Ridge habitat at Windarling that are potential roosting and nesting areas. Overall the impact to the species is negligible.
- Major Mitchell Cockatoo *Cacatua leadbeateri:* The Transportation Corridor may reduce the number of available nesting hollows through the loss of trees in Eucalypt woodland. The potential impact to the species is considered to be negligible.
- Carpet Python *Morelia spilota imbricata:*. Very limited loss of habitat, in particular the sheltered sites amongst the ranges. This species is expected to be widespread though at low densities in the surrounding Eucalypt Woodlands. The potential impact to this species is considered negligible.

6.4.4 Management

One fauna species that occur in the Project Area is of conservation significance and warrants special consideration in the environmental management of the development. The following management measures are outlined in the project EMP:

- Management measures as detailed in Section 6.3 for terrestrial fauna;
- Areas of particular significance such as Malleefowl habitat will be avoided;
- Effective management decisions on significant species such as Malleefowl, require knowledge of their distribution and conservation status. A targeted Malleefowl survey to determine the distribution and abundance of Malleefowl within the project area will be conducted;
- Implemention of a Malleefowl Conservation Plan for management of local Malleefowl populations. Malleefowl will be monitored to ensure that they are not being directly affected by the project; and
- Habitats and fauna species of conservation significance require special consideration in relation to the location of developments within the project area. Where possible proposed infrastructure such as waste dumps, haul roads and rail lines will be located to avoid impacting areas deemed as preferred habitat for rare species. Areas known to support Malleefowl and in particular active mounds will not be disturbed; and
- Impact to Sandplain and Eucalypt Woodland areas along the Transportation Corridor and Rocky Gorge areas in the ranges will be minimised so as to reduce potential impacts to local Pink Cockatoo and Peregrine Falcon populations.

6.4.5 Predicted Outcome

Impacts to rare fauna include limited loss of suitable habitat in the Windarling mine area for Peregrine Falcon.

Implementation of the Malleefowl Conservation Plan will ensure that there are no direct impacts to Malleefowl or their mounds within the project area.

Commitment 7 – Fauna Surveys
Additional targeted surveys for Rare and Priority Fauna, of areas to be disturbed but not yet surveyed.

Commitment 8 – Malleefowl Conservation Plan
Portman will develop and implement a Malleefowl Conservation Plan for the project area, including detailed survey of proposed impact areas for Malleefowl and their mounds.

6.5 WATERCOURSES

6.5.1 EPA Objective

- *Maintain the integrity, functions and environmental values of watercourses and sheetflow.*

The EPA's 'Guidelines for Environment and Planning' (EPA, 1997) provides management advice for watercourses and rivers. The EPA's Guidelines do not provide a specific buffer width which appears to be applicable to the conditions encountered for this proposal, but it does provide a list of factors that should be considered in determining an appropriate buffer width from watercourses and rivers.

The EPA's guidelines seek an assessment of the potential impacts on surface water flow rates, drainage patterns, sediment transport and wetlands, as a result of mining activities and railway construction. Sediment transport and other potential pollution-related impacts are considered in Section 7.1 - Surface Water Quality.

6.5.2 Potential Impacts

As no dewatering is planned at the mine sites, and due to the absence of any sizeable watercourses or rivers in the vicinity of the proposed mines, impacts associated with surface drainage are not likely to be significant. There will be some negligable alterations to existing minor drainage lines that periodically contain surface water as it passes from upland to lowland areas.

Potential impacts associated with the transportation corridor or any roads that will be constructed may include the diversion or alteration of watercourses that exist. An increase in surface water run-off in areas near roads may also be expected, which may affect the quality of nearby watercourses as discussed in Section 7.1.

6.5.3 Predicted Impacts

6.5.3.1 Proposed Mine Areas

Since there is minimal development of surface water drainage features in the upland mine areas there is little or no need for watercourses to be diverted or altered due to mining activities. Disturbance of intermittent flows in minor drainage lines in midslope and lower slope areas may influence localised soil moisture conditions.

6.5.3.2 Transportation Corridor

Much of the area along the Transportation Corridor consists of relatively flat country and there is minimal development of watercourses. The Transportation Corridor as currently planned, passes to the east of Lake Deborah and to the south-west of an intermittent watercourse in the area of Clarkson Flat, thereby avoiding potential drainage areas. The Corridor then passes across an area of Sandplain and continues northward through the Jackson Range.

The Corridor has the potential to affect surface water flow in intermittent streams and areas of sheet flow. Intermittent streams flow on a seasonal basis whereas areas of sheet flow and continuous drainage are likely to exist only after intense rainfall following cyclonic activity. Drainage culverts along the Transportation Corridor will be designed to adequately dispose of storm water in drainage channels and maintain surface water flows. Sheetflow will be maintained in broad valley landform areas by installing multiple culverts and through the use of contour dispersion channels. This ensures that run-off water is redistributed as sheet flow downstream of the railway embankment.

Roads will include culverts to accommodate high volumes of surface run-off following significant rainfall events.

6.5.4 Management

Environmental management of watercourses in the project area will include:

- Structures within the mine area will be located to minimise alterations to surface drainage. Of special consideration in the Transportation Corridor is the potential effect on Cracking Clay environments.
- Drains and culverts will be incorporated at appropriate points along the length of the rail line and roads in order to minimise disruption to existing patterns of water flow. Design of culverts will minimise upstream flooding and downstream erosion.
- The alignment of the railway will avoid areas that have the potential for sheet flow where practicable. Effective management of these areas will require special engineering works to maintain flow regimes.
- Disturbance to minor drainage lines in midslope and lower slope areas of the ranges will be minimised so as to maintain current (episodic) flow regimes.

6.5.5 Predicted Outcome

Negligible impact is expected in the vicinity of the proposed mines due to the absence of clearly defined watercourses.

The impact on watercourses as a result of the construction and operation of the transportation corridor is expected to be negligible due to the minimal relief and consequently poor development of drainage systems and the absence of susceptible vegetation types in the project area.

6.6 GROUNDWATER

6.6.1 EPA Objective

- *Maintain (sufficient) quantity of groundwater so that existing and potential uses, including ecosystem maintenance, are protected.*

The Water and Rivers Commission (WRC) has responsibility for issuing groundwater extraction licences and ensuring that such licences take into account environmental impacts. Groundwater licences are issued as either exploration or production licences. The WRC must be satisfied that the groundwater resources are sufficient for the proposed abstraction. Saline groundwater resources are considered to be non-renewable.

6.6.2 Potential Impacts

Groundwater extraction licences will only be required to supply water for construction and the dust management programme. Dewatering is not currently planned at the mine sites hence the quantity of groundwater at the mine areas will not be significantly affected.

Preliminary water demand estimates for construction of the railway, minesite construction and mine operation are as follows (Rockwater, 2001):

	Saline water (kL/d)	Sub-potable water (kL/d)
Railway construction	3000 to 4000	1000
Minesite construction	1500 to 2500	500
Mine operation	1000 to 1500	<500

Due to the absence of surface water and the need to use water as part of the ongoing dust management programme groundwater will need to be extracted to meet this demand. This would result in a localised reduction in groundwater volume. As the groundwater is saline (10-35000 mg/L) to hypersaline (>35000 mg/L), vegetation and habitats surrounding haul roads may be adversely affected by the dust suppression spraying operations. Adverse effects on fringing vegetation are often apparent at salinities greater than 2000 mg/L (Pen, 1999).

6.6.3 Predicted Impacts

As a result of extraction to meet dust suppression requirements there will be a localised reduction in groundwater volume at bore sites. The volume of water extracted is not likely to be sufficient to create a drawdown detrimental to the surrounding environment.

Saline groundwater extracted for dust suppression may have adverse effects on localised vegetation along haul roads.

6.6.4 Management

- Monitoring wells will be installed to record groundwater levels in the vicinity of bores to ensure that drawdown does not reach undesirable levels.
- Dust suppression spraying on haul roads will be contained by the use of a restricted spraying device that broadcasts water only onto the road and not on adjacent vegetation.
- Spoon drains along haul roads will be used to collect excess water from dust suppression sprays. The residual salt remaining from evaporation of the excess saline water will be periodically removed by scraping and removed to a suitable location for disposal.

6.6.5 Predicted Outcome

It is predicted that groundwater levels in the area of bores will drop marginally. There is currently limited information concerning groundwater in the area and determinations of the distribution and extent of aquifers will need to be made to allow adequate assessment.

There will be some limited disturbance to vegetation along haul roads due to the use of saline water for dust suppression, but this should be minimised by limiting spraying to road surfaces.

Commitment 9 – Groundwater
Portman will implement a monitoring plan to ensure that groundwater levels are not significantly reduced in and near extraction areas.

6.7 LANDSCAPE VALUES

The landscape assessment is a combination of two distinct aspects - visual impacts in terms of the extent to which the development will be visible in the landscape, together with the physical impact of the placement of the mining operation on the structure of the landscape itself. The landscape assessment is therefore carried out at two levels - in relation to the impacts on the site context (public roads or amenity areas) and in relation to the impact with the site itself (on site character).

Guidelines that have been used in the assessment of visual amenity are:

- Department of Minerals and Energy Guidelines for Mining in Arid Environments (DME, 1996) which specifies minimum technical criteria that should be met in mining landform construction and takes into account the potential for erosion and progressive revegetation and rehabilitation of overburden waste dump sites; and
- Australian and New Zealand Minerals and Energy Council (ANZMEC) 'Strategic Framework for Mine Closure' (2000) Guidelines.

6.7.1 EPA Objective

- *Manage and mitigate impacts to landscape values.*

In order to meet this objective the following scope of works was proposed in the EPA Draft Guidelines:

- Assessment of potential impacts of the proposal on existing landforms/landscape values.
- Evaluation of the landscape values of the project area and how these will be affected by the proposal and proposed measures to manage such impacts; and
- Details of measures proposed to rehabilitate the impacted areas to an acceptable standard and which will integrate the post mining landform with the surrounding environment.

In accordance with EPA requirements, a visual assessment of the proposed mine sites and transportation corridor was undertaken to identify potential areas of significant visual impact and recommend measures to mitigate impacts to landscape values.

6.7.2 Potential Impacts

Temporary and permanent changes to landforms result from mining operations. The stability and visual characteristics of the permanent new landforms can pose long term liabilities.

The construction and operation of a mine will require the clearing of vegetation, stockpiling of overburden and waste rock, excavation of pits as well as the placement of infrastructure such as crushers and workshops on the site. The construction of a transportation corridor will require cuts and fills as well as the placement of rail lines and associated infrastructure. All of this can create a negative impact on the environment and although all of the infrastructure can be removed on decommissioning, the physical scars of mining on the landscape can be significant and long term. The minimisation of visual amenity impacts through screening and sensitive placement of infrastructure is therefore a significant aspect of mine planning.

6.7.3 Predicted Impacts

The area directly affected by the proposed mines is relatively small in the context of the region, and is in a relatively remote area. Environmental disturbance will be contained as far as possible to the deposits and areas immediately adjacent. Topographic changes will occur as the existing profile of the landscape will be altered due to the presence of open-cut pits and mine waste dumps. The decommissioned mining pits will remain inconsistent with the surrounding landform.

Short to medium term changes to the landscape will include:

- Access and haul roads;

- Processing plant, offices, workshops, powerlines; and
- Laydown and other work areas.

Permanent alterations to landforms will occur as a result of:

- Mine Pits;
- Waste stockpiles;
- Railway formation and cuttings; and
- Borrow pits.

Many of the facilities associated with operation of the mines will be visible from the air. Some of the mine scars on hills will be partially visible from public access roads because the ironstone hills are prominent features in the landscape. However, the area is isolated and is subject to low levels of visitation by members of the public.

Apart from excavation of ore bodies and the creation of open pits, the main visual impact will be from waste dumps constructed alongside each pit, covering an area of 41 and 219 ha respectively for Mt Jackson and Windarling, which will have a negative impact on visual amenity. At Mt Jackson the J2 waste dump will be observable abutting the ranges when approached from the south along the Bullfinch-Evanston Road but will be obscured once past Mt Jackson (Figure 6.8 and 6.9). The J3 waste dump will generally be obscured by the intervening ranges but will be observable from some portions of the Bullfinch-Evanston Road to the north of Mt Jackson (Figure 6.8 and 6.10). At Windarling the two waste dumps will be barely observable, if at all, over the treetops in the distance (minimum of 4.5 and 7 km away) along the southern approach on the Bullfinch-Evanston Road (Figure 6.1).

Mt Jackson

As all deposits are located at elevated locations within the ironstone ranges, it will be impossible to screen mine sites from every angle. The J2 mine area is well screened from the north by the surrounding hills. Similarly, J3 is well screened from the east and south-east by Muddarning and Yenganning Hills. Natural screening in the form of vegetation and trees includes woodland and shrubland vegetation.

J2 and J3 will be visible from the west as they are located close to the Bullfinch-Evanston Road, which runs from SW to NE, and the natural screening of trees does not completely conceal the view (Plate 1). This road is an unsealed minor road and carries limited traffic, primarily people travelling to stations to the north.

However, for the most part trees and vegetation will screen the J3 mining operation (Plate 2), and to a lesser extent J2. Generally, the public will not have clear views from any other angles, except from some of the unsealed exploration tracks in the immediate vicinity.

Windarling

Deposits in the Windarling area lie from four (W4) to 10 (W1) kilometres to the west of the unsealed Bullfinch-Evanston Road (Plate 3). Natural screening in the area consists of low woodland vegetation and shrubs, principally of the genus *Acacia*, and intervening hills.

There are no public roads or vantage points within close proximity to the proposed Windarling mine although there are various unsealed pastural and exploration tracks in the area.

Mt Manning Nature Reserve lies northeast of Windarling but views of the northern deposits from the reserve are limited due to the considerable distance (approximately 30 km) involved (Plate 4).

Range Landscape

Within the Koolyanobbing wider region there are a number of ranges and associated hills across the landscape. The most well known formations include the Helena and Aurora, Die Hardy and Koolyanobbing Ranges (Figure 6.12). Some ranges are in close proximity to each other, for example the Windarling and Die Hardy Ranges (10-15km), whilst the Mt Manning Range in the north of the region is approximately 100km from the Highclere Hills in the south. In terms of the relevant landscape features of this study, this is the furthest extent of range systems from each other.

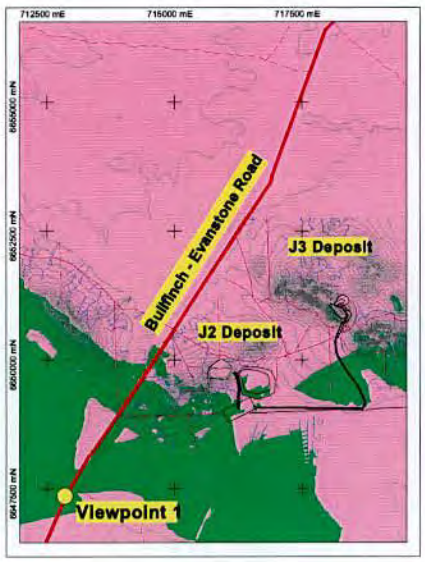
There will be a negligible impact to the Jackson Range, as only 4% of it will be directly removed by the operations. For the region as a whole, there will be a loss of approximately 0.28% of the range systems in the landscape (Table 6.9).

There will be a major impact to the local landscape values at Windarling, although this will be negligible on a regional scale. The Windarling Ranges contribute 2% (796ha) of the total Banded Ironstone Formations (BIF) in the wider region and of this, approximately 70% will be altered due to the proposed operations. Although a major portion of the range will be impacted, this is about 1.71% of the BIF ranges in the region, and is considered negligible on a regional scale.

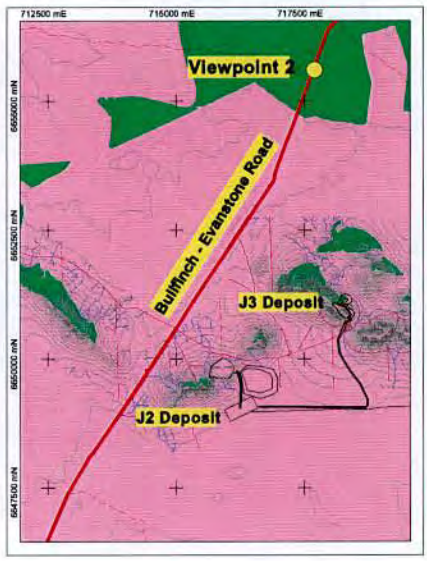
Overall, the impact on the landscape features from the proposed operations at Mt Jackson and Windarling is minimal for the region as a whole. Approximately 2% of the Banded Iron Formations of the region will be directly impacted upon.

Table 6.9 : Impact to Range Landscape in Region.

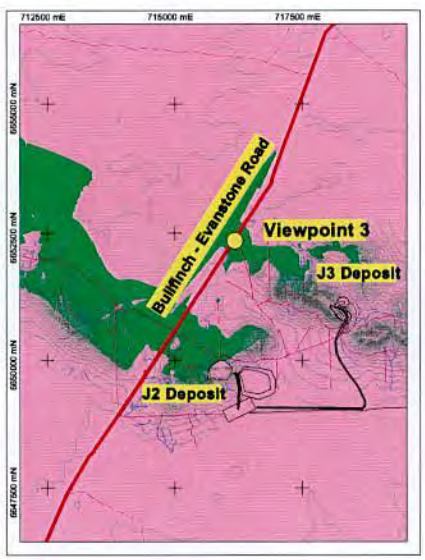
Range Formation	Area of Range or Footprint (ha)	Area of Range as a % in Region	Area affected by Mine Footprint (ha)	% Impact on Range	% Impact on Region
Johnston Range	666	2%	0	0%	0%
Yokradine Hills/ Die Hardy Ranges	4301	13%	0	0%	0%
Mt Manning Range	779	2%	0	0%	0%
Windarling Range	796	2%	560	70%	1.71%
Jackson Range	2180	7%	92	4%	0.28%
Helena and Aurora Range	4339	13%	0	0%	0%
Range east of Helena and Aurora Range	1719	5%	0	0%	0%
Koolyanobbing Range	4583	14%	0	0%	0%
Woongaring Hills to The Sisters – Highclere Hills	13379	41%	0	0%	0%
TOTAL	32742	100%	652		1.99%



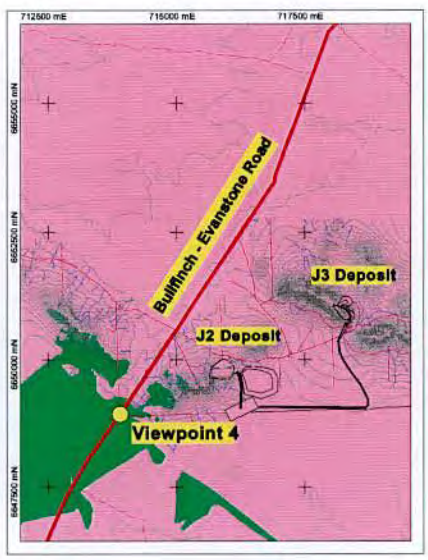
Visibility from Viewpoint 1



Visibility from Viewpoint 2



Visibility from Viewpoint 3



Visibility from Viewpoint 4

Visibility Legend

- Invisible
- Visible
- Viewpoint Location

N

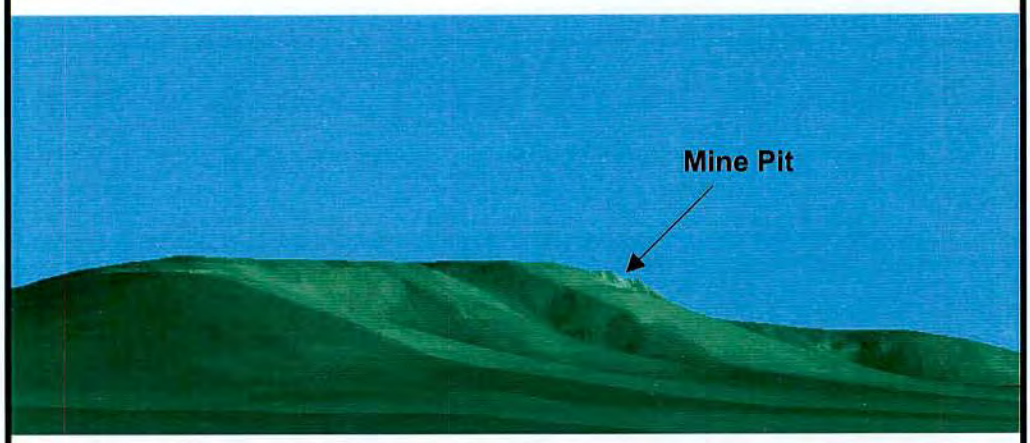
0 4km

Datum: AMG84 (Zone 50)

MOUNT JACKSON VISUAL AMENITY

Figure 6 .8

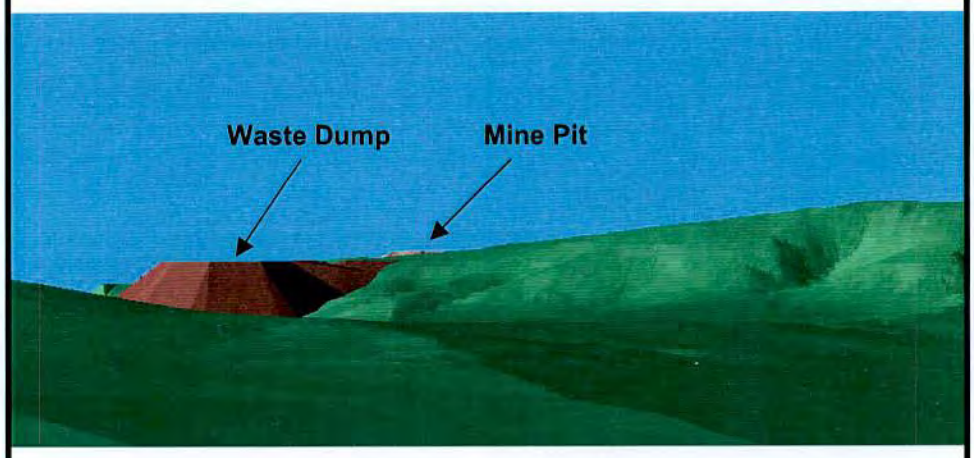
Mount Jackson – Pre Mining
Visibility from Viewpoint 1



Mount Jackson – Post Mining
Visibility from Viewpoint 1
Looking North East towards Deposit J2

Figure 6.9

Mount Jackson – Pre Mining
Visibility from Viewpoint 2



Mount Jackson – Post Mining
Visibility from Viewpoint 2
Looking South towards Deposit J3

Figure 6.10

Plate 1: Southern approach to J2 along the Bullfinch-Evanston Road.

Plate 2: Northern approach to J3 along the Bullfinch-Evanston Road.

Plate 3: Windarling from the Bullfinch-Evanston Road.

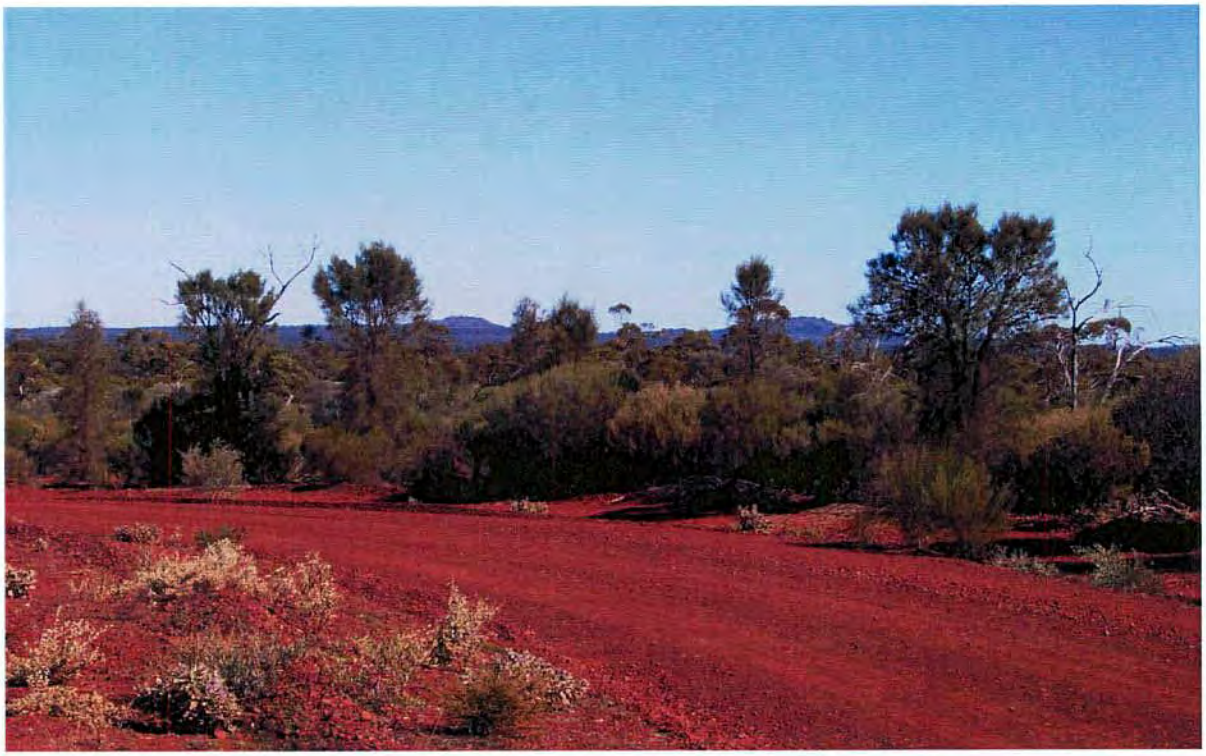
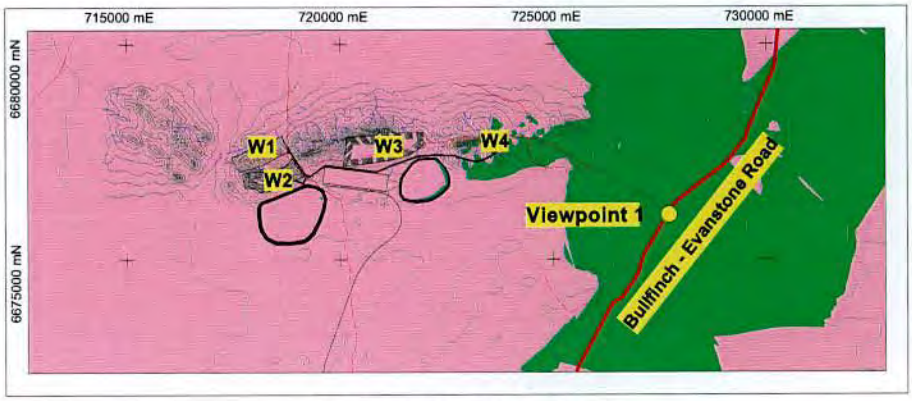
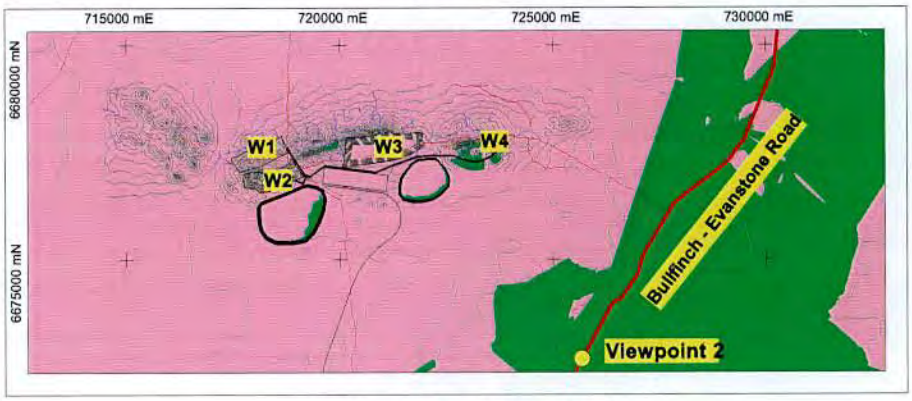


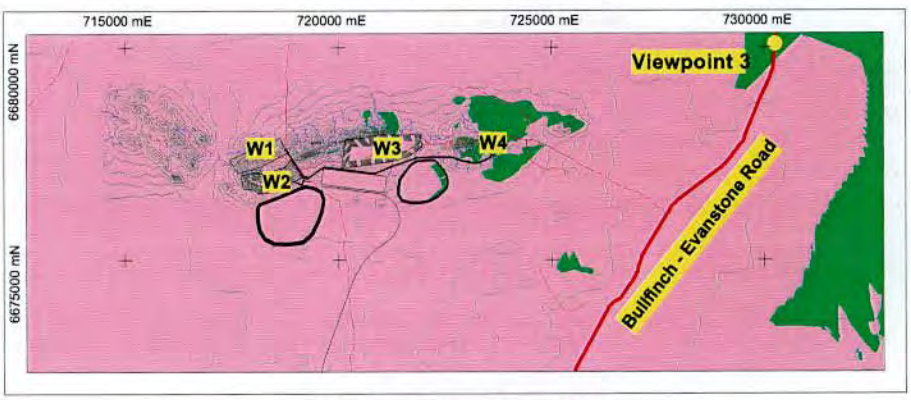
Plate 4: Windarling from Mt Manning.



Visibility from Viewpoint 1



Visibility from Viewpoint 2



Visibility from Viewpoint 3

Visibility Legend

- Invisible
- Visible
- Viewpoint Location

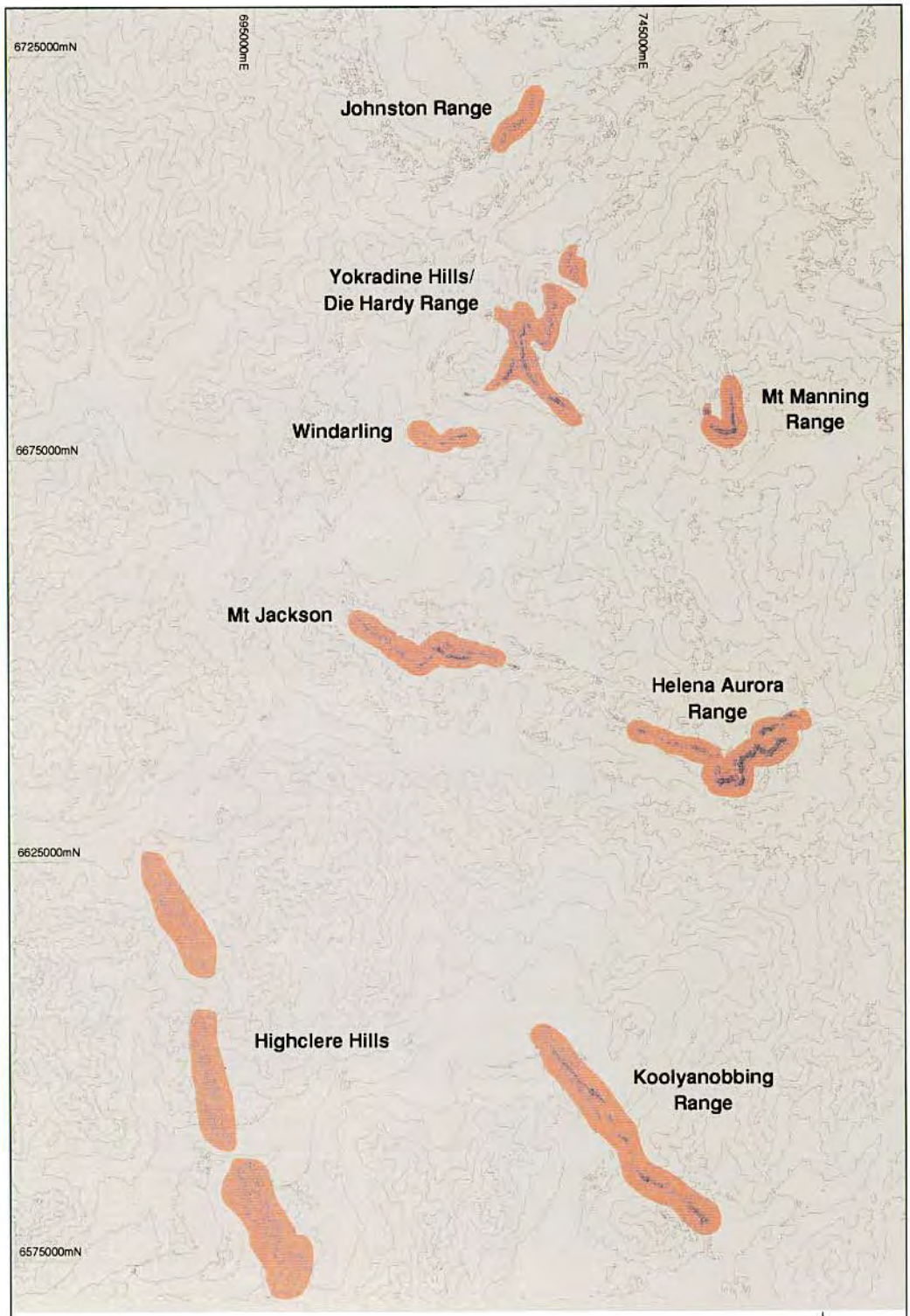
N

0 5km

Datum: AMG84 (Zone 50)

WINDARLING VISUAL AMENITY

Figure 6.11



RANGE LANDFORMS IN THE REGION

Figure 6.12

Mt Manning Nature Reserve lies to the north of the sites. This reserve is frequented mostly by nature enthusiasts and walkers. Views from Mt Manning are limited due to the considerable distance between the two sites.

Transportation Corridor

The construction of a rail link will require clearing of vegetation, exposing soils, cuts and fills, drainage structures, the laying of ballast, concrete sleepers, rail line and trackside equipment. Infrastructure such as radio towers, quarries and groundwater bores will also be required. These factors will cause localised artificial contrasts to the natural surrounding landscape.

6.7.4 Management

Minimising disturbance to landscape values will be a key component in the planning of the mine areas, transportation corridor and infrastructure. The Project EMP documents measures that are to be implemented in order to minimise the visual impacts of the project.

Mitigation will be achieved through the confinement of operations within existing site boundaries to a relatively small area of the site partially screened by existing natural enclosures, and by the final reshaping and planting of the site to visually-blend with the surrounding landscape.

Vegetation has an important role in softening and screening artificial elements within natural landscapes. Therefore during any earthworks, vegetation clearing will be kept to a minimum and unnecessary damage to existing vegetation or surrounding areas will be avoided.

Measures to be implemented to minimise impacts to landscape values will include:

- A 'minimum clearing' policy for the project area, with areas to be cleared only when required and necessary;
- Upon completion of construction areas no longer required will be contoured and slopes stabilised and revegetated;
- Wherever possible overburden will be stored in low valleys or behind ridge lines to maintain the existing skyline;
- Overburden will be stored and rehabilitated and waste dumps will be constructed and rehabilitated in accordance with DMPR Guidelines for Mining in Arid Environments (DME, 1996). The Guidelines cover a wide range of matters including ideal profiles for waste dumps in the context of surrounding landform, likelihood of erosion and revegetation of dumps;
- Supplementary planting and use of existing vegetation and trees will be used to screen mine operations from public viewing and/or vantage points;
- A rehabilitation and mine closure system will be established for both temporary and permanent landforms, to ensure that the landscape will be returned to its former function prior to the operation of the mine;
- A review of end-use of landform to be discussed with CALM;
- Borrow pits will be selected and operated as far as practicable with a view to minimise erosion, damage to the surrounding vegetation and visual impact; and
- To blend in with the surrounding environment an appropriate colour will be used for painting the rail trackside infrastructure.

Management of rehabilitation works are discussed in greater detail in Section 6.8 (Decommissioning and Rehabilitation).

6.7.5 Predicted Outcome

Due to the nature of open-cut mining a change to the land surface and topography of portions of the ironstone ranges is inevitable (Jackson Range 4%; Windarling 70%; overall for region 1.99%). The permanent landforms that will remain after mining will include mine voids, waste dumps, and rail formation cuts and fills. Temporary landforms will be rehabilitated and infrastructure will be removed.

For all proposed mine sites, mining will take place at an elevated location because the deposits occur along the ranges and hills. This renders it difficult to completely conceal the mines from all public view points. The principal vantage point will be from the public Bullfinch-Evanston Road to the deposits at Mt Jackson, and possibly in the distance to deposits at Windarling.

Commitment 17 – Visual Amenity Study
Portman will undertake a Visual Amenity Study of the project area.

Commitment 3 – Closure Plan
Portman will prepare a detailed Closure Plan for the Project. The plan will address closure actions to be taken for mine voids, waste dumps, and associated infrastructure including the Transportation Corridor and will provide the basis for an eventual 'walk-away' closure strategy for the Project.

6.8 DECOMMISSIONING AND REHABILITATION

6.8.1 EPA Objectives

- *Ensure that decommissioning and rehabilitation are carried out in a planned sequential manner consistent with best practice and the ANZMEC Strategic Framework for Mine Closure (ANZMEC, 2000);*
- *Ensure ecosystem function is maintained following mine closure;*
- *Avoid State liability;*
- *Ensure that the post-mining landform is safe, stable, non-erodible, and is integrated into the surrounding environment.*

6.8.2 Policy and Technical Framework

The 'Strategic Framework for Mine Closure' has evolved as a cooperative development between the Australian and New Zealand Minerals and Energy Council (ANZMEC) and the Australian Minerals Industry (represented by the Minerals Council of Australia). It is designed to provide a broadly consistent framework for mine closure across the various Australian jurisdictions and outlines a set of principles to provide guidance in the development of mine closure plans and policies.

The objective of the Strategic Framework for Mine Closure is to encourage the development of comprehensive Closure Plans that return all mine sites to viable, and wherever practicable, self-sustaining ecosystems, and that these plans are adequately financed, implemented and monitored within all jurisdictions (ANZMEC, 2000).

The Strategic Framework for Mine Closure is structured around a set of objectives and principles grouped under six key areas. Key requirements of relevance to the Koolyanobbing Expansion Project are as folows:

- Stakeholder involvement
  - Identification of stakeholders and interested parties;
  - Effective consultation;
- Planning
  - Mine closure should be integral to the whole of life mine plan;
  - Closure Plans should be developed to reflect the status of the project;
  - The dynamic nature of closure planning requires regular review;
- Financial provision
  - A cost estimate for closure should be developed from the Closure Plan;
  - Closure cost estimates should be reviewed regularly to reflect changing circumstances;
- Implementation
  - Adequate resources must be provided to assure conformance with the Closure Plan;
  - The on-going management and monitoring requirements after closure should be assessed and adequately provided for;
- Standards
  - Legislation provides a broad regulatory framework for the closure process;
  - Stakeholders should develop standards that are both acceptable and achievable;
  - Completion criteria are specific to the project and should reflect its unique set of environmental, social and economic circumstances;
  - An agreed set of indicators should be developed to demonstrate successful rehabilitation;
- Relinquishment
  - The Responsible Authority should make the final decision on accepting closure;
  - Once completion criteria have been met, the company may relinquish their interest; and
  - Records of the history of a closed site should be preserved to facilitate future land use planning.

6.8.3 Potential Impacts

Certain environmental values of the project area will be impacted as a result of the proposed development due to the construction of mine pits, the Transportation Corridor and associated infrastructure and access routes. Much of the impact will be to the ironstone ranges that are the source of the iron ore deposits, but the Transportation corridor, access roads and associated infrastructure will impact limited areas of lowland.

Rehabilitation of these areas will occur progressively as disturbed areas are no longer utilised. Mine pits will therefore be rehabilitated once the avilable iron ore resource has been mined at each deposit, and decommissioning of the mine area and Transportation corridor will follow the conclusion of the project. The objective of mine closure will be to minimise long-term environmental impacts, particularly in relation to landforms and vegetation, and to create a self-sustaining natural ecosystem that closely resembles the pre-impact status of the area and in which ecosystem function is maintained.

6.8.4 Predicted Impacts

Mine closure will address impacts to:

Mt Jackson mine areas J2 and J3, including mine pits, ore and waste material stockpile areas and crusher sites;

Windarling mine areas W1, W2, W3, W4 and W5, including mine pits, ore and waste material stockpile areas and crusher sites;

Transportation Corridor including rail line, train loading facilities and associated maintenance access road;

Access and haul roads to mine areas; and

Associated infrastructure including expansion of existing facilities at Koolyanobbing.

There will be a variety of impacts on the environment during both the construction and operation phases of the proposed development.

6.8.5 Management

Mine rehabilitation is an ongoing programme designed to restore the physical, chemical and biological quality or potential of air, land and water regimes disturbed by mining to a state acceptable to the regulators and to post-mining land users. The objective of mine closure is to prevent or minimise adverse long-term environmental impacts, and to create a self-sustaining natural ecosystem or alternate land use based on an agreed set of objectives (ANZMEC, 2000).

Decommissioning and rehabilitation will take place in accordance with ANZMEC Guidelines (2000) for Mine Closure.

Aspects of the operation to be decommissioned in the medium term, such as plant sites and access roads, will be progressively rehabilitated. All plant, buildings and other structures will be removed, the areas ripped and rehabilitation works as described in Section 6.1 (Vegetation Communities) and in the project EMP completed.

The primary management strategy involved in addressing the large scale clearing of native vegetation and fauna habitats in the Koolyanobbing Expansion area will be the preparation and implementation of a detailed Closure Plan and Rehabilitation Programme. The ultimate aim of this ongoing programme will be to rehabilitate disturbed areas to an array of vegetation types and fauna habitats that reflect the pre-disturbance state as closely as possible. The community thus established should be self-sustaining in order to create a stable long-term environment.

The Rehabilitation Programme will need to address a wide variety of issues at various stages of project implementation. These issues are likely to include:

- Progressive / ongoing rehabilitation activities as impacted areas become available;
- Topsoil collection and stockpiling / stockpile management;
- Mulching and stockpiling of cleared vegetation;
- Battering of waste dump slopes to an angle of 20° or less, and additional treatment (e.g. moonscaping or the addition of benches at regular vertical intervals) such that surfaces are stable and able to resist long-term erosion;
- Consideration of deep ripping to loosen the compacted substratum to enable root penetration and increase microrelief to trap seeds and water;

- Respreading of topsoil/vegetation mulch as soon as practically possible to maximise the viability of seeds and soil microbiota;
- Seed/tissue sourcing from local vegetation, with particular attention to the rehabilitation and propagation of significant flora species;
- Seeds from a range of plants including herbs, grasses, shrubs and trees should be applied - while herbs and some grasses provide only an ephemeral cover, they are fast-growing and will assist in the initial stabilisation of soil surfaces, as well as increasing substrate microrelief and hence seed lodgement and water penetration;
- The application of fertilizer if necessary to offset the loss of nutrients and soil microbiota associated with topsoil storage;
- Monitoring with infill planting and weed control as necessary; and
- The development of suitable completion or "walk-away" criteria.

A detailed rehabilitation programme will be prepared, approved and implemented prior to the commencement of clearing and mining activities in the project area. The early establishment of rehabilitation programmes will increase the effectiveness in all respects.

At least six months prior to the anticipated date of decommissioning, or at an alternative time agreed by the DEWCP, Portman will prepare a final decommissioning plan.

Final Pit Voids

A safety bund wall will be constructed around the perimeter of all final pit voids consistent with the DMPR 'Guidelines for Safety Bund Walls Around Abandoned Open Pits, 1991'.

On completion of mining, voids will form discrete catchments that would intercept rainfall and runoff. Limited freshwater may form ephemeral ponding on the pit floor.

Waste Rock Dumps

The waste rock dumps will be progressively rehabilitated during mining operations with final rehabilitation following completion of mining. Given the arid climate and the evaporation and precipitation balance of the area, water harvesting over the waste dump will provide water for vegetation. The closure design for the wast dumps will be:

- Twenty to fifteen degree inter-bench outslopes;
- 10m wide berms incorporating a 1m high bund and an effective growth medium;
- Final maximum elevation below natural ridgelines achieved by 15m lifts and selectively placed landforming.
- A footprint based on that shown in Figures 3.3 and 3.4; and
- Each bench sheeted with growth material.

Landforming including shaped paddock dumped-structures will occur on the top of the waste dump to form undulations 2 to 5 m high. The paddock-dumped structures will provide a more natural profile of the waste dump and mimic the ridges in the surrouding environment. In addition, landforming on the top of the waste dump will include discrete sections of growth material strategically placed.

Blending with the local topography will be achieved by minimising the length of straight planes on the dump outslopes.

All berms will have cross bunds at approximately 30m spacing for horizontal drainage control.

Rehabilitation trials will be conducted on the side of the primary benches as soon as practicable to establish natural vegetation communities typical of the local vegetation. Rehabilitation trials will include all flora species of conservation value from the local area that prefer ridgeline or stony slope habitats.

Topsoil sheeting material will be required to sheet the benches and slopes of the waste dumps and will be sourced from prestripping the pit, waste dump and infrastructure areas prior to commencement of mining.

Acid Drainage

Acid drainage (AD) is unlikely to be a concern for the majority of the waste material from the Project. However waste characterisation will be undertaken prior to commencement of mining to confirm the AD risk level.

Transportation Corridor

Closure of the Transportation Corridor will include closure of the:

- Access Road; and
- Rail formation.

Closure of the access road will be subject to a consultative process with identified stakeholders including the landholders, local community and Yilgarn Shire and it may be determined the road will be left for pastoral and community use. The infrastructure associated with the Transportation Corridor will be dismantled and removed from the area. Where appropriate these areas will be fully rehabilitated, ripped and seeded with locally indigenous species.

Post Closure Monitoring

The mine closure and decommissioning strategy that will be prepared prior to construction will also incorporate a post closure monitoring programme. In addition, at least six months prior to the anticipated date of decommissioning, or at an alternative time agreed by the EPA, Portman will prepare a detailed post-closure monitoring programme. Key components of a post-closure monitroing programme will include:

- Ecosystem Function Analysis; and
- Visual inspection and photo-monitoring.

Ecosystem Function Analysis

Ecosystem function analysis (EFA) will be conducted on the waste dumps and other disturbed areas to determine the progress of rehabilitation towards the completion criteria. EFA transects used during operation and progressive rehabilitation of disturbed areas and the results will be compared with post closure monitoring EFA results.

Visual inspection and photo-monitoring

An annual visual inspection will be conducted to determine changes in rehabilitated landforms such as significant erosion losses and vegetation establishment. In addition, photo monitoring will be conducted for rehabilitated areas over the Project Area to determine the progress of change.

6.8.6 Predicted Outcome

With proper and appropriate 'best practice' management environmental impacts can be minimised but a limited permanent modification due to mining will remain with respect of the final pit woids and waste dump areas. Development and implementation of the Closure Plan will ensure that the mine is integrated back into its original environment as well as possible.

Commitment 3 – Closure Plan

Portman will prepare a detailed Closure Plan for the Project. The plan will address closure actions to be taken for mine voids, waste dumps, and associated infrastructure including the Transportation corridor and will provide the basis for an eventual 'walk-away' closure strategy for the Project.

7.1 SURFACE WATER QUALITY

7.1.1 EPA Objective

- *Maintain or improve the quality of surface water to ensure that existing and potential uses, including ecosystem maintenance are protected, consistent with the Australian and New Zealand Water Quality Guidelines (ANZECC, 2000).*

As part of the National Water Quality Management Strategy the Australian and New Zealand Environment and Conservation Council (ANZECC) has prepared a series of guidelines for Fresh and Marine Water Quality (ANZECC, 2000). Key issues underpinning the application of the guidelines are sustainable use of water resources and cooperative best management.

To implement the Strategy at a local level it is necessary to identify the environmental values of waterbodies and then apply the relevant water quality guidelines for measuring performance. The Strategy includes guidelines for chemical and physical parameters in water and sediment, as well as biological indicators.

7.1.2 Potential Impacts

Surface water or permanent water in the area is very scarce. Primarily it consists of artificially created dams for agriculture. Streams within the project area are ephemeral and non-cyclical. After seasonal rain, water can be held for short periods in the steep drainage gullies of some of the ranges.

As no dewatering is planned at the mine sites, and due to the absence of any watercourses or rivers in the vicinity, there is not likely to be any impact to surface water quality within the project area due to construction and operation of the mines and associated infrastructure.

Any impact to water quality will be with regard to the transportation corridor or any roads that will be constructed which would result in an increase in surface water run-off. Increased sedimentation may occur near roads. Issues of maintenance of drainage patterns and flow have been addressed previously in regard to surface drainage.

Water quality may be adversely affected by proposed dust suppression techniques which will require spraying of saline bore water on haul roads.

There will be no acid mine drainage discharged from the site hence there are no associated water quality issues.

7.1.3 Predicted Impacts

Due to the general absence of watercourses in the vicinity of the proposed mine sites and currently no requirement for dewatering of mine pits surface water quality of surface drainage features is unlikely to be adversely affected.

The utilisation of saline water for dust suppression may result in the build up of mineral salts on road surfaces and in drains. These salts may potentially be dissolved and mobilised in the case of high rainfall generating flow and redistributed in surrounding areas where they could adversely affect the condition of vegetation and may infiltrate the soil profile. Similarly, spraying of saline water on areas fringing haul roads may be detrimental to vegetation thereby affecting habitats and ecosystem functioning.

Changes to surface water quality due to operations at the mine site or along the transportation corridor may arise as a result of:

- Contaminants from materials used in surface operations such as waste oils or accidental spills;
- Erosion of constructed earthworks including mine pits and haul roads;
- Increased levels of turbidity resulting from localised areas of accelerated and increased surface water flow such as along roads;
- Minor contamination in parking areas and along haul roads due to general vehicle movements. Vehicle maintenance will be undertaken in designated workshop areas thereby eliminating the potential for contamination of surface water by oil and other vehicle fluids. Prevention of contaminants entering the environment is the preferred approach.
- The risk of an accident, which results in pollution of surface waters from railway operations, is considered to be negligible.
- The potential for point source pollution impacts in the project area can be minimised by the responsible disposal of wastewater and sewage and by appropriate storage of fuels and chemicals, including an impervious bunded area surrounding stores. The transport of fuel and chemicals by road or rail will be undertaken according to DMPR Guidelines. Response plans will be developed and suitable training conducted to ensure swift and effective clean up in the event of contamination of ground and water.

7.1.4 Management

Proposed management measures to minimise impacts to water quality are further detailed in the project EMP and include:

- Design of workshop buildings to incorporate closed drainage systems routed through oil-water separators;
- Fuels and oils will be stored in above-ground tanks located within impervious bunded enclosures;
- Run-off from workshop areas and other areas likely to contain small spills of oils and solvents will be directed to sumps and oil traps that will remove contaminants from the water. These oil traps will be pumped out as necessary and the waste oils and solvents will be removed for recycling or disposal in a Local Government Authority approved liquid waste disposal site;
- Wastewater treatment plants to be utilised to treat wastewater from sewage facilities;
- Staff to comply with chemicals handling and storage guidelines;
- Emergency procedures to be followed for fuel, oil or chemical spillages as outlined in the Spill Prevention and Response Procedures of the project EMP;
- Employees to report spills via incident reports;
- Surface water run-off from mine pits and haul roads will be discharged into settlement ponds with the capacity to hold a 1 in 5 year Average Recurrence Interval rainfall event (based on the maximum pit size during minesite operations) before discharging into natural drainage channels;

- Drainage design from other areas such as mine access roads will emphasise infiltration and retention rather than directing run-off to natural drainage systems; and
- Construction of waste dumps adjacent to mining pits will be in accordance with DMPR Guidelines to ensure that erosion and sediment laden run-off is minimised.
- Saline water for dust suppression will be broadcast on haul roads by the use of a spraying device that restricts water to road surfaces so that adjacent surface water features and associated vegetation are not impacted. The salt remaining from excess water that collects in spoon drains will be periodically removed so that it does not enter natural drainage systems.

Only ore and fuel will be carted on the railway so there is limited opportunity for impacts to surface water quality. Portman propose a number of management measures relating specifically to railway operations to minimise the possibility of contaminants entering the environment including:

- No litter to be disposed of from trains; and
- Refuelling only to occur in designated areas at Koolyanobbing fitted with internal drainage systems and oil interceptors.

7.1.5 Predicted Outcome

Impact on sediment loads in surface water is considered negligible.

The potential for hydrocarbon or chemical spills is always a possibility but is considered negligible.

7.2 GROUNDWATER QUALITY

7.2.1 EPA Objective

- Maintain or improve the quality of groundwater to ensure that existing and potential uses, including ecosystem maintenance are protected, consistent with the *Australian and New Zealand Water Quality Guidelines (ANZECC, 2000)*.

As part of the National Water Quality Management Strategy ANZECC has prepared a series of guidelines for Fresh and Marine Water Quality (ANZECC, 2000). The WA Guidelines for Fresh and Marine Waters (EPA, 1993) promote the concept of environmental values of groundwater.

7.2.2 Potential Impacts

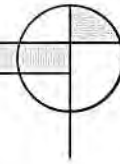
The mined material in this region is oxidised, so acid-mine drainage will not be an issue.

Changes to groundwater quality at the mine could potentially arise in the event of materials used in surface operations such as waste oils or from accidental fuel spills reach the groundwater.

7.2.3 Predicted Impacts

7.2.3.1 Mine Areas

As previously noted all of the ore to be mined as part of the current proposal lies above the groundwater table. The groundwater is extremely saline and not suitable for potable supplies.



It is unlikely that infiltration of liquid pollutants into the groundwater will occur as a result of surface spills. Exploration drilling indicates that the depth to groundwater is generally greater than 50 metres. Impacts and management of pollutants are dealt with in detail in relation to Surface Water Quality (Section 7.1).

7.2.3.2 Transportation Corridor

The railway passes through the Lake Deborah Catchment, which is extremely saline. The potential for contaminants to cause groundwater pollution from railway operations is considered unlikely because of the low probability of spills occurring and substantial depths to groundwater.

7.2.4 Management

- Potential groundwater contaminants such as hydrocarbons, will be contained, collected and disposed of appropriately and in accordance with existing procedures.
- In the event of a significant hydrocarbon or contaminant spill monitoring of groundwater quality will be undertaken in locations near the spill on a quarterly basis to identify any changes to physical and chemical parameters.

7.2.5 Predicted Outcome

The impact on groundwater quality is likely to be negligible.

7.3 PARTICULATES/DUST

7.3.1 EPA Objective

- *Use all reasonable and practicable measures to minimise emissions*
- *Ensure that particulate/dust emissions, both individually and cumulatively, meet appropriate criteria and do not cause an environmental or human health problem*

The EPA Guidelines for dust are outlined in Guidance Statement No.18: *Prevention of air quality impacts from land development sites.* The document provides guidance on the control of dust from land development sites.

With the formation of a National Environment Protection Measure for Ambient Air Quality (NEPM), there is a requirement for Western Australia to implement it. The means of implementation is not set down by the NEPM and Western Australia therefore has the flexibility to implement the most appropriate mechanisms for its own circumstances. The EPA will develop a draft Environmental Protection Policy (EPP) to provide the statutory framework for implementation of the NEPM and for the establishment and achievement of air quality objectives throughout the State.

The National Environment Protection Council (NEPC) set uniform standards for ambient air quality. The standards contained in the NEPM for ambient air quality for particulates are PM^{10} values of $50mg/m^3$ over an averaging period of one day.

7.3.2 Potential Impacts

The following have the potential to generate dust/particulates;

- general construction activities e.g. blasting, earthworks;

- mining operations such as pit excavation, and overburden and waste removal;
- ore handling;
- ore transport; and
- crushing and processing.

Dust can potentially affect vegetation and fauna habitats, as well as posing a potential health risk. Dust accumulation on vegetation adjacent to haul roads diminishes light penetration to the foliage thereby decreasing rates of photosynthesis and limiting plant growth.

Asbestiform Fibres

Exploration drilling programmes have encountered asbestiform material that occurs naturally in the rocks. This material poses an occupational health hazard if inhaled. However, based on the relatively shallow depth of mining proposed for the project, it is unlikely that this material will be encountered. Although fibrous material can be encountered in the mineralised ore body none contains asbestiform fibres, the principal hazard, hence there is little risk that mining of ore or handling of overburden and waste rock will be a serious occupational hazard.

The Department of Minerals and Energy publication *'Asbestos Management in Mining'* (DME, undated) defines the problem (i.e. types of asbestos and associated health risks), details occupational health standards and recommends a number of strategies to manage asbestos. The Australian occupational health standards are recognised as the most stringent in the world.

7.3.3 Predicted Impacts

Dust control is a necessary component of occupational health and safety and these control measures are also expected to reduce off-site dust movement and limit environmental effects.

Experience from other iron ore operations in the state has shown that dust generated from rail haulage is negligible.

Construction works, pre-mine development, mining and crushing of ore and the use of gravel access roads and haul roads are the greatest potential sources of dust. Dry processing (primary crushing) also generates dust. If left in stockpiles for extended periods, the outer portions can crust and limit wind-blown dust.

7.3.4 Management

Dust generation is regulated by the Works Approval and Licensing process under Part v of the Environmental Protection Act 1986. Portman will ensure all Works Approval and Licence conditions are met. Proposed measures to manage dust in the project area include:

- Watering by truck-mounted sprays on unsealed regularly trafficked roads such as access tracks, work areas and haul roads;
- Minimisation of dust generation by limiting clearing and prompt progressive rehabilitation of disturbed areas;
- Water sprays will be fitted to dump hoppers and crushing and screening plants;
- Regular house keeping will be undertaken to collect and remove material that may represent a potential dust source from around conveyors and loading/unloading areas;

- Product stockpiles will be monitored to determine whether there is significant fugitive dust and additional water will be applied if they become a source of dust;
- Personnel will be removed from mine pits in advance of blasting for safety reasons;
- Other measures of minimising site disturbance include limiting vehicle speeds and restricting access to some areas; and
- Standard asbestiform fibre management procedures that meet the requirements of the DMPR will be implemented, if asbestiform mineralisation is encountered during construction or mining.

7.3.5 Predicted Outcome

Construction and operation will generate limited environmental dust but with dust control measures the impacts on ambient dust levels and the environment will be negligable.

Commitment 10 – Dust
Portman will implement dust management measures for mining operations, including a dust monitoring programme.

7.4 WASTE MATERIALS

7.4.1 EPA Objective

- *Ensure that wastes are contained and isolated from ground and surface water surrounds and treatment or collection does not result in long term impacts on the natural environment.*

7.4.2 Potential Impacts

Construction and operation activities generate waste materials, such as plastic, paper, wood, scrap metal, tyres, rubber, batteries and domestic solid wastes.

If not adequately handled, stored or disposed of, this material can contaminate local soil, groundwater or surface waters. Contamination can arise from the escape of leachate containing elevated nutrients, biological oxygen demand or heavy metals. Other impacts from landfills may include vermin, feral fauna, fire and smoke, and spread of wind borne litter into the surrounding countryside.

7.4.3 Predicted Impacts

The permanent village at Koolyanobbing and the proposed accommodation facilities at Windarling will produce the largest volumes of domestic waste. Currently waste from Koolyanobbing is diverted to an existing landfill, specifically designed to deal with such waste. However, as Windarling is a considerable distance from Koolyanobbing and accommodation facilities are planned for this area, a landfill will be purpose-built to deal with waste from this area. The landfill site will be selected in accordance with guidelines prepared by the Geological Survey of Western Australia (Hirschberg, 1993) and operated in accordance with the Department of Environmental Protection's Code of Practice for Country Landfills (DEP, 1996a) and Landfill Waste Classifications (DEP, 1996b).

The volumes of waste from the Windarling accommodation village alone will not be significant and as the landfill will be designed in accordance with relevant guidelines the impact on the local environment is considered minor. Waste from the Mt Jackson operations will be disposed of at the proposed landfill site at Windarling.

Sewage waste will be generated from the village, administration buildings and workshops at Windarling. This waste will be treated in a wastewater treatment plant located near the village at Windarling. Ablution facilities at Mt Jackson will be septic system based.

Wherever the anticipated usage is less than ten people a standard septic system and leach drain will be provided. Larger collections systems will consist of a package treatment plant based on the biofilter system with treated effluent discharged into a fenced non-overflow evaporation pond or irrigated area.

7.4.4 Management

- Reduction - where possible waste reduction will be a priority;
- Recycling - where practical solid materials such as scrap metal will be recycled or reused. It is anticipated that the project will participate in a "Ruggies" style recycling programme;
- Recycling facilities will be provided for collection of different waste streams e.g. plastics, metals, glass, wood;
- Non-recyclables, organics and putrescibles will be diverted to landfill;
- Each sewage treatment facility will be serviced by the unit supplier on a contract basis. Treatment and disposal of wastes will be in accordance with the Health Act and local authority requirements;
- Waste fuels and oils will be stored in above-ground tanks located within impervious bunded enclosures.
- Run-off from workshop areas and other areas likely to contain small spills of oils and solvents will be directed to sumps and oil traps that will remove contaminants from the water. These oil traps will be pumped out as necessary and the waste oils and solvents will be removed for recycling or disposal in a Local Government Authority approved liquid waste disposal site.

Management of waste is dealt with in further detail in the project EMP.

7.4.5 Predicted Outcome

The management of waste is expected to result in negligible environmental impacts due to the low volumes produced and the removal of much of the waste from site.

7.5 NOISE

7.5.1 EPA Objective

- *Ensure that noise levels meet acceptable standards.*
- *Ensure that noise emissions meet appropriate criteria and do not cause an environmental or human health problem.*

Criteria for assessing environmental noise are specified in the Environmental Protection (Noise) Regulations 1997 under the jurisdiction of the DEWCP. The regulations are a 'prescribed standard' under Schedule 4 of the Act. Noise emissions that exceed the prescribed standard can be regarded as 'pollution' and 'unreasonable noise' under Section 3 of the Act. The regulations prescribe assigned noise levels for noise-receiving locations. These relate to residential and commercial premises, are largely administered by local governments, and do not apply to remote areas. The

Regulations also consider blasting noise. For daytime blasting the air blast levels received at any other premises must be less than 125 dB

7.5.2 Potential Impacts

During the construction phase, noise can be generated by earthmoving equipment, heavy haulage vehicles and during the assemblage of infrastructure. During operations blasting, earthmoving machinery, and ore handling and processing will generate noise. Equipment such as vehicle engines, generators and conveyors also produce noise.

Noise will be generated along the rail line by the operation of locomotives and the passage of carriages along the rails, and will also be produced from the passage of vehicles along access and haul roads.

7.5.3 Predicted Impacts

7.5.3.1 Mine Areas

Due to the distance (>65km) from the nearest townships of Koolyanobbing and Bullfinch, noise from blasting and general mining activities will not have a social impact.

Noise and vibration may cause local populations of animals to relocate away from the noise source. This is particularly the case for ground dwelling reptiles and small mammals, but birds, bats and large mammals such as kangaroos are also disturbed at a local level by noise.

7.5.3.2 Transportation Corridor

Construction of the railway will cause increases in noise levels generated by earthmoving equipment and during the assemblage of the rail line.

Ore loading facilities at each of the mine sites will generate noise. The transport of ore along the railway represents a periodic, transitory noise source. Previous experience with rail lines in remote areas suggests that fauna become accustomed to the passage of trains after a period of time.

7.5.4 Management

Measures to be implemented to manage noise include:

- Personnel in areas subject to elevated noise levels will be supplied with and instructed to use appropriate protective hearing equipment;
- Diesel generators will be located in enclosures and at a sufficient distance from areas where people are present to minimise sound generated disturbance;
- Installed equipment will be designed to meet occupational noise standards (maximum level of 85dB at one metre from the source); and
- Regular servicing of trains will be undertaken to ensure minimisation of noise generation.

7.5.5 Predicted Outcome

Project noise will have no impact on settlements within the area.

Environmental impacts from noise will be negligible.

8.1 ABORIGINAL CULTURE AND HERITAGE

8.1.1 EPA Objective

- *Ensure that the proposal complies with the requirements of the Aboriginal Heritage Act 1972;*
- *Ensure that changes to the biological and physical environment resulting from the project do not adversely affect cultural associations with the area.*

The Aboriginal Heritage Act 1972 states that no Aboriginal site can be disturbed without consent from the Minister for Aboriginal Affairs.

8.1.2 Potential Impacts

Aboriginal sites as listed on the Department of Indigenous Affairs (DIA) database have been recorded within the project area and some have the potential to be impacted by the proposed development.

8.1.3 Predicted Impacts

Section 5.14.1 (Aboriginal Sites and Heritage) describes the results of archaeological and ethnographic surveys, and the current involvement of native title claimants in relation to locations within the project area. The Central West Goldfields and Ballardong people have native title claims over portions of the project area.

Sites on the DIA database include SO0104 Mt Jackson. This site cannot be reliably located but may refer to the significance of the general area. Site SO2875 Marda Dam is located approximately four kilometres north of Mt Jackson. The Marda area will not be disturbed by mining activity but is close to the proposed mine area at Mt Jackson, hence there may be increased visitation to the area.

Sites identified during the indigenous heritage survey include seven sites and site series (of related sites due to proximity and association) within five kilometres of the mine areas, three sites within 15 kilometres, and the remaining five sites between 16 and 35 kilometres from the nearest mine area. These sites are therefore not likely to be impacted directly by mining activity, but two sites are located in close proximity to access roads and will require special consideration.

The proposed Transportation Corridor passes approximately one kilometre to the west of Site KY23 in the southern part of the corridor, and close to the site series KY05-09 in the section of the corridor between Mt Jackson and Windarling. The alignment of the railway will be designed to avoid the claypan and artefact scatters associated with the chain of claypans in the area of sites KY05-09.

8.1.4 Management

Portman is committed to consulting with Aboriginal communities and elders as part of the planning process for any exploration or mining activities being considered in the area.

Measures to be implemented to manage Aboriginal culture and heritage issues will include:

- Ethnographic and archaeological surveys to be undertaken in areas not already surveyed;
- The findings of archaeological and ethnographic surveys will be forwarded to the Department of Indigenous Affairs. The registration of identified sites will take place where considered appropriate by the Department;

- Consultation with the Central West Goldfields and Ballardong people will be ongoing regarding all Aboriginal sites directly affected or in proximity to elements of the Expansion Project;
- If any Aboriginal site is required to be disturbed for the Project, a written application (under Section 18 of the Aboriginal Heritage Act 1972) will be made to the Aboriginal Cultural Materials Committee for consent by the Minister for Aboriginal Affairs;
- Any new Aboriginal site identified during construction and operation will be reported to Portmans' Aboriginal Training and Liaison Department for assessment and notification to the Central West Goldfields and Ballardong people and the DIA; and
- Workforce induction programmes will include Aboriginal cultural and heritage issues.

8.1.5 Predicted Outcome

Based on surveys undertaken to date the proposed Expansion Project will not have a significant impact on Aboriginal Culture and Heritage.

Commitment 12 - Additional Aboriginal Site Surveys
Portman will involve the appropriate indigenous custodians in additional archaeological and ethnographic surveys to identify sites within the project area that are likely to be disturbed and assess their significance, where required.

Commitment 13 – Mechanism for Future Aboriginal Site Surveys
Additional indigenous heritage site surveys will be undertaken in accordance with a heritage survey protocol that is to be agreed with the Ballardong and Central West people through establishment of a Land Use Agreement.

Commitment 14 - Consultation on Section 18 Application.
Portman will consult with the appropriate indigenous custodians on Aboriginal sites in the Project area prior to any Section 18 application being developed in keeping with an agreed protocol.

Commitment 15 - Submission of Section 18 Application.
Portman will make a written application to the Aboriginal Cultural Materials Committee (for subsequent consent by the Minister for Aboriginal Affairs) if any identified Aboriginal site in the Project area is required to be disturbed.

Commitment 16 – Establishment of a Land Use Agreement
Portman will establish a Land Use Agreement with the Ballardong and Central West Native Title Claimants to identify and assess any social and cultural aspects of the physical and biological environment impacted.

8.2 NON-INDIGENOUS HERITAGE

8.2.1 EPA Objective

- *Comply with statutory requirements in relation to areas of cultural or historical significance.*

The statutory policy and technical framework is provided by the *Federal Australian Heritage Commission Act*, the *Heritage Act of Western Australia 1990* and the *Town Planning and Development Act 1928* which together provide for registers of heritage places. Under these Acts local authorities are required to compile Municipal Heritage Inventories. In addition to this community groups such as the National Trust maintain registers of significant places.

8.2.2 Potential Impacts

As described in Section 5.14.2 (Non-indigenous Heritage), no part of the proposal will affect heritage listed areas as they lie outside the project area.

8.2.3 Predicted Impacts

There are no predicted impacts to Non-indigenous heritage sites.

8.2.4 Management

No specific management strategies are proposed.

8.2.5 Predicted Outcome

No impacts to Non-indigenous heritage are anticipated.

9.1 INTRODUCTION

The aim of this section is to document environmental management strategies to be applied to the Koolyanobbing Expansion Project and to outline Portman's Environmental Policy.

9.2 ENVIRONMENTAL POLICY

Portman recognises that managing environmental issues is an essential component of the proposed Koolyanobbing Expansion Project. Portman will strive to achieve high standards in environmental management and has a stated Environmental Policy that involves:

- Satisfying all relevant laws, regulations and standards as a minimum;
- Establishing an Environmental Management System;
- Ensuring that environmental matters are an integral part of operations planning; and
- Adopting best practice techniques.

Portman will also review and report on the environmental performance of the company and ensure that the Environmental Policy remains relevant to achieving its target of minimal impact to the environment.

The full Portman Environmental Policy is detailed in Appendix B.

9.3 ENVIRONMENTAL MANAGEMENT SYSTEM

Portman is currently developing an Environmental Management System (EMS) for its mining operations at Koolyanobbing and for the proposed Expansion Project. Portman intends to maintain a 'continual improvement' strategy towards its EMS.

The aim of undertaking the EMS process is to improve existing procedures and practices to embrace all of the elements of the ISO 14001 standards. By developing and implementing an ISO 14001 based EMS Portman intends to achieve their stated environmental objectives as outlined in the Environmental Policy.

The EMS will include the following elements:

- Environmental policy and commitment;
- Planning of environmental requirements;
- Implementation of environmental requirements;
- Measurement and evaluation of environmental performance; and
- Review and improvement of environmental outcomes.

The EMS will be developed prior to commissioning of the Project.

Commitment 2 – Environmental Management System
Portman will develop and subsequently implement a formal Environmental Management System (EMS) for the Project and the existing Koolyanobbing operations that embraces the ISO 14001 standards.

9.4 ENVIRONMENTAL MANAGEMENT PLAN

Portman recognises that an Environmental Management Plan (EMP) which details the application of management procedures to the Koolyanobbing operations and the proposed Expansion Project and reflects existing commitments is required. To this end, a draft project Mining Environmental Management Plan has been prepared that addresses environmental issues associated with project implementation, construction and operation.

Portman has committed to the finalisation, of the project EMP to EPA requirements, prior to construction. The EMP will include, but not be limited to consideration of:

- Monitoring of key environmental aspects;
- Management of environmental impacts from construction and operation;
- Rehabilitation and revegetation of disturbed areas;
- Dust management;
- Weed management;
- Implementation of DMPR guidelines for Mining in Arid Environments, Asbestos Management in Mining and ANZMEC Guidelines;
- An overview of timing for implementation of commitments; and
- Reporting requirements.

Commitment 1 – Environmental Management Plan
An Environmental Management Plan will be prepared prior to construction to address monitoring and management of key environmental issues associated with the Koolyanobbing Expansion Project, timing for implementation of commitments, and reporting requirements.

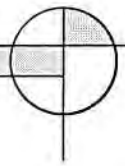
9.5 MANAGEMENT AREA

Portman is currently developing a Memorandum of Understanding (MOU) with CALM for collaborative land management in the Mt Manning, Windarling, Mt Jackson and Helena-Aurora Range area. This MOU relates to a proposed Management Area incorporating the exploration and mining leases held by Portman, Unallocated Crown Land, and the Mt Manning Nature Reserve managed by CALM and vested in the Conservation Commission.

The MOU recognises the existence of areas proposed as conservation reserves, and aims to progress conservation tenure arrangements, integrate management practices and enhance the conservation values of the area whilst permitting a variety of land uses, including mining. Management will recognise the biophysical values of the Management Area and facilitate compatible land uses.

Management Plans will be developed for the Management Area by Portman, in consultation with and for agreement between Portman and CALM. Management Plans to be developed include:

- Biodiversity Management Plan;
- Mining Environmental Management Plan;
- Threatened Flora Management and Conservation Plan;



- Malleefowl Conservation Plan; and
- Conservation Tenure Implementation Plan.

Full details of the MOU are provided in Appendix F.

Commitment 18 – Establishment and implementation of a MOU with CALM
Portman will establish and implement a Memorandum of Understanding with the Department of CALM to progress conservation tenure arrangements and integrate environmental management practices to enhance the conservation values of the area whilst permitting a variety of land uses (including mining).

Commitment 19 – Biodiversity MP
Portman will develop and implement a Biodiversity Management Plan in collabaration with the Department of CALM.

Commitment 20 – Conservation Tenure Implementation Plan
Portman will develop and implement a Conservation Tenure Implementation Plan in collabaration with the Department of CALM.

9.6 INTEGRATION OF ENVIRONMENTAL MANAGEMENT SYSTEMS AND ENVIRONMENTAL REPORTING

Each of the above voluntary environmental management systems or legal requirements requires some form of reporting.

The reporting requirements from the PER process will be integrated within other existing annual reporting frameworks to address all environmental reporting requirements simultaneously. Audit table codes will be included in reports for ease of reference.

Portman will prepare and submit reports to Government on the environmental performance of the project and its compliance with environmental requirements through Annual Environmental Reports. Reporting will commence once project construction is underway.

This section summarises management commitments for the Koolyanobbing Expansion Project. Where subsequent approvals processes ensure adequate environmental management, they are not reproduced here.

Commitment/Management Actions/Policy	Objective	Action	Phase	Sign-off	Compliance criteria
1 - EMP					
1.1.1.1.1 Prepare, implement and regularly revise an Environmental Management Plan (EMP) for the Project. The EMP will include, but not be limited to: • ***monitoring of key environmental aspects;*** • management of environmental impacts from construction and operation; • rehabilitation and revegetation of disturbed areas; • ***an overview of timing for implementation of commitments; and*** • reporting requirements.	Manage environmental impacts of the construction and operation phases of the Project.	Develop and implement EMP to manage the Project.	Prior to construction.	DEWCP (DMPR, CALM)	Annual and triennial reporting.
2 – Environmental Management System					
Develop and subsequently implement a formal Environmental Management System (EMS) for the Project and the existing Koolyanobbing operations that embraces the ISO 14001 system and incorporates the following: • environmental policy and corporate commitment to the EMS; • mechanisms and processes to ensure planning, implementation and operation of actions to meet environmental requirements; • measurement and evaluation of environmental performance; and • review and improvement of environmental outcomes.	Manage environmental factors associated with the Project and fulfil requirements of all Project commitments and conditions.	Develop and Implement EMS.	Prior to commissioning.	DEWCP	EMS developed and implemented.

Commitment	Objective	Action	Phase	Sign-off	Compliance criteria
3 – Closure Plan					
Portman will prepare a detailed Closure Plan for the Project. The plan will address closure actions to be taken for mine voids, waste dumps, and associated infrastructure including the rail corridor and will provide the basis for an eventual 'walk-away' closure strategy for the Project.	Prepare a detailed closure plan for the decommissioning and rehabilitation of the Project.	Develop Plan.	Prior to operation commencing and ongoing as the project develops.	DEWCP (DMPR, CALM)	Closure Plan approved by DEWCP.
4 – Flora and Vegetation Surveys					
Additional flora and vegetation survey of areas to be disturbed but not yet surveyed.	Identify and assess the environmental impacts of development in areas not already surveyed or lacking information.	Undertake additional required botanical surveys.	Prior to Construction.	DEWP, CALM	Completion and reporting of additional surveys.
5 – Rare and Priority Flora Surveys					
Additional surveys for Rare and Priority Flora in areas to be disturbed but not yet surveyed.	Determine the location and extent of Rare and Priority Flora populations.	Undertake additional surveys as required.	Prior to Construction.	DEWCP, CALM	Completion and reporting of additional surveys.
6 – Threatened Flora MP					
Portman will prepare and implement a Threatened Flora Management and Conservation Plan for the Project. The Plan will address management of Threatened Flora impacted by the proposed development.	Protect Threatened Flora taxa, consistent with the provisions of the Wildlife Conservation Act and the EPBC Act.	Prepare and Implement Management Plan.	Prior to Construction.	DEWCP, CALM	Plan approved and implemented.

Commitment	Objective	Action	Phase	Sign-off	Compliance criteria
7 – Fauna Surveys					
Additional targeted surveys for Rare and Priority Fauna in areas to be disturbed but not yet surveyed.	Identify and assess the environmental impacts of development in areas not already surveyed or lacking information.	Undertake additional surveys as required.	Prior to Construction.	DEWCP, CALM	Completion and reporting of additional surveys.
8 – Malleefowl Conservation Plan					
Portman will develop and implement a Malleefowl Conservation Plan for the project area, including detailed survey of proposed impact areas for Malleefowl and their mounds.	Manage Malleefowl *Leipoa ocellata* populations.	Prepare and Implement Management Plan.	Prior to Construction.	DEWCP, CALM	Plan approved and implemented.
9 - Groundwater					
Portman will implement a monitoring plan to ensure that groundwater levels are not significantly reduced in and near extraction areas.	Maintain aquifer characteristics, including groundwater quantity and quality.	Monitor groundwater in and near groundwater extraction sites.	Prior to Construction & Ongoing during Operational Phase.	DEWCP	Baseline and monitoring data obtained.
10 - Dust					
Portman will implement dust management measures for mining operations, including a dust monitoring programme.	Maintain acceptable levels of dust.	Monitor dust levels in mining areas and along haul roads.	Operation	DEWCP	Baseline and monitoring data obtained.

Commitment	Objective	Action	Phase	Sign-off	Compliance criteria
11 - Weeds					
Portman will develop and implement a Weed Management Plan, including implementation of weed hygiene procedures.	Maintain the number/type of weeds at an acceptable level. Ensure additional weed species do not become established in the project area.	Prepare and Implement Plan.	Prior to Construction	DEWCP (CALM)	Plan approved and implemented.
12 – Aboriginal Site Surveys					
Portman will involve the appropriate indigenous custodians in additional archaeological and ethnographic surveys to identify sites and their significance within the Project area likely to be disturbed, where required.	Identify any heritage sites in areas not already surveyed.	Undertake additional surveys.	Prior to construction.	DIA	Additional surveys conducted.
13 – Future Aboriginal Site Surveys					
Additional Aboriginal site surveys will be undertaken in accordance with a heritage survey protocol that is to be agreed with the Ballardong and Central West people through establishment of a Land Use Agreement.	Agree on a survey protocol.	Establish survey protocol.	Prior to Construction	DIA	Agreed protocol in place.
14 – Consultation on Section 18 Application					
Portman will consult with the appropriate indigenous custodians on Aboriginal sites in the Project area prior to any Section 18 application being developed in keeping with an agreed protocol.	Consult with the appropriate indigenous custodians on sites.	Conduct consultation.	Prior to Construction.	DIA	Project design minimises impact on sites.
15 – Submission of Section 18 Application					
Portman will make a written application to the Aboriginal Cultural Materials Committee (for subsequent consent by the Minister for Aboriginal Affairs) if any identified Aboriginal site in the Project area is required to be disturbed.	Obtain consent to disturb nominated Aboriginal sites.	Submit written application.	Prior to Construction.	DIA	Consent issued by Minister.

Commitment	Objective	Action	Phase	Sign-off	Compliance criteria
16 – Establishment of a Land Use Agreement					
Portman will establish a Land Use Agreement with the Ballardong and Central West native title claimants to identify and assess any social and cultural aspects of the physical and biological environment impacted.	Obtain agreement with the Native Title Claimants.	Negotiate Land Use Agreement.	Prior to construction.	Ballardong and Central West native title claimants	Registration with NNTT
17 – Visual Amenity Study					
Portman will undertake a Visual Amenity Study of the project area.	Evaluate landscape values and assess impacts associated with the proposal.	Undertake survey and prepare Study.	Prior to construction.	DEWCP	Completion of survey and preparation of Visual Amenity Study.
18 – Establishment of a MOU with CALM					
Portman will establish a Memorandum of Understanding with the Department of CALM to progress conservation tenure arrangements and integrate environmental management practices to enhance the conservation values of the area whilst permitting a variety of land uses (including mining).	Collabarative land management in the Mt. Manning, Windarling, Mt Jackson and Helena-Aurora Range area.	Develop and facilitate the MOU. Prepare and implement Management Plans for the Management Area	Prior to construction. Ongoing collaborative management.	CALM	Agreement on the MOU and undertaking of collaborative land management. Plans approved and implemented.
19 – Biodiversity MP					
Portman will develop and implement a Management Area Biodiversity Management Plan in collabaration with the Department of CALM	Document conservation and biodiversity issues in the Mt Jackson, Bungalbin and Mt. Manning area and provide strategies for management.	Prepare and implement the Management Area Biodiversity Management Plan	Prior to construction. Ongoing consultation and collaborative management.	CALM	Plan approved and implemented.

Commitment	Objective	Action	Phase	Sign-off	Compliance criteria
20 – Conservation Tenure Implementation Plan					
Portman will develop and implement a Conservation Tenure Implementation Plan in collabaration with the Department of CALM.	Rationalisation of tenure issues within the Management Area for the purposes of multiple land use and with the ultimate aim of conservation.	Prepare and implement the Conservation Tenure Implementation Plan.	Prior to construction. Ongoing consultation.	CALM	Plan approved and implemented.

Alford, J.J. (1995) Two species of *Tetratheca* (Tremandraceae) from the Coolgardie and Austin botanical districts, Western Australia. *Nuytsia* 10: 143-149.

ANZECC (2000) Australian and New Zealand Guidelines for Fresh and Marine Water Quality. Canberra.

ANZMEC (2000), *'Strategic Framework for Mine Closure'*. Australian and New Zealand Minerals and Energy Council and Minerals Council of Australia. Canberra, ACT.

Atkins, K.J. (2001), *'Declared Rare and Priority Flora List'*. Department of Conservation and Land Management, August 2001.

Australian Interaction Consultants (2001) Site identification survey and consultation report for S18 hearing under the Aboriginal Heritage Act (1972) of tenements in the Koolyanobbing – Windarling areas in the Yilgarn region of Western Australia. Unpublished report commissioned by Portman Iron Ore Ltd.

Australian Mining Industry Council (1989), *'Mine Rehabilitation Handbook'*.

Bates, D.M. (1901-14) The Native Tribes of Western Australia. Edited by I. White, 1985. National Library of Australia, Canberra.

Beard J.S. (1972), *'The Vegetation of the Jackson Area', Western Australia.* Vegmap, Perth

Beard, J.S. (1981), *'Swan. Explanatory Notes to Sheet 7 1:1,000,000 Series Vegetation Survey of Western Australia'*. UWA Press, Nedlands.

Beard, J.S., (1978), *'The Vegetation of the Kalgoorlie Area, Western Australia'*, Vegmap, Perth

Beard, J.S. (1979), *'A New Phytogeographic Map of Western Australia'*. West. Aust. Herb, Res. Notes.

Beard, J.S. (1990), *'Plant Life of Western Australia'*, Kangaroo Press, Kenthurst.

Benshemesh J., (2000) *'National Recovery Plan for Malleefowl'*. Department for Environment and Heritage.

Biological Surveys Committee (1985), 'Biological Survey of the Eastern Goldfields of Western Australia'. Western Australian Museum. Perth, WA.

Butcher, R. (2001) *Identification of Tetratheca material collected from the Die Hardy Range.* Unpublished report prepared for Mattiske Consulting Pty Ltd on behalf of Portman Iron Ore Limited, Perth.

Butcher, R., Byrne, M. and Coates, D. (2001) *DNA Sequence Variation in the Declared Rare Species Tetratheca aphylla, T. paynterae and T. harperi (Tremandraceae).* Unpublished report prepared for Portman Iron Ore by the Department of Conservation and Land Management, Perth.

CALM (Department of Conservation and Land Management) (1994), *'Regional Management Plan Goldfields Region 1994-2004'*.

CALM (2001), Declared Rare and Priority Flora List. Publicly available list prepared by the Department of Conservation and Land Management.

Chapman, A. and Pronk, G. (1996) Vertebrate Fauna. In (eds) Lyons, M.N. and Chapman A., *'A Biological Survey of the Helena Aurora Range, Eastern Goldfields Western Australia'*. Report for the Biodiversity Group, Environment Australia.

Chapman, A. and Thomas, R. (1996) Introduction. In (eds) Lyons, M.N. and Chapman A., *'A Biological Survey of the Helena Aurora Range, Eastern Goldfields Western Australia'*. Report for the Biodiversity Group, Environment Australia.

Chin, R.J. and Smith, R.A. (1983), *'1:250,000 series – Explanatory Notes'*. Jackson Sheet, Western Australia, Geological Survey of Western Australia.

Clarke, P.A. (2001) Report on Aboriginal cultural sites in the Koolyanobbing – Windarling area. Unpublished report commissioned by Portman Iron Ore Ltd.

Commander, D.P., Kern, A.M. and Smith, R.A. (1992) Hydrogeology of the Tertiary palaeochannels in the Kalgoorlie Region. Western Australia Geological Survey, Record 1991/10.

Dames and Moore (1993), *'Notice of Intent for the Redevelopment of Koolyanobbing Iron Ore Deposits'*. Unpublished report commissioned by Portman Iron Ore Ltd.

Dell, J., How, R.A., Newbey, K.R. and Hnatiuk, R.J. (1985), *'The Biological Survey of the Eastern Goldfields of Western Australia. Part 3: Jackson-Kalgoorlie Study Area'*. WA Museum, Perth.

DEP (Department of Environmental Protection) (1996b), *'Landfill Waste Classification and Waste Definitions'*.

DEP (1996a), *'Discussion Paper for Code of Practice Rural Landfill Management'*, November 1996.

DME (Department of Minerals and Energy) (1996), *'Guidelines for Mining in Arid Environments'* Department of Minerals and Energy, WA.

DME (undated), *'Asbestos Management in Mining'*. Department of Minerals and Energy Mining Operations Division.

Ecologia Environmental Consultants (2001), *'Koolyanobbing Expansion Project Vertebrate Fauna Assessment Survey'*. Unpublished Report Commissioned by Portman Iron Ore Ltd.

Environmental Protection Authority, (1993), 'Draft WA Guidelines for Fresh and Marine Waters'.

Environmental Protection Authority, (1997), *'Guidelines for Environment and Planning'*.

Environmental Protection Authority, (2000), *'General requirements for Terrestrial Biological Surveys'*. Preliminary Position Statement No. 3.

Gibson N. and Lyons M.N. (1997a), *'Floristic Survey of the Mount Manning Range of the Eastern Goldfields of Western Australia'*, Unpublished Report for the Australian Heritage Commission prepared by Department of Conservation and Land Management.

Gibson N. and Lyons M.N. (1997b), *'Floristic Survey of the Hunt Range, Yendilberin and Watt Hills of the Eastern Goldfields of Western Australia'*, Unpublished Report for the Australian Heritage Commission prepared by Department of Conservation and Land Management.

Gibson N. and Lyons M.N. (1997c), *'Floristic Survey of the Highclere Hills of the Eastern Goldfields of Western Australia'*, Unpublished Report for the Australian Heritage Commission prepared by Department of Conservation and Land Management.

Gibson N., Lyons M.N. and Lepschi, B.J. (1996) Vegetation and Flora. In (eds) Lyons, M.N. and Chapman A., *'A Biological Survey of the Helena Aurora Range, Eastern Goldfields Western Australia'*. Report for the Biodiversity Group, Environment Australia.

Gibson N., Lyons M.N. and Lepschi, B.J. (1997), *'Flora and vegetation of the eastern goldfields ranges, Part I: Helena and Aurora Range'*, CALMScience 2: 231-246.

Government of Western Australia, (1997), *'Wetlands Conservation Policy for Western Australia'* Policy Document.

Halpern Glick Maunsell (2001), *'Portman Limited Northern Resources Rail Route Options'*. Unpublished report commissioned by Portman Iron Ore Ltd.

Henry-Hall (1990), 'Nature Conservation Reserves in the Eastern Goldfields, Western Australia, Southern Two Thirds of CTRC System 11' Unpublished Report to EPA Red Book Task Force 1990.

Hirschberg K. J. B. (1993), 'Geological and Hydrogeological Guidelines for Landfill Site Selection', Geological Survey of Western Australia.

Johnson, S.L., Commander, D.P. and O'Boy, C.A. (1998) Groundwater Resources of the Northern Goldfields, Western Australia. Hydrogeological Record Series. Water and Rivers Commission, Perth.

Keighery, G.J. (1980) 'Notes on the biology, distribution and conservation of Dryandra arborea (Proteaceae). West Australian Naturalist 14: 212-213.

Macleod, J. and Gerhardy, S. (1996), *'Minerals in Western Australia: Bedrock of the Economy'*. Chamber of Mines and Energy of Western Australia Inc.

Malnic, J. (1997), *'Uncapped drill holes are Silent Killers'*. Australia's Mining Monthly, March 1997, p.16.

Mattiske Consulting Pty Ltd (2000), *'Declared Rare and Priority Flora Search of Proposed Drill Lines Mt Jackson – Koolyanobbing'*. Unpublished report commissioned by Portman Iron Ore Ltd.

Mattiske Consulting Pty Ltd (2001a), *'Review of Flora on Portman Iron Ore proposed expansion areas'*. Unpublished report commissioned by Portman Iron Ore Ltd.

Mattiske Consulting Pty Ltd (2001b), *'Declared Rare and Priority Flora Search of Proposed Mining Areas on Windarling Deposits 3, 4 and 5'*. Unpublished report commissioned by Portman Iron Ore Ltd.

Mattiske Consulting Pty Ltd (2001c), *'Review of Vegetation on Portman Iron Ore proposed expansion areas'*. Unpublished report commissioned by Portman Iron Ore Ltd.

Milewski A.V. and Hall, N.J. (1995), *'Physical Environment In: The Biological Survey of the Eastern Goldfields of Western Australia. Part 12. Barlee Menzies Study Area'*. Records of the Western Australia Museum Supplement 49: 174-182, 1995.

Newbey, K.R. (1985), *'Physical Environment. In: The Biological Survey of the Eastern Goldfields of Western Australia. Part 3: Jackson-Kalgoorlie Study Area'*. WA Museum, Perth.

Newbey K.R. and Hnatiuk R.J. (1985), Vegetation and Flora In: The Biological Survey of the Eastern Goldfields of Western Australia. Part 3 Jackson-Kalgoorlie Study Area. *Records of the Western Australian Museum Supplement* 23: 5-10

Pen, L. (1999) Managing our rivers – a guide to the nature and management of streams in Western Australia. Water and Rivers Commission, Perth.

Portman Limited (2000), 'Annual Report'.

Rockwater (2001) Groundwater supply for proposed Mt Jackson and Windarling mines results of initial study. Unpublished report commissioned by Portman Iron Ore Ltd.

Serventy, D.L. and Whittell, H.M., (1976), *'Birds of Western Australia'*. University of Western Australia Press, Perth.

Thackway, R. and Cresswell, I.D. (1995), *'An Interim Biogeographic Regionalisation for Australia'*. Australian Nature Conservation Agency, Canberra.

Tindale, N.B. (1974) Aboriginal tribes of Australia: their terrain, environmental controls, distribution, limits and proper names. ANU Press, Canberra.

WA Museum (1995) *'Biological Survey of the Eastern Goldfields of Western Australia, Part 11. Boorabbin-Southern Cross Study Area'*. Western Australian Museum, Perth.

Western Australian Planning Commission (1996) *'State Planning Strategy'*. WAPC, November 1996.

LIST OF ABBREVIATIONS

AAD	Aboriginal Affairs Department
AHD	Australian Height Datum
ANZECC	Australian and New Zealand Environment and Conservation Council
ANZMEC	Australian and New Zealand Minerals and Energy Council
BIF	Banded Iron Formation
CALM	Department of Conservation and Land Management
CC	Conservation Commission
DEP	Department of Environmental Protection
DEWCP	Department of Environment, Water and Catchment Protection
DIA	Department of Indigenous Affairs
DME	Department of Minerals and Energy
DMPR	Department of Minerals and Petroleum Resources
DOLA	Department of Land Administration
DRF	Declared Rare Flora
DRD	Department of Resources Development
EMS	Environmental Management System
ESD	Ecologically Sustainable Development
EPA	Environmental Protection Authority
EPBC	Environment Protection and Biodiversity Conservation (Act)
Fe	Iron
ha	hectare
IBRA	Interim Biogeographic Regionalisation for Australia
kL/d	kilolitres per day
km	kilometre
mg/L	milligrams per litre
Mt	Megatonne
Mtpa	Megatonne per annum
mya	million years ago
MOU	Memorandum of Understanding
NPNCA	National Parks and Nature Conservation Authority
P	Phosphorus
PER	Public Environmental Review
S	Sulfur
TDS	Total Dissolved Salts
VCL	Vacant Crown Land
WA	Western Australia
WAM	West Australian Museum
WRC	Water and Rivers Commission

The Koolyanobbing Iron Ore Expansion Project Public Environmental Review document was planned, coordinated and executed by:

ecologia Environmental Consultants
76 Thomas Street
West Perth WA 6005

Additional technical input for the project was provided by:

Mattiske Consulting Pty Ltd

Halpern Glick Maunsell Pty Ltd

CAD Resources

SJR Environmental Research Consulting

Australian Interaction Consultants

Dr. Phillip A. Clarke

Department of Conservation and Land Management

Rockwater

Environmental Protection Authority
Guidelines for preparation of a PER

KOOLYANOBBING IRON ORE EXPANSION

50 kilometres north east of Southern Cross

PORTMAN IRON ORE LIMITED

(WA EPA Assessment Number 1374)

1. **Overview**
2. **Objectives of the environmental review**
3. **Preparation of the environmental review document**
4. **Contents of the environmental review document**
5. **Public consultation**
6. **Other information**

Attachment 1	Plan showing location and details of the proposal
Attachment 2	Example of the invitation to make a submission
Attachment 3	Advertising the environmental review
Attachment 4	Example of the newspaper advertisement

These guidelines are provided for the preparation of the proponent's environmental review document. The specific environmental factors to be addressed are identified in Section 4.2.

The environmental review document must address all elements of these guidelines prior to approval being given to commence the public review.

The environmental review document must also address any requirements of the Commonwealth Government under the *Environment Protection and Biodiversity Conservation Act 1999.*

The EPA expects the proponent to fully consult with interested members of the public and relevant stakeholders, and to take due care in ensuring any other relevant environmental factors, which may be of interest to the public and stakeholders, are addressed. The PER should document the results of all consultation undertaken. In particular, as directed by the Minister for the Environment and Heritage in her appeal determination, the proponent must actively consult with the Wildflower Society of WA during preparation of the PER.

- provide the basis of the proponent's environmental management program, which shows that the environmental impacts resulting from the proposal, including cumulative impact, can be acceptably managed;
- communicate clearly with the public (including government agencies), so that the EPA can obtain informed public comment to assist in providing advice to government; and
- provide a document which clearly sets out the reasons why the proposal should be judged by the EPA to be environmentally acceptable.

3. Preparation of the environmental review document

Proponents are encouraged to maintain close contact with the DEP/EPA officer during the preparation of the environmental review. The environmental review should be provided to the DEP/EPA officer for comment. At this stage the document should have all figures produced in the final format and colours.

The proponent and DEP/EPA officer/Manager should agree on the time to be taken to review the draft, taking into account the level of consultation during the environmental review preparation, DEP/EPA officer's availability and the need for external review. Revision of the document may be requested to ensure that it addresses all topics and issues in these guidelines, can be read by the educated lay-person, contains no significant error of science and meets the required format.

When the EPA is satisfied with the standard of the environmental review document it will provide a written sign-off to the proponent, giving approval to advertise the document for public review. The review document may not be advertised for release before written approval is received.

Following approval to release the review for public comment, the final environmental review document should also be provided to the DEP/EPA project officer as an electronic copy, in PC Microsoft Word 2000 format, and any scanned figures. Where possible, these figures should be legible and meaningful in a black and white format.

4. Contents of the environmental review document

The environmental review document should include an executive summary, introduction and at least the following:

4.1 The proposal

General requirements

The environmental review document should provide a comprehensive description of the proposal including its location (address and certificate of title details where relevant). Specific matters requiring attention are:

- justification and objectives for the proposed development;
- the legal framework, including existing zoning and environmental approvals, and decision making authorities and involved agencies; and
- consideration of alternative options.

Guidelines for the preparation of the PER document

1. Overview

All environmental reviews have the objective of protecting the environment. Environmental impact assessment is deliberately a public process in order to obtain broad ranging advice. The review requires the proponent to:

- describe the proposal;
- describe the receiving environment;
- outline the potential impacts of the proposal on factors of the environment;
- identify the proposed management strategies to ensure those environmental factors are appropriately protected; and
- demonstrate that the proposal should be judged by the EPA to be environmentally acceptable.

Throughout the assessment process it is the objective of the Environmental Protection Authority (EPA) to help the proponent to design the proposal to improve the protection to the environment. The Department of Environmental Protection (DEP) administers the environmental impact assessment process on behalf of the EPA.

The primary purpose of the environmental review is to provide information to the EPA and the public on the proposal within the local and regional framework, with the aim of emphasising how the proposal may impact the relevant environmental factors and how those impacts may be mitigated and managed so as to be environmentally acceptable.

The language used in the body of the environmental review should be kept simple and concise, considering the audience includes non-technical people, and any extensive, technical detail should either be referenced or appended to the environmental review. The environmental review will form the legal basis of the Minister for the Environment and Heritage's approval of the proposal and therefore the environmental review should include a description of all the main and ancillary components of the proposal.

Information used to reach conclusions should be properly referenced, including personal communications. Such information should not be misleading or presented in a way that could be construed to mislead readers. Assessments of the significance of an impact should be soundly based rather than unsubstantiated opinion, and each assessment should lead to a discussion of the management of the environmental factor.

2. Objectives of the environmental review

The objectives of the environmental review are to:

- place this proposal in the context of the local and regional environment;
- adequately describe all components of the proposal, so that the Minister for the Environment and Heritage can consider approval of a well-defined project;

- provide the basis of the proponent's environmental management program, which shows that the environmental impacts resulting from the proposal, including cumulative impact, can be acceptably managed;
- communicate clearly with the public (including government agencies), so that the EPA can obtain informed public comment to assist in providing advice to government; and
- provide a document which clearly sets out the reasons why the proposal should be judged by the EPA to be environmentally acceptable.

3. Preparation of the environmental review document

Proponents are encouraged to maintain close contact with the DEP/EPA officer during the preparation of the environmental review. The environmental review should be provided to the DEP/EPA officer for comment. At this stage the document should have all figures produced in the final format and colours.

The proponent and DEP/EPA officer/Manager should agree on the time to be taken to review the draft, taking into account the level of consultation during the environmental review preparation, DEP/EPA officer's availability and the need for external review. Revision of the document may be requested to ensure that it addresses all topics and issues in these guidelines, can be read by the educated lay-person, contains no significant error of science and meets the required format.

When the EPA is satisfied with the standard of the environmental review document it will provide a written sign-off to the proponent, giving approval to advertise the document for public review. The review document may not be advertised for release before written approval is received.

Following approval to release the review for public comment, the final environmental review document should also be provided to the DEP/EPA project officer as an electronic copy, in PC Microsoft Word 2000 format, and any scanned figures. Where possible, these figures should be legible and meaningful in a black and white format.

4. Contents of the environmental review document

The environmental review document should include an executive summary, introduction and at least the following:

4.1 The proposal

General requirements

The environmental review document should provide a comprehensive description of the proposal including its location (address and certificate of title details where relevant). Specific matters requiring attention are:

- justification and objectives for the proposed development;
- the legal framework, including existing zoning and environmental approvals, and decision making authorities and involved agencies; and
- consideration of alternative options.

Brief description of the proposal which is the subject of these guidelines

Portman Iron Ore Limited (the proponent) proposes to undertake staged expansion of its existing Koolyanobbing Iron Ore operations over the next five years. The proposed development locations are indicated on the attached plan (Attachment 1).

The proposed extended mining operations will involve development of up to nine new greenfields small scale open cut mines and the construction of associated waste dumps and infrastructure. The new mines are proposed to the north of Koolyanobbing at Windarling, Mt Jackson and Bungalbin. The resource is small but the ore is to a large degree high grade and high value. The new mines will result in the extension of the life of the current mine by providing high-grade ore which can be blended with the remaining lower grade ore from the existing mine. New rail lines (138 kilometres) will be installed from Koolyanobbing to Mt Jackson and Windarling.

The expected mine life is 20 years and iron ore production will increase from the current 2.5 mtpa to 8mtpa over the next 5 years.

The scope of this proposal is the extended mining operations and the railway from the minesites to Koolyanobbing. It is intended that iron ore associated with this proposal will be transported by rail to Esperance and it is noted that the scope of the Esperance Port Upgrade, which was assessed by the EPA in 2000 (EPA Bulletin 989), was for receipt of a maximum of 4 million tonnes per annum of iron ore. Any approval to mine up to 8 million tonnes per annum of iron ore at Koolyanobbing will not override what has been approved for the Esperance Port Upgrade.

Key characteristics of the proposal

The Minister's statement will bind the proponent to implementing the proposal in accordance with any technical specifications and key characteristics[1] in the environmental review document. It is important therefore, that the level of technical detail in the environmental review, while sufficient for environmental assessment, does not bind the proponent in areas where the project is likely to change in ways that have no environmental significance.

Include a description of the components of the proposal, including the nature and extent of works proposed. This information must be summarised in the form of a table, an example of which follows:

[1] Changes to the key characteristics of the proposal following final approval would require assessment of the change and can be treated as non-substantial and approved by the Minister, if the environmental impacts are not significant. If the change is significant, it would require assessment under section 38 or section 46. Changes to other aspects of the proposal are generally inconsequential and can be implemented without further assessment. It is prudent to consult with the Department of Environmental Protection about changes to the proposal.

Table 1: Key characteristics (example only)

Element	Description
Life of project (mine production)	< 5 yrs (continual operation)
Size of ore body	682 000 tonnes (upper limit)
Depth of mine pit	less than 30m
Water table depth	50m below ground surface
Area of disturbance (including access)	100 hectares
Mine operation	Daylight hours only, Monday to Friday
List of major components • pit • waste dump • infrastructure (water supply, roads, etc)	refer 'Plans, specifications, charts' section immediately below for details of map requirements
Ore mining rate • maximum	 • 200,000 tonnes per year
Solid waste materials • maximum	 • 800,000 tonnes per year
Water supply • source • maximum hourly requirement • maximum annual requirement	 • XYZ borefield, ABC aquifer • 180 cubic metres • 1 000 000 cubic metres
Fuel storage capacity and quantity used	litres; litres per year

Plans, specifications, charts

Provide adequately dimensioned plans showing clearly the location and elements of the proposal that are significant from the point of view of environmental protection. Locate and show dimensions (for progressive stages of development, if relevant) of plant, amenities buildings, access ways, stockpile areas, dredge areas, waste product disposal and treatment areas, all dams and water storage areas, mining areas, storage areas including fuel storage, landscaped areas etc.

Only those elements of plans, specifications and charts that are significant from the point of view of environmental protection are of relevance here.

Always include:

- a map showing the proposal in the local context - an overlay of the proposal on a base map of the main environmental constraints;
- a map showing the proposal in the regional context; and, if appropriate,
- a process chart / mass balance diagram showing inputs, outputs and waste streams.

The plan/s should include contours, north arrow, scale bar, legend, grid coordinates, the source of the data, and a title. The dates of any aerial photos should be shown.

Other logistics

- timing and staging of project; and
- ownership and liability for waste during transport, disposal operations and long-term disposal (where appropriate to the proposal).

4.2 Environmental factors

The environmental review should focus on the relevant environmental factors for the proposal, and these should be agreed in consultation with the EPA and DEP and relevant public and government agencies.

At this preliminary stage, the EPA believes the specific relevant environmental factors, objectives and work required for this proposal are as detailed in the table below.

Environmental Issue	**Objective(s)**
PROTECTION OF BIOLOGICAL DIVERSITY	• Maintain the general abundance and diversity of species. • Maintain the geographic distribution and productivity of vegetation communities. • Protect Declared Rare and Priority Flora, consistent with the provisions of the *Wildlife Conservation Act 1950*, and provisions of the *Environment Protection and Biodiversity Conservation Act 1999* (the EPBC Act). Protect other flora species of conservation significance (e.g. undescribed taxa, range extensions). • Maintain the general abundance, species diversity and geographical distribution of terrestrial fauna. • Protect Specially Protected (Threatened) Fauna, consistent with the provisions of the *Wildlife Conservation Act 1950*, and provisions of the EPBC Act.
Environmental factor	**Scope of work**
Terrestrial Flora — vegetation communities	Baseline studies to identify existing vegetation communities and discussion of the results in a regional/ecosystem context Assessment of potential impacts (direct and indirect) on vegetation communities as a result of mining activities and infrastructure. Proposed measures to manage impacts.
Terrestrial Flora — Declared rare and priority flora; flora of conservation significance	Baseline studies to identify any Declared Rare Flora, Priority Flora or other species of conservation significance and discussion of the results in a regional/ecosystem context. Assessment of potential impacts (direct and indirect) on Declared Rare Flora, Priority Flora and flora of particular conservation significance as a result of mining activities and infrastructure. Proposed measures to manage impacts
Terrestrial Fauna	Baseline studies to identify existing terrestrial fauna throughout the areas to be affected by the proposal and discussion of the results in a regional/ecosystem context. Review of existing invertebrate data for the area and identify any species of significance. Assessment of potential impacts (direct and indirect) on terrestrial fauna as a result of mining and associated activities. Proposed measures to manage impacts.
Terrestrial Fauna — Specially Protected (Threatened) Fauna	Baseline studies to identify Specially Protected (Threatened) Fauna (including invertebrates) found within the areas to be affected by the proposal and discussion of results in a regional/ecosystem context. Assessment of potential impacts (direct and indirect) on terrestrial fauna as a result of mining and associated activities. Proposed measures to manage impacts.

Environmental issue	Objective(s)
PRESERVATION OF LANDSCAPE VALUES; DECOMMISSIONING AND REHABILITATION	• Manage and mitigate impacts to landscape values. • Ensure that decommissioning and rehabilitation are carried out in a planned sequential manner consistent with best practice and the ANZMECC Strategic Framework for Mine Closure (ANZMECC, 2000). • Ensure ecosystem function is maintained following mine closure. • Avoid State liability. • Ensure that the post-mining landform is, safe, stable, non-erodible, and is integrated into the surrounding environment.
Environmental factor	**Scope of work**
Landscape values	Assessment of potential impacts of the proposal on existing landforms/landscape values. Evaluation of the landscape values of the project area and how these will be affected by the proposal and proposed measures to manage such impacts. Details of measures proposed to rehabilitate the impacted areas to an acceptable standard and which will integrate the post mining landform with the surrounding environment.
Decommissioning and rehabilitation	Present, as part of the review document: • an integrated mining, decommissioning and rehabilitation strategy (which includes progressive rehabilitation of disturbed areas including the railway corridor); and • a close-out strategy to ensure ecosystem function will be maintained following mine closure and impacts on landscape values will be minimised.
Environmental issue	**Objective(s)**
MAINTENANCE OF SURFACE WATER FUNCTION AND QUALITY.	• Maintain the integrity, functions and environmental values of watercourses and sheetflow. • Maintain or improve the quality of surface water to ensure that existing and potential uses, including ecosystem maintenance are protected, consistent with the *Australian and New Zealand Water Quality Guidelines* (ANZECC, 2000).
Environmental factor	**Scope of work**
Watercourses	Baseline studies to identify watercourses, and types of surface water flow including sheetflow throughout the areas to be affected by the proposal. Assessment of the potential impacts on surface water flow rates, drainage patterns, erosion and sediment transport, as a result of mining, railways and other associated activities. Proposed measures to manage impacts.
Surface water quality	Details of potential for acid mine drainage, hydrocarbon use/storage, dewatering activities, and fate of water used/pumped. Assessment of the implications for local and regional surface/groundwater quality. Proposed measures to manage impacts.

Environmental issue	Objective(s)
MAINTENANCE OF GROUNDWATER FUNCTION AND QUALITY	• Maintain (sufficient) quantity of groundwater so that existing and potential uses, including ecosystem maintenance, are protected. • Maintain or improve the quality of groundwater to ensure that existing and potential uses, including ecosystem maintenance are protected, consistent with the *Australian and New Zealand Water Quality Guidelines* (ANZECC, 2000).
Environmental factor	**Scope of work**
Groundwater quantity	Details of the hydrogeological systems of the project area, existing beneficial uses of groundwater (including ecosystem maintenance), and the proposed dewatering operations. Assessment of the potential short-term and long-term impacts on groundwater systems as a result of below-the-watertable mining. Proposed measures to manage impacts, including managing impacts on dependent vegetation
Groundwater quality	Details of the existing water quality of groundwater aquifers. Identification of potential sources of groundwater contamination associated with the proposal, including the potential for acid mine drainage. Assessment of the potential impacts on local/regional groundwater quality. Proposed measures to manage impacts.
Environmental issue	**Objective**
MINIMISATION AND MANAGEMENT OF EMISSIONS AND WASTE	• Use all reasonable and practicable measures to minimise emissions. • Ensure that particulate/dust and noise emissions (including those associated with rail transport), both individually and cumulatively, meet appropriate criteria and do not cause an environmental or human health problem; and • Ensure that wastes are contained and isolated from ground and surface water surrounds and treatment or collection does not result in long-term impacts on the natural environment.
Environmental factor	**Scope of work**
Particulates / Dust	Identification of sources of particulates/dust (including emissions associated with rail transport) and estimates of project-wide emissions. Analysis of the significance of these emissions with regard to human health and environmental impacts, in particular, impacts on vegetation. Proposed measures to manage potential impacts.
Noise	Identification of sources of noise including that associated with rail transport. Analysis of the significance of these emissions with regard to human health and environmental impacts. Proposed measures to manage potential impacts.
Solid waste	Details of the composition, storage and disposal of all solid wastes. Proposed measures to manage impacts.

Environmental issue	Objective(s)
EFFECT ON SOCIAL SURROUNDINGS	• Ensure that the proposal complies with the requirements of the *Aboriginal Heritage Act 1972*; and • Ensure that changes to the biological and physical environment resulting from the project do not adversely affect cultural associations with the area.
Environmental factor	**Scope of work**
Aboriginal culture and heritage	Identification of Aboriginal cultural and heritage sites of significance through archaeological and ethnographic surveys of the project area and through consultation with local Aboriginal groups and the Department of Indigenous Affairs. Consultation with the Aboriginal people of the area to determine potential impacts of the proposal on cultural associations with the project area. Proposed measures to manage impacts.
Non-indigenous heritage	Identification of non-indigenous heritage sites that may be adversely impacted by the proposal. Proposed measures to manage impacts.

These factors should be addressed within the PER document for the public to consider and make comment to the EPA. The EPA expects to address these factors in its report to the Minister for the Environment and Heritage.

The EPA expects the proponent to fully consult with interested members of the public and take due care in ensuring all other relevant environmental factors, which may be of interest to the public, are addressed.

Further environmental factors may be identified during the preparation of the environmental review, therefore on-going consultation with the EPA, DEP and other relevant agencies is recommended. The DEP/EPA can advise on the recommended EPA objective for any new environmental factors raised. Minor matters which can be readily managed as part of normal operations for the existing operations or similar projects may be briefly described.

For discussion under each environmental factor:

- a description of where this factor fits into the broader environmental / ecological context (only if relevant - may not be applicable to all factors);
- a clear definition of the area of assessment for this factor;
- the EPA objective for this factor;
- a description of what is being affected - why this factor is relevant to the proposal;
- a description of how this factor is being affected by the proposal - the predicted extent of impact;
- a straightforward description or explanation of any relevant standards / regulations / policy;
- environmental evaluation - does the proposal meet the EPA's objective as defined above;
- if not, environmental management proposed to ensure the EPA's objective is met; and
- predicted outcome.

Environmental issue	Objective(s)
EFFECT ON SOCIAL SURROUNDINGS	• Ensure that the proposal complies with the requirements of the *Aboriginal Heritage Act 1972*; and • Ensure that changes to the biological and physical environment resulting from the project do not adversely affect cultural associations with the area.
Environmental factor	**Scope of work**
Aboriginal culture and heritage	Identification of Aboriginal cultural and heritage sites of significance through archaeological and ethnographic surveys of the project area and through consultation with local Aboriginal groups and the Department of Indigenous Affairs. Consultation with the Aboriginal people of the area to determine potential impacts of the proposal on cultural associations with the project area. Proposed measures to manage impacts.
Non-indigenous heritage	Identification of non-indigenous heritage sites that may be adversely impacted by the proposal. Proposed measures to manage impacts.

These factors should be addressed within the PER document for the public to consider and make comment to the EPA. The EPA expects to address these factors in its report to the Minister for the Environment and Heritage.

The EPA expects the proponent to fully consult with interested members of the public and take due care in ensuring all other relevant environmental factors, which may be of interest to the public, are addressed.

Further environmental factors may be identified during the preparation of the environmental review, therefore on-going consultation with the EPA, DEP and other relevant agencies is recommended. The DEP/EPA can advise on the recommended EPA objective for any new environmental factors raised. Minor matters which can be readily managed as part of normal operations for the existing operations or similar projects may be briefly described.

For discussion under each environmental factor:

- a description of where this factor fits into the broader environmental / ecological context (only if relevant - may not be applicable to all factors);
- a clear definition of the area of assessment for this factor;
- the EPA objective for this factor;
- a description of what is being affected - why this factor is relevant to the proposal;
- a description of how this factor is being affected by the proposal - the predicted extent of impact;
- a straightforward description or explanation of any relevant standards / regulations / policy;
- environmental evaluation - does the proposal meet the EPA's objective as defined above;
- if not, environmental management proposed to ensure the EPA's objective is met; and
- predicted outcome.

The proponent should provide a summary table of the above information for all environmental factors, under the three categories of biophysical, pollution management and social surroundings as shown below:

Table 2: Environmental factors and management (example only)

Environ-mental Factor	EPA Objective	Existing environment	Potential impact	Environmental management	Predicted outcome
BIOPHYSICAL					
Vegetation community types 3b and 20b	Maintain the abundance, species diversity, geographic distribution and productivity of vegetation community types 3b and 20b	Reserve 34587 contains 45 ha of community type 20b and 34 ha of community type 3b	Proposal avoids all areas of community types 20b and 3b	Surrounding area will be fully rehabilitated following construction	Community types 20b and 3b will remain untouched Area surrounding will be revegetated with seed stock of 20b and 3b community types
POLLUTION MANAGEMENT					
Dust	Ensure that the dust levels generated by the proposal do not adversely impact upon welfare and amenity or cause health problems by meeting statutory requirements and acceptable standards	Light industrial area - three other dust producing industries in close vicinity Nearest residential area is 800 metres	Proposal may generate dust on two days of each working week.	Dust Control Plan will be implemented	Dust can be managed to meet EPA's objective
SOCIAL SURROUNDINGS					
Visual amenity	Visual amenity of the area adjacent to the project should not be unduly affected by the proposal	Area already built-up	This proposal will contribute negligibly to the overall visual amenity of the area	Main building will be in 'forest colours' and screening trees will be planted on road	Proposal will blend well with existing visual amenity and the EPA's objective can be met

4.3 Environmental management

The EPA expects the proponent to have in place an environmental management system (EMS) appropriate to the scale and impacts of the proposal, including provisions for performance review and a commitment to continuous improvement.

The system may be integrated with quality and health and safety systems and should include the following elements:

- environmental policy and commitment;
- planning of environmental requirements;
- implementation of environmental requirements;

- measurement and evaluation of environmental performance; and
- review and improvement of environmental outcomes.

A description of the environmental management system should be included in the environmental review documentation. If appropriate, the documentation can be incorporated into a formal environmental management system (such as AS/NZS ISO 14001). Public accountability should be incorporated into the approach on environmental management.

The environmental management program (EMP) is the key document of an environmental management system. The EMP should provide plans to manage the relevant environmental factors, define the performance objectives, describe the resources to be used, outline the operational procedures and outline the monitoring and reporting procedures which would demonstrate the achievement of the objectives.

4.4 Environmental management commitments

The final stage of the Environmental Impact Assessment (EIA) process is reached when the Minister for the Environment and Heritage issues the Ministerial Statement for the project, which is a set of legally enforceable conditions and procedures for the implementation of the project. One of the standard procedural conditions is a requirement for the proponent to implement the key commitments which have been made during the EIA process and which the EPA and the proponent wish to become legally enforceable.

It is accepted practice for a list of the proponent's key commitments to be attached to the Minister's statement, however, it is not compulsory for the proponent to make any legally enforceable commitments. The EPA will recommend conditions to address environmental matters that the implementation of the proposal should be subject to. The EPA expects proponents to implement all the commitments, which are made as part of the public review of the proposal, as part of their commitment to good environmental management.

Commitments that are to be made legally enforceable should not be made lightly and should focus on the important, on-going, high-risk issues that will need a higher level of environmental management in terms of achieving a satisfactory outcome. They would be key components within the proponent's environmental management system and would be subject to both internal (company) and external (regulator) audit processes to ensure both compliance as well as outcome.

Smaller-scale, generalised, overly-specific and/or non-controversial management actions, objectives and policies that the proponent intends to undertake in implementing the proposal (e.g. return 150 mm of topsoil, avoid coral reefs, minimise clearing of vegetation) do not need to be included in the list of legally enforceable commitments.

Ideally, management actions, etc, should be separated from the commitments in the public review document and they would not become specifically legally binding as would the commitments. However, the proponent would still be expected to implement these management actions as part of responsible environmental management as this is what the EPA will base its recommendations of acceptability upon.

It is important to ensure the commitments are auditable and, therefore, proponents are advised to follow a tabular format as explained below.

4.4.1 Commitment components

The commitments need to be framed in a format similar to that of the environmental conditions so that they have clarity and enforceability and, therefore, can be readily implemented by the proponent and audited efficiently by the DEP. The required standard format for all commitments comprises a number of components as follows:

The proponent will, for a specific topic (environmental issue), undertake an action **(what, how, where)** to meet an environmental objective **(why)** to a time frame **(when)**, and on advice from a relevant advisory agency **(from whom**, eg. government agencies such as Department of CALM, Department of Mineral and Petroleum Resources, Shire Council). With regard to 'advice from whom', this need only be included if the expertise and/or statutory responsibilities of the third party is relevant to implementing the commitment.

It is important for the consolidated list of commitments to be numbered correctly for easy reference in the implementation and auditing stages of the project. These should therefore be sequentially numbered 1, 2, 3, ... without use of subgroups such as 1.1, 1.2 or 2(i) or 2(a), 2(b).

4.4.2 Paragraph format

In applying the standard components (topic what, why, when, from whom) an example of a commitment in paragraph form is as follows:

Prepare and implement a Dust Control Plan that will minimise dust generation on-site and aim to prevent dust emission from construction of the foreshore extension in order to protect the amenity of nearby land users. The Plan will be prepared during the design (project planning) phase and will include measures that ensure dust levels do not exceed EPA dust control criteria (EPA, 1996). The Plan will be prepared and implemented on advice from the Shire of Widgie. The approved Plan will be implemented during the construction phase.

However, writing the commitment in paragraph form can result in a confusing or clumsy sentence structure that may be difficult to interpret for future auditing purposes. Hence, a paragraph format is not acceptable and a tabular format is now required.

4.4.3 Tabular format

It is recommended that the table column headings be titled: 'commitment number', 'topic', 'actions', 'objectives', 'timing' and 'advice from'. The example in paragraph format above can be written in tabular form as per example 1 below. Note that the tabular format also overcomes the sometimes long-winded sentence structure where there are multiple specific actions for the plan to address. Also, it is desirable to create a separate commitment for the preparation and implementation parts of the commitment. Finally, the tabular format provides an immediate audit framework for use both by the proponent and the DEP, which enables efficient administration of environmental approvals. An example of the three most common formats is given below and Example 4 shows how to rewrite a management strategy into a commitment.

Example 1. Prepare and Implement format

This is the most common format and will apply most of the time where there is an on-going need to address the issue.

No.	Topic	Actions	Objectives	Timing	Advice from*
1.	Dust management	Prepare a Dust Control Plan for the foreshore construction site which addresses: 1) prevention of dust generation; 2) prevention of dust emissions off-site; and 3) monitoring and compensatory measures to address accidental emissions off-site.	1) Maintain the amenity of nearby residents. 2) Dust levels at nearest critical premise are within EPA dust control criteria (EPA, 1996).	Design phase (prior to the start of construct-ion)	Shire of Widgie
2.	Dust management	Implement the approved Dust Control Plan referred to in commitment 1.	Achieve the objectives of Commitment 1.	During construction	Shire of Widgie

* this may be left blank if no advisory local or state government agency is relevant; note that the DEP or the EPA or the Minister for the Environment and Heritage are never noted in this column. They are the regulators and the commitments are to their requirements, not advice.

Example 2. Once-off Action format

This format is for actions that have a clear completion time.

No.	Topic	Action	Objectives	Timing	Advice from
3.	Fauna protection	Undertake a trapping programme, approved by CALM, for capturing and relocating the Southern Brown Bandicoots from the area to be cleared.	Relocate the Southern Brown bandicoots to an area and in a manner where the population will be protected	Design (prior to the start of ground disturbance)	CALM

Example 3. Prepare, Implement and Upgrade format

This format is for circumstances when there is a clear need to modify a plan based on a study that is yet to be completed.

No.	Topic	Action	Objectives	Timing	Advice from
4.	Waste Rock Dump	Prepare a Waste Rock Dump Management Plan that: 1) ensures natural drainage is reinstated; 2) identifies rehabilitation options and techniques; 3) achieves a visual quality objective of level 3; 4) etc.	Construct a waste rock dump that: 1) blends with local landscape; 2) is stable in the long-term; and 3) will not produce leachate that would pollute the nearby wetlands.	Prior to the start of construction of the mine	Dept. Minerals and Energy
5.	Waste Rock Dump	Implement the WRDM Plan referred to in commitments 4 and 6.	As for commitment 4.	During construction and operations	DME
6.	Waste Rock Dump	Modify the WRDM Plan referred to in commitment 4 after the Acid Mine Drainage study referred to in commitment 9 is completed and the study findings approved by the EPA.	Ensure that drainage, including subsurface leachate, does not exceed water quality criteria (NHMRC, 1999).	During operations	DME

Example 4. How to rewrite a management action, etc, into a commitment

No.	Topic	Action	Objectives	Timing	Advice from
1.	Waste material	Remove waste material which cannot be accommodated on-site due to potential changes in final design levels to an acceptable landfill. **this is a management action and is rewritten below**	To prevent contaminated material removed from the western part of the site being relocated inconsistent with the final plans for the development.	During remedial works	Shire of Widgie
1.	Excess waste material	Prepare a Waste Material Plan for any excess contaminated material that: 1) identifies the quantity and location of the material; 2) specifies the methods of removal and transport of the material; and 3) identifies the landfill site for disposal and the monitoring methods for the landfill disposal operation.	Ensure that contaminated material that cannot be contained on-site is disposed of at an acceptable landfill site.	During the remedial stage (prior to the validation stage)	Shire of Widgie
2.	Excess waste material	Implement the approved Waste Material Plan referred to in commitment 1.	Achieve the objectives of commitment 1.	After plan is approved by the DEP (during remedial stage)	Shire of Widgie

5. Public consultation

A description of the public participation and consultation activities undertaken by the proponent in preparing the environmental review should be provided. It should describe the activities undertaken, the dates, the groups/individuals involved and the objectives of the activities. Cross-reference should be made with the description of environmental management of the factors that should clearly indicate how community concerns have been addressed. Those concerns that are dealt with outside the EPA process can be noted and referenced.

5.1. Availability of the environmental review

Copies for distribution free of charge

Supplied to the Department of Environmental Protection (DEP):

- Library/Information Centre 9
- EPA members 6
- DEP (Perth) 6
- DEP (Kalgoorlie) 1

Distributed by the proponent to:

Commonwealth Government	•	Environment Australia 3
State Government departments	•	Department of Conservation & Land Management 5
	•	Department of Indigenous Affairs 1
	•	Department of Mineral and Petroleum Resources 4
	•	Water and Rivers Commission 2
Local Government authorities	•	Shire of Yilgarn 2
Libraries	•	J S Battye Library 3
	•	The Environment Centre 1
Other	•	Conservation Council of WA 1
	•	Wildflower Society of Western Australia (Inc) 1

3.2 Available for public viewing

- J S Battye Library;
- Department of Environmental Protection Library; and
- DEP Kalgoorlie

6. Other information

Additional detail and description of the proposal, if provided, should go in a separate section.

Attachment 1

Plans showing location and details of the proposal

Attachment 2

The first page of the proponent's environmental review document must be the following invitation to make a submission, with the parts in square brackets amended to apply to each specific proposal. Its purpose is to explain what submissions are used for and to detail why and how to make a submission.

Invitation to make a submission

The Environmental Protection Authority (EPA) invites people to make a submission on this proposal. If you are able to, electronic submissions emailed to the DEP/EPA Project Assessment Officer would be most welcome.

Cable Sands (WA) Pty Ltd proposes to develop a mineral sands mine near Tutunup, approximately 14 km south of Capel. In accordance with the *Environmental Protection Act 1986* and *Environment Protection and Biodiversity Conservation Act 1999* (Cth) a PER has been prepared which describes this proposal and its likely effects on the environment. The PER is available for a public review period of 6 weeks from **[date]** closing on **[date]**.

Comments from government agencies and from the public will help the EPA to prepare an assessment report in which it will make recommendations to government.

Why write a submission?

A submission is a way to provide information, express your opinion and put forward your suggested course of action - including any alternative approach. It is useful if you indicate any suggestions you have to improve the proposal.

All submissions received by the EPA will be acknowledged. Submissions will be treated as public documents unless provided and received in confidence subject to the requirements of the Freedom of Information Act, and may be quoted in full or in part in the EPA's report.

Why not join a group?

If you prefer not to write your own comments, it may be worthwhile joining with a group interested in making a submission on similar issues. Joint submissions may help to reduce the workload for an individual or group, as well as increase the pool of ideas and information. If you form a small group (up to 10 people) please indicate all the names of the participants. If your group is larger, please indicate how many people your submission represents.

Developing a submission

You may agree or disagree with, or comment on, the general issues discussed in the PER or the specific proposals. It helps if you give reasons for your conclusions, supported by relevant data. You may make an important contribution by suggesting ways to make the proposal more environmentally acceptable.

When making comments on specific elements of the PER:

- clearly state your point of view;
- indicate the source of your information or argument if this is applicable;
- suggest recommendations, safeguards or alternatives.

Points to keep in mind

By keeping the following points in mind, you will make it easier for your submission to be analysed:

- attempt to list points so that issues raised are clear. A summary of your submission is helpful;
- refer each point to the appropriate section, chapter or recommendation in the PER;
- if you discuss different sections of the PER, keep them distinct and separate, so there is no confusion as to which section you are considering;
- attach any factual information you may wish to provide and give details of the source. Make sure your information is accurate.

Remember to include:

- your name;
- address;
- date; and
- whether you want your submission to be confidential.

The closing date for submissions is: **[date]**

Submissions should ideally be emailed to
peter.walkington @environ.wa.gov.au

OR addressed to:

The Environmental Protection Authority
PO Box K822
PERTH
WA 6842

[Westralia Square
141 St George's Terrace
PERTH WA 6000]

Attention: Peter Walkington

Attachment 3

Advertising the environmental review

The proponent is responsible for advertising the release and arranging the availability of the environmental review document in accordance with the following guidelines:

Format and content

The format and content of the advertisement should be approved by the DEP/EPA before appearing in the media. For joint State-Commonwealth assessments, the Commonwealth also has to approve the advertisement. The advertisement should be consistent with the attached example.

Note that the DEP/EPA officer's name should appear in the advertisement.

Size

The size of the advertisement should be two newspaper columns (about 10 cm) wide by about 14 cm long. Dimensions less than these would be difficult to read.

Location

The approved advertisement should, for PER's and ERMP's, appear in the Saturday edition of the news section of the main daily paper ("The West Australian"), and in the news section of the main local paper at the commencement of the public review period, and again two weeks prior to the closure of the public review period.

Timing

Within the guidelines already given, it is the proponent's prerogative to set the time of release, although the DEP/EPA should be informed. The advertisement should not go out before the report is actually available, or the review period may need to be extended.

Attachment 4

Example of the newspaper advertisement

Proponent Name

Public/ Environmental Review/and Management Programme

TITLE OF PROPOSAL

(Public Review Period: **[date]** to **[date]**)

Proponent is planning to [brief description of proposal].

A Public Environmental Review (PER) / Environmental Review and Management Programme (ERMP) has been prepared by the company to examine the environmental effects associated with the proposed development, in accordance with Western Australian Government procedures. The PER / ERMP describes the proposal, examines the likely environmental effects and the proposed environmental management procedures.

[Proponent] has prepared a project summary which is available free of charge from the company's office address.

Copies of the PER/ERMP may be purchased for $10 from:

Company Name
Street
Suburb/Town WA Postcode
Telephone: (08) 9xxx xxxx

Copies of the complete PER/ERMP will be available for examination at:

- Department of Environmental Protection
  Library Information Centre
  8th Floor, Westralia Square
  141 St Georges Terrace
  PERTH WA 6000
- Relevant local libraries
- Department of Environmental Protection
  Regional Office - if appropriate

Submissions on this proposal are invited by **[closing date]**. Please email your submission to:

project.officer@environ.wa.gov.au OR address to:

Chairman
Environmental Protection Authority
PO Box K822
PERTH WA 6842
Attention: **[Project Officer name]**

If you have any questions on how to make a submission, please ring the project officer, **[Project Officer name]**, on (08) 9222 7xxx.

Attachment 4

Example of the newspaper advertisement

Proponent Name

Public/ Environmental Review/and Management Programme

TITLE OF PROPOSAL

(Public Review Period: [**date**] to [**date**])

Proponent is planning to [brief description of proposal].

A Public Environmental Review (PER) / Environmental Review and Management Programme (ERMP) has been prepared by the company to examine the environmental effects associated with the proposed development, in accordance with Western Australian Government procedures. The PER / ERMP describes the proposal, examines the likely environmental effects and the proposed environmental management procedures.

[Proponent] has prepared a project summary which is available free of charge from the company's office address.

Copies of the PER/ERMP may be purchased for $10 from:

Company Name
Street
Suburb/Town WA Postcode
Telephone: (08) 9xxx xxxx

Copies of the complete PER/ERMP will be available for examination at:

- Department of Environmental Protection
  Library Information Centre
  8th Floor, Westralia Square
  141 St Georges Terrace
  PERTH WA 6000
- Relevant local libraries
- Department of Environmental Protection
  Regional Office - if appropriate

Submissions on this proposal are invited by [**closing date**]. Please email your submission to:

project.officer@environ.wa.gov.au OR address to:

Chairman
Environmental Protection Authority
PO Box K822
PERTH WA 6842
Attention: [**Project Officer name**]

If you have any questions on how to make a submission, please ring the project officer, [**Project Officer name**], on (08) 9222 7xxx.

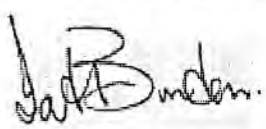
Portman recognises that excellence in managing environmental responsibilities is essential in successful business practices.

The company understands that mining is a temporary land use, and that it is associated with a range of potential impacts. Therefore, Portman is committed to ensuring that the protection of the environment will not be compromised for profit or production.

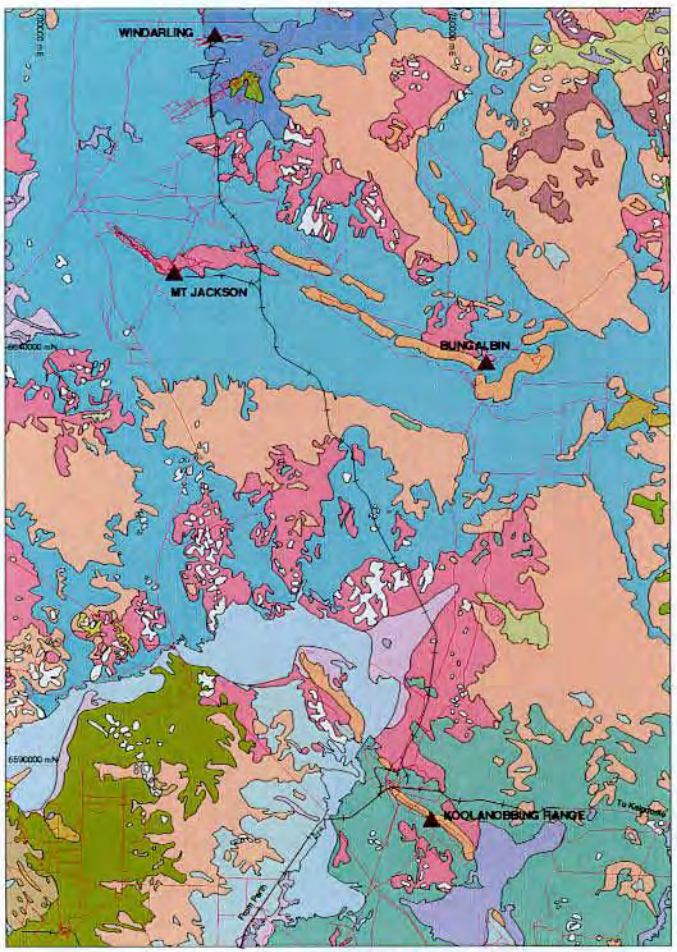
Portman will strive to achieve excellence in environmental management by pursuing high standards of environmental performance in all its activities. In order to achieve and maintain these high standards, Portman will:

- Satisfy all of the relevant international and national laws, regulation and standards as a minimum;
- Establish a structured Environmental Management System to achieve the necessary improvements of its environmental performance, which will be monitored by ongoing audits;
- Ensure that environmental matters are an integral part of operations planning and long term strategy;
- Evaluate environmental risks associated with the company's activities and take appropriate action to minimise potential risks;
- Develop, implement and monitor comprehensive environmental management plans, which will list objectives for all operations and activities;
- Provide adequate training of all employees to recognise the potential impacts of their activities and to ensure that competence in environmental management techniques remains an integral part of all operations;
- Adopt and use best practice techniques in order to:
  - Minimise environmental impacts,
  - Rehabilitate the environment,
  - Conserve important flora and fauna populations, and
  - Promote environmental awareness.
- Recognise and protect special heritage and cultural values;
- Support and participate in community based environmental projects;
- Maintain a close working relationship with government and other related industries to continually improve environmental management and performance.

Portman will regularly review and publicly report on the environmental performance of the company and will ensure that this policy remains relevant to achieving its target of minimal impact to the environment.



IAN BURSTON
Managing Director



LEGEND

Veg Assoc	H Code	Beard Code	Description	Super Group
8	Mi-05j	e8,34Mi	Medium woodland; salmon gum & gimlet	5
18	Li-02a	a1Li	Low woodland; mulga (Acacia aneura)	10
19	Li-03a	a1Li	Low woodland; mulga between sandridges	10
125	sl	sl	Bare areas; salt lakes	59
127	mud	mud	Bare areas; mudflats	61
129	r	r	Bare areas; rock outcrops	63
141	Mi-05m	e6,8,34Mi	Medium woodland; York gum, salmon gum & gimlet	5
142	Mi-05f	e6,8Mi	Medium woodland; York gum & salmon gum	5
143	Mi-11c	e6,8,c2Mi	Medium woodland; York gum, salmon gum & Allocasuarina cristata	5
144	Mi-05p	e6,8,9,34,35Mi	Medium woodland; wandoo, salmon gum, morrel, gimlet & rough fruited mallee	5
147	CS-01g	aSi k1Ci	Succulent steppe with scrub; acacia species over saltbush	56
202	Si-01f	a1,14Si	Shrublands; mulga & Acacia quadrimarginea scrub	20
352	Mi-05c	e6Mi	Medium woodland; York gum	5
435	Sc-02l	a33,34,35Sc	Shrublands; Acacia neurophylla, A. beauverdiana & A. resinomarginea thicket	19
437	Sc-02m	an5c	Shrubalnds; Mixed acacia thicket on sandplain	19
511	Mi-05g	e8,9Mi	Medium woodland; salmon gum & morrel	5
520	Sc-02b2	a14Sc	Shrublands; Acacia quadrimarginea thicket	19
535	Mi-05q	e35Mi	Medium woodland; rough fruited mallee on greenstone hills	5
536	Mi-05k	e9,35Mi	Medium woodland; morrell & rough fruited mallee (E. corrugata)	5
537	Mi-05e	e9Mi	Medium woodland; morrel (E. longicornis)	5
538	Si-03d	a15Si	Shrublands; Acacia brachystachya scrub	20
554	SL-01c	c2Li a9Si	Low woodland over scrub; Allocasuarina cristata over bowgada scrub	17
555	HS-01a	e22Si t8Hi	Hummock grasslands, mallee steppe; red mallee over spinifex Triodia scariosa	45
936	Mi-05d	e8Mi	Medium woodland; salmon gum	5
1068	Mi-06r	e8,9,34,39Mi	Medium woodland; salmon gum, morrel, gimlet & Eucalyptus sheathiana	5

NOTES

Horizontal Datum: AMG84 (Zone 50)
Vertical Datum: AHD
This figure to be read in conjunction with
Mattiske Consulting Pty Ltd report numbered PIL0101/096/01

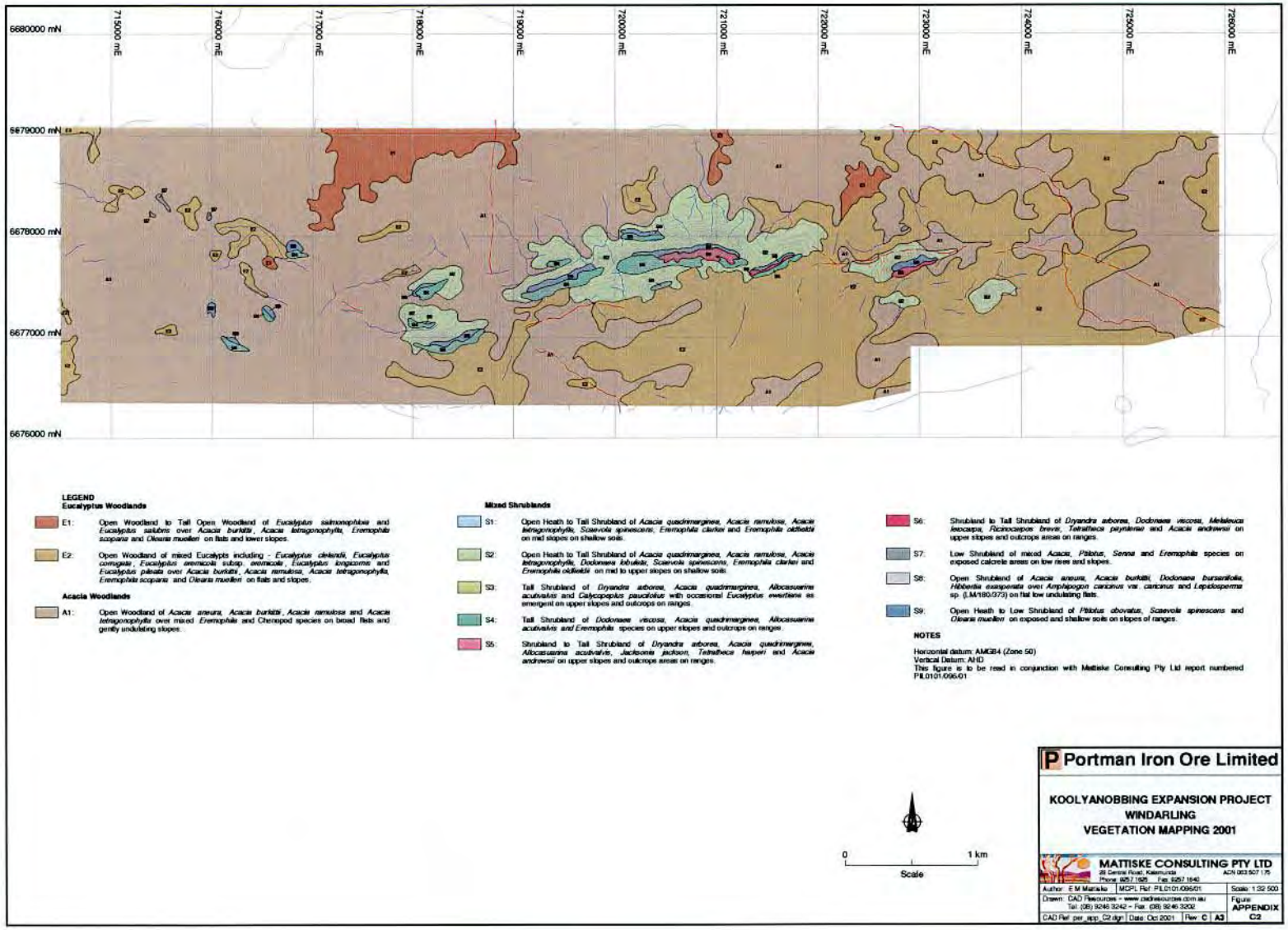
0 20 km
Scale

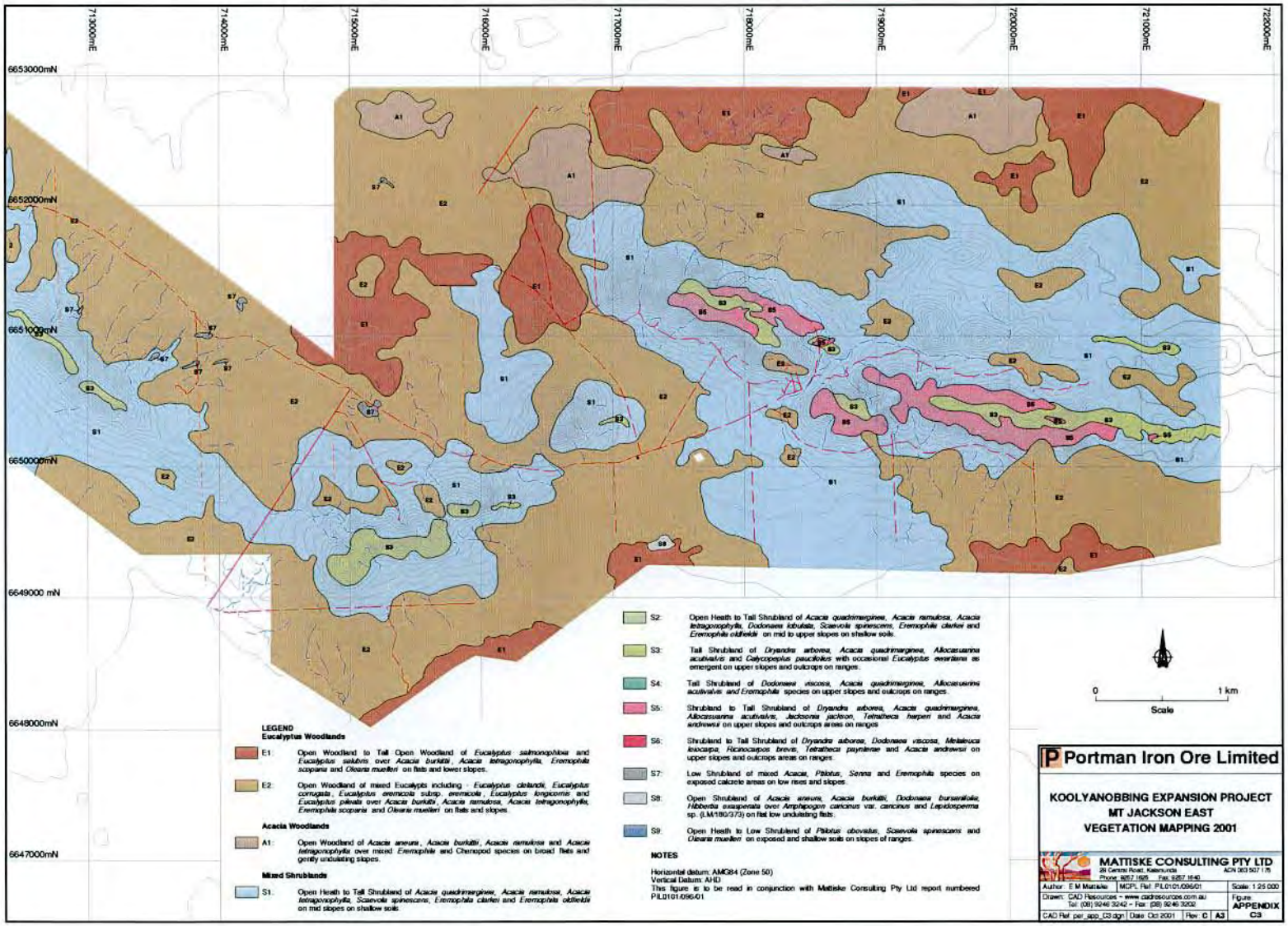
Portman Iron Ore Limited

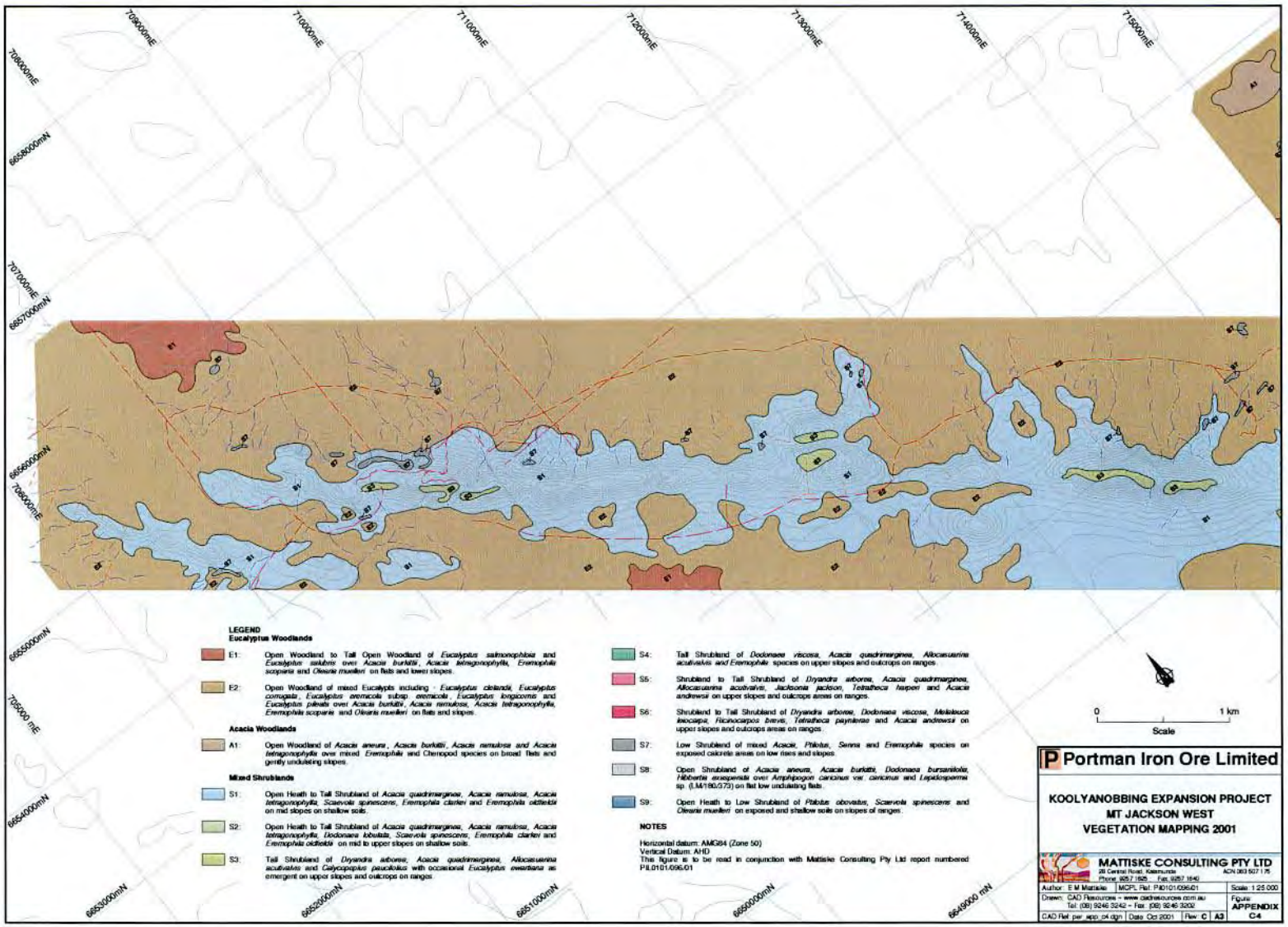
KOOLYANOBBING EXPANSION PROJECT
BEARD VEGETATION

MATTISKE CONSULTING PTY LTD
28 Central Road, Kelmscott ACN 063 507 176
Phone: 9257 1625 Fax: 9257 1848

Author: E.M Mattiske	MCPL Ref: PIL0101/096/01		Scale: 1:500 000
Drawn: CAD Resources – www.cadresources.com.au Tel: (08) 9246 3242 – Fax: (08) 9246 3202			Figure: APPENDIX C1
CAD Ref: per_app_C1.dgn	Date: Oct 2001	Rev: A A3	


6680000 mN
6679000 mN
6678000 mN
6677000 mN
6676000 mN
715000 mE
716000 mE
717000 mE
718000 mE
719000 mE
720000 mE
721000 mE
722000 mE
723000 mE
724000 mE
725000 mE
726000 mE
LEGEND
Eucalyptus Woodlands
E1: Open Woodland to Tall Open Woodland of Eucalyptus salmonophloia and Eucalyptus salubris over Acacia burkittii, Acacia tetragonophylla, Eremophila scoparia and Olearia muelleri on flats and lower slopes.
E2: Open Woodland of mixed Eucalypts including - Eucalyptus oleosa, Eucalyptus corrugata, Eucalyptus eremicola subsp. eremicola, Eucalyptus longicornis and Eucalyptus pileata over Acacia burkittii, Acacia ramulosa, Acacia tetragonophylla, Eremophila scoparia and Olearia muelleri on flats and slopes.
Acacia Woodlands
A1: Open Woodland of Acacia ansura, Acacia burkittii, Acacia ramulosa and Acacia tetragonophylla over mixed Eremophila and Chenopod species on broad flats and gently undulating slopes.
Mixed Shrublands
S1: Open Heath to Tall Shrubland of Acacia quadrimarginea, Acacia ramulosa, Acacia tetragonophylla, Scaevola spinescens, Eremophila clarkei and Eremophila oldfieldii on mid slopes on shallow soils.
S2: Open Heath to Tall Shrubland of Acacia quadrimarginea, Acacia ramulosa, Acacia tetragonophylla, Dodonaea lobulata, Scaevola spinescens, Eremophila clarkei and Eremophila oldfieldii on mid to upper slopes on shallow soils.
S3: Tall Shrubland of Dryandra arborea, Acacia quadrimarginea, Allocasuarina acutivalvis and Callycopolus paucifolius with occasional Eucalyptus ewartiana as emergent on upper slopes and outcrops on ranges.
S4: Tall Shrubland of Dodonaea viscosa, Acacia quadrimarginea, Allocasuarina acutivalvis and Eremophila species on upper slopes and outcrops on ranges.
S5: Shrubland to Tall Shrubland of Dryandra arborea, Acacia quadrimarginea, Allocasuarina acutivalvis, Jacksonia jacksoni, Tetratheca hisperi and Acacia andrewsii on upper slopes and outcrops areas on ranges.
S6: Shrubland to Tall Shrubland of Dryandra arborea, Dodonaea viscosa, Melaleuca leucopia, Ricinocarpos brevis, Tetratheca paynterae and Acacia andrewsii on upper slopes and outcrops areas on ranges.
S7: Low Shrubland of mixed Acacia, Ptilotus, Senna and Eremophila species on exposed calcrete areas on low rises and slopes.
S8: Open Shrubland of Acacia ansura, Acacia burkittii, Dodonaea bursariifolia, Hibbertia exasperata over Amphipogon caricinus var. caricinus and Lepidosperma sp. (LM/180/373) on flat low undulating flats.
S9: Open Heath to Low Shrubland of Ptilotus obovatus, Scaevola spinescens and Olearia muelleri on exposed and shallow soils on slopes of ranges.
NOTES
Horizontal datum: AMG84 (Zone 50)
Vertical Datum: AHD
This figure is to be read in conjunction with Mattiske Consulting Pty Ltd report numbered PIL0101.006-01
0
1 km
Scale
Portman Iron Ore Limited
KOOLYANOBBING EXPANSION PROJECT
WINDARLING
VEGETATION MAPPING 2001
MATTISKE CONSULTING PTY LTD
38 Centre Road, Kalamunda ACN 053 507 175
Phone: 9257 1525 Fax: 9257 1640
Author: E M Mattiske | MCPL Ref: PIL0101.006/01 | Scale: 1:32 500
Drawn: CAD Resources - www.cadresources.com.au Tel: (08) 9246 3242 - Fax: (08) 9246 3302 | Figure: APPENDIX C2
CAD Ref: per_app_C2.dgn | Date: Oct 2001 | Rev: C | A3


713000mE
714000mE
715000mE
716000mE
717000mE
718000mE
719000mE
720000mE
721000mE
722000mE
6653000mN
6652000mN
6651000mN
6650000mN
6649000 mN
6648000mN
6647000mN
LEGEND
Eucalyptus Woodlands
E1: Open Woodland to Tall Open Woodland of Eucalyptus salmonophloia and Eucalyptus salubris over Acacia burkittii, Acacia tetragonophylla, Eremophila scoparia and Olearia muelleri on flats and lower slopes.
E2: Open Woodland of mixed Eucalypts including - Eucalyptus clelandii, Eucalyptus corrugata, Eucalyptus eremicola subsp. eremicola, Eucalyptus longicornis and Eucalyptus pileata over Acacia burkittii, Acacia ramulosa, Acacia tetragonophylla, Eremophila scoparia and Olearia muelleri on flats and slopes.
Acacia Woodlands
A1: Open Woodland of Acacia aneura, Acacia burkittii, Acacia ramulosa and Acacia tetragonophylla over mixed Eremophila and Chenopod species on broad flats and gently undulating slopes.
Mixed Shrublands
S1: Open Heath to Tall Shrubland of Acacia quadrimarginea, Acacia ramulosa, Acacia tetragonophylla, Scaevola spinescens, Eremophila clarkei and Eremophila oldfieldii on mid slopes on shallow soils.
S2: Open Heath to Tall Shrubland of Acacia quadrimarginea, Acacia ramulosa, Acacia tetragonophylla, Dodonaea lobulata, Scaevola spinescens, Eremophila clarkei and Eremophila oldfieldii on mid to upper slopes on shallow soils.
S3: Tall Shrubland of Dryandra arborea, Acacia quadrimarginea, Allocasuarina acutivalvis and Calycopeplus paucifolius with occasional Eucalyptus exeriana as emergent on upper slopes and outcrops on ranges.
S4: Tall Shrubland of Dodonaea viscosa, Acacia quadrimarginea, Allocasuarina acutivalvis and Eremophila species on upper slopes and outcrops on ranges.
S5: Shrubland to Tall Shrubland of Dryandra arborea, Acacia quadrimarginea, Allocasuarina acutivalvis, Jacksonia jacksonii, Tetratheca harperi and Acacia andrewsii on upper slopes and outcrops areas on ranges
S6: Shrubland to Tall Shrubland of Dryandra arborea, Dodonaea viscosa, Melaleuca leiocarpa, Ricinocarpos brevis, Tetratheca paynterae and Acacia andrewsii on upper slopes and outcrops areas on ranges.
S7: Low Shrubland of mixed Acacia, Ptilotus, Senna and Eremophila species on exposed calcrete areas on low rises and slopes.
S8: Open Shrubland of Acacia aneura, Acacia burkittii, Dodonaea bursariifolia, Hibbertia exasperata over Amphipogon caricinus var. caricinus and Lepidosperma sp. (LM/180/373) on flat low undulating flats.
S9: Open Heath to Low Shrubland of Ptilotus obovatus, Scaevola spinescens and Olearia muelleri on exposed and shallow soils on slopes of ranges.
NOTES
Horizontal datum: AMG84 (Zone 50)
Vertical Datum: AHD
This figure is to be read in conjunction with Mattiske Consulting Pty Ltd report numbered PIL0101/096/01
0
1 km
Scale
Portman Iron Ore Limited
KOOLYANOBBING EXPANSION PROJECT
MT JACKSON EAST
VEGETATION MAPPING 2001
MATTISKE CONSULTING PTY LTD
Author: E M Mattiske
MCPL Ref: PIL0101/096/01
Scale: 1:25 000
Drawn: CAD Resources - www.cadresources.com.au
Tel: (08) 9246 3242 - Fax: (08) 9246 3202
Figure: APPENDIX C3
CAD Ref: per_app_C3.dgn
Date: Oct 2001
Rev: 0
A3


708000mE
709000mE
710000mE
711000mE
712000mE
713000mE
714000mE
715000mE
6658000mN
6657000mN
6656000mN
6655000mN
6654000mN
6653000mN
6652000mN
6651000mN
6650000mN
6649000 mN
707000mE
708000mE
705000 mE
LEGEND
Eucalyptus Woodlands
E1: Open Woodland to Tall Open Woodland of Eucalyptus salmonophloia and Eucalyptus salubris over Acacia burkittii, Acacia tetragonophylla, Eremophila scoparia and Olearia muelleri on flats and lower slopes.
E2: Open Woodland of mixed Eucalypts including : Eucalyptus clelandi, Eucalyptus corrugata , Eucalyptus aremicola subsp. aremicola , Eucalyptus longicornis and Eucalyptus pileata over Acacia burkittii, Acacia nimulosa, Acacia tetragonophylla, Eremophila scoparia and Olearia muelleri on flats and slopes.
Acacia Woodlands
A1: Open Woodland of Acacia aneura , Acacia burkittii, Acacia nimulosa and Acacia tetragonophylla over mixed Eremophila and Chenopod species on broad flats and gently undulating slopes.
Mixed Shrublands
S1: Open Heath to Tall Shrubland of Acacia quadrimarginea, Acacia nimulosa, Acacia tetragonophylla, Scaevola spinescens, Eremophila clarkei and Eremophila oldfieldii on mid slopes on shallow soils.
S2: Open Heath to Tall Shrubland of Acacia quadrimarginea, Acacia nimulosa, Acacia tetragonophylla, Dodonaea lobulata, Scaevola spinescens, Eremophila clarkei and Eremophila oldfieldii on mid to upper slopes on shallow soils.
S3: Tall Shrubland of Dryandra arborea, Acacia quadrimarginea, Allocasuarina acutivalvis and Calycopeplus paucifolius with occasional Eucalyptus ewartiana as emergent on upper slopes and outcrops on ranges.
S4: Tall Shrubland of Dodonaea viscosa, Acacia quadrimarginea, Allocasuarina acutivalvis and Eremophila species on upper slopes and outcrops on ranges.
S5: Shrubland to Tall Shrubland of Dryandra arborea, Acacia quadrimarginea, Allocasuarina acutivalvis, Jacksonia jacksoni, Tetratheca haperi and Acacia andrewsii on upper slopes and outcrops areas on ranges.
S6: Shrubland to Tall Shrubland of Dryandra arborea, Dodonaea viscosa, Melaleuca leiocarpa, Ricinocarpos brevis, Tetratheca paynterae and Acacia andrewsii on upper slopes and outcrops areas on ranges.
S7: Low Shrubland of mixed Acacia, Ptilotus, Senna and Eremophila species on exposed calcrete areas on low rises and slopes.
S8: Open Shrubland of Acacia aneura, Acacia burkittii, Dodonaea bursariifolia, Hibbertia exasperata over Amphipogon caricinus var. caricinus and Lepidosperma sp. (LM/180/373) on flat low undulating flats.
S9: Open Heath to Low Shrubland of Ptilotus obovatus, Scaevola spinescens and Olearia muelleri on exposed and shallow soils on slopes of ranges.
NOTES
Horizontal datum: AMG84 (Zone 50)
Vertical Datum: AHD
This figure is to be read in conjunction with Mattiske Consulting Pty Ltd report numbered P#J0101.096/01
0
1 km
Scale
Portman Iron Ore Limited
KOOLYANOBBING EXPANSION PROJECT
MT JACKSON WEST
VEGETATION MAPPING 2001
MATTISKE CONSULTING PTY LTD
28 Central Road, Kalamunda ACN 063 507 175
Phone: (08) 9257 1625 Fax: (08) 9257 1640
Author: E.M Mattiske | MCPL Ref: P#J0101.096/01 | Scale: 1:25 000
Drawn: CAD Resources - www.cadresources.com.au Tel: (08) 9246 3242 - Fax: (08) 9246 3200 | Figure: APPENDIX C4
CAD Ref: per_app_c4.dgn | Date: Oct 2001 | Rev: C | A3

MJ = Mt Jackson
WIN = Windarling
BU = Bungalbin
RC = Transportation Corridor
• denotes introduced species

State Conservation Codes:
R = DRF taxa
P1 = Priority 1
P2 = Priority 2
P3 = Priority 3
P4 = Priority 4

Federal Conservation Codes:
V = Vulnerable
E = Endangered

FAMILY		Species	RC	BU	MJ	WIN
OPHIOGLOSSACEAE		*Ophioglossum lusitanicum*		1		
ADIANTACEAE		*Cheilanthes austrotenuifolia*	1	31	14	
		Cheilanthes brownii		5		
		Cheilanthes lasiophylla	1	3	3	3
		Cheilanthes sieberi subsp. sieberi	2	7	11	29
CUPRESSACEAE		*Callitris canescens*	2			
		Callitris glaucophylla			3	2
		Callitris tuberculata	1			
JUNCAGINACEAE		*Triglochin* sp. scps		1		
POACEAE	•	*Aira caryophyllea*	7	10	12	21
		Amphipogon caricinus var. *caricinus*	3	1	2	
		Amphipogon strictus	4	2	14	
		Aristida contorta	11		5	2
		Austrodanthonia caespitosa	7	10	16	27
		Austrodanthonia setacea		3		
		Austrodanthonia sp. (EB/W148/06)				1
		Austrodanthonia sp. scps		1		
		Austrostipa elegantissima	18	52	32	21
		Austrostipa nitida	12		2	
		Austrostipa platychaeta		3	1	
		Austrostipa scabra			13	29
		Austrostipa trichophylla	9	28	17	8
		Austrostipa sp. (BR/D3/018)			1	
		Austrostipa sp. (EB/W142/003)				9
		Austrostipa sp. (LM/158/030)	1			
		Austrostipa sp. (LM/175/999)			2	
		Austrostipa sp. (LM/186/466)			1	
		Austrostipa sp. (PGA/153/057)		1		
		Bromus arenarius		4	1	2
	•	*Bromus diandrus*		1	1	4
	•	*Bromus rubens*		3	1	8
		Elymus scaber		3		3
		Enneapogon caerulescens				2
		Eragrostis dielsii	1		1	
		Eragrostis eriopoda		1		
		Eriachne pulchella subsp. *pulchella*			1	
		Eriachne sp. caperg		1		
		Monachather paradoxus	2		9	5
		Neurachne sp. Helena & Aurora		39		
	•	*Pentaschistis airoides*	1	9	8	6
	•	*Rostraria pumila*			1	
		Triodia rigidissima	5	10		
		Triodia scariosa	1			

FAMILY	Species	RC	BU	MJ	WIN
	Triodia sp. (LM/162/056)	1			
	Triodia sp. (LM/167/079)		1		
	Triodia sp. (LM/169/117)		1		
	Triodia sp. (LM/172/169)		1		
	Triodia sp. (LM/J34/039)	2			
	• *Vulpia bromoides*		1		
	• *Vulpia myuros*		9		
	• *Vulpia myuros* var. *myuros*	1	2	2	2
	Poaceae sp. (BR/D3/006)			1	
	Poaceae sp. (BR/D4/006)			1	
	Poaceae sp. (EB/W144/001)				1
	Poaceae sp. (LM/172/179)		1		
POACEAE cont.	Poaceae sp. (LM/174/234)			1	
	Poaceae sp. (LM/175/256)			1	
	Poaceae sp. (LM/177/317)			1	
	Poaceae sp. (LM/183/416)			1	
	Poaceae sp. (LM/184/999)			1	
	Poaceae sp. (LM/189/517)			1	
	Poaceae sp. (LM/193/578)			1	
	Poaceae sp. (PGA/151/018)		1		
	Poaceae sp. (PGA/153/059)		1		
	Poaceae sp. (PGA/155/132)		1		
CYPERACEAE	*Lepidosperma* aff. *angustatum* scps		4	2	
	Lepidosperma sp. (LM/180/373)			1	
	Lepidosperma sp. (PGA/154/103)		1		
	Lepidosperma sp. (PGA/155/119)		1		
	Schoenus nanus		3		
DASYPOGONACEAE	*Chamaexeros macranthera*		4		
	Lomandra effusa		1	1	
PHORMIACEAE	*Dianella revoluta* var. *divaricata*	1	22	13	7
ANTHERICACEAE	*Sowerbaea multicaulis* (P4)	1			
	Thysanotus manglesianus	1	1	1	4
	Thysanotus patersonii		23	2	1
ASPHODELACEAE	*Bulbine semibarbata*		1		
HAEMODORACEAE	*Conostylis argentea*		5		
ORCHIDACEAE	*Caladenia incrassata*		2		
	Caladenia microchila		2		
	Caladenia saccharata		1		
	Cyanicula amplexans		2		
	Pterostylis picta		3		
	Pterostylis sp. inland		10		
	Thelymitra aff. *macrophyllum* scps		8		
CASUARINACEAE	*Allocasuarina acutivalvis*		10		
	Allocasuarina acutivalvis subsp. *acutivalvis*	3	4	22	4
	Allocasuarina campestris	1	2		
	Allocasuarina dielsiana			5	4
	Allocasuarina eriochlamys subsp. *eriochlamys*		3	4	
	Allocasuarina sp. (BR/J7)			1	
	Casuarina pauper	2		1	3
URTICACEAE	*Parietaria cardiostegia*		2		
PROTEACEAE	*Dryandra arborea*	1	19	13	4
	Dryandra sp. (LM/179/353)			1	
	Grevillea acuaria	1	1		

FAMILY	Species	RC	BU	MJ	WIN
	Grevillea erectiloba (P4)			1	
	Grevillea excelsior	2			
	Grevillea georgeana (P3)		2		
	Grevillea haplantha subsp. *haplantha*		2		
	Grevillea juncifolia subsp. *temulenta*	1			
	Grevillea paradoxa	1	1	4	
	Grevillea sarissa subsp. *sarissa*			3	1
	Grevillea zygoloba	3	28	11	
PROTEACEAE cont.	*Grevillea* sp. (LM/170/140)		1		
	Grevillea sp. (LM/J39/151)	2			
	Hakea minyma		4		
	Hakea recurva subsp. *recurva*	3		5	1
	Isopogon gardneri			1	
SANTALACEAE	*Exocarpos aphyllus*	5	9	4	
	Santalum acuminatum	5	2	3	
	Santalum spicatum	2	12	16	18
LORANTHACEAE	*Amyema benthamii*			1	1
	Amyema miquelii	2	2	5	
	Amyema preissii		1		
	Amyema sp. (BR/D4/026)			1	
	Amyema sp. (LM/187/999)			1	
	Amyema sp. (PGA/164/171)		1		
POLYGONACEAE *	*Acetosa vesicaria*				
CHENOPODIACEAE	*Atriplex amnicola*	3		2	
	Atriplex hymenotheca			1	
	Atriplex nummularia		13		
	Atriplex nummularia subsp. *spathulata*	8	1	10	2
	Atriplex paludosa subsp. *baudinii*	1			
	Atriplex vesicaria	9	14	7	
	Atriplex vesicaria subsp. *variabilis*	1			
	Dissocarpus paradoxus				4
	Enchylaena lanata	1		2	
	Enchylaena tomentosa		5		
	Enchylaena tomentosa var. *tomentosa*			2	13
	Eriochiton sclerolaenoides			6	1
	Halosarcia pruinosa	1			
	Maireana ?lobiflora	1			
	Maireana appressa			1	
	Maireana carnosa	2		2	
	Maireana georgei	10	22	20	15
	Maireana planifolia	1			
	Maireana radiata		3		1
	Maireana tomentosa subsp. *tomentosa*	7	2		2
	Maireana trichoptera	7	15	3	
	Maireana triptera	5		12	1
	Maireana sp. (BR/W127/999)				1
	Maireana sp. (LM/178/327)			1	
	Maireana sp. carn		1		
	Rhagodia drummondii	4	5	9	12
	Rhagodia eremaea				1
	Rhagodia preissii subsp. *preissii*	1	1		
	Rhagodia spinescens	1			
	Sclerolaena bicornis	8	1	15	2

FAMILY		Species	RC	BU	MJ	WIN
		Sclerolaena convexula			1	
		Sclerolaena densiflora	7		2	
		Sclerolaena diacantha	4	14	4	2
		Sclerolaena fusiformis	1	5	1	4
		Sclerolaena patenticuspis			10	2
		Sclerolaena sp. (PGA/151/023)		1		
		Chenopodiaceae sp. (BR/W115/004)				1
		Chenopodiaceae sp. (EB/W148/009)				1
AMARANTHACEAE		*Ptilotus aervoides*		3	1	
		Ptilotus carlsonii		2		
		Ptilotus divaricatus var. *divaricatus*	2		9	
		Ptilotus drummondii	1	4	3	
		Ptilotus drummondii var. *drummondii*		11		
		Ptilotus exaltatus		13		
		Ptilotus exaltatus var. *villosus*	11	1	18	5
		Ptilotus gaudichaudii		13		
		Ptilotus gaudichaudii var. *gaudichaudii*	2		11	5
		Ptilotus helipteroides			3	1
		Ptilotus holosericeus	4	11	4	
		Ptilotus obovatus	11	24	34	36
		Ptilotus polystachyus	1			
		Ptilotus sp. (PGA/155/122)		1		
		Ptilotus sp. (PGA/163/166)		1		
GYROSTEMONACEAE		*Codonocarpus cotinifolius*	2			
		Gyrostemon ramulosus	2			
AIZOACEAE		*Gunniopsis quadrifida*		1		
	•	*Mesembryanthemum nodiflorum*		1		
		Tetragonia sp. indet h&h		1		
PORTULACACEAE		*Calandrinia corrigioloides*		9		
		Calandrinia eremaea		5		
		Calandrinia sp. scps		7		
CARYOPHYLLACEAE	•	*Cerastium glomeratum*		1		
		Stellaria filiformis		1		
LAURACEAE		*Cassytha melantha*		4	1	
		Cassytha nodiflora			1	
BRASSICACEAE	•	*Carrichtera annua*			2	
		Lepidium genistoides (P2)	1			
		Lepidium oxytrichum		2		
		Lepidium rotundum		4		
		Lepidium sp. scps		1		
		Stenopetalum filifolium	2	4	10	9
		Stenopetalum robustum		12		
		Brassicaceae sp. (LM/159/038)	1			
DROSERACEAE		*Drosera macrantha subsp. macrantha*		8		
		Drosera sp. (LM/191/544)			1	
		Drosera sp. (PGA/154/104)		1		
CRASSULACEAE		*Crassula colorata*		9		
		Crassula colorata var. *acuminata*	1	1	2	3
PITTOSPORACEAE		*Cheiranthera filifolia* var. *filifolia*	1		1	
		Pittosporum phylliraeoides		1		
		Pittosporum phylliraeoides var. *microcarpa*	3	1	1	1
MIMOSACEAE		*Acacia acanthoclada* subsp. *acanthoclada*			1	
		Acacia acanthoclada subsp. *glaucescens* (P3)			2	

FAMILY		Species	RC	BU	MJ	WIN
		Acacia acuminata	2	5	2	
		Acacia acuminata(narrow phyllode variant)			1	
		Acacia adinophylla (P1)		7		
		Acacia andrewsii	1		3	5
MIMOSACEAE cont.		*Acacia aneura*	1	5	8	16
		Acacia aneura var. *aneura*	2		2	2
		Acacia assimilis subsp. *assimilis*	3	1	1	
		Acacia assimilis subsp. *atroviridis*		2	1	
		Acacia ayersiana			3	11
		Acacia burkittii	6	1	13	6
		Acacia colletioides	5	6	1	
		Acacia coolgardiensis subsp. *effusa*		2		3
		Acacia cylindrica (P3)		1		
		Acacia eremophila		2		
		Acacia erinacea	1	7	7	2
		Acacia glutinosissima		1		
		Acacia hemiteles	1	2		
		Acacia ligulata			1	
		Acacia minyura			3	4
		Acacia multispicata		1		
		Acacia nyssophylla			1	
		Acacia oswaldii	1			
		Acacia prainii	3	5		
		Acacia quadrimarginea	2	20	25	27
		Acacia ramulosa var. *ramulosa*	3		14	34
		Acacia resinimarginea		5	1	
		Acacia steedmanii			1	
		Acacia stowardii				1
		Acacia tetragonophylla	7	7	19	27
		Acacia sp. (LM/189/510)			1	
		Acacia sp. (PGA/163/167)		1		
CAESALPINIACEAE		*Senna artemisioides* subsp. *filifolia*	7	16	10	6
PAPILIONACEAE (FABACEAE)		*Bossiaea walkeri*	1	2	1	
		Daviesia purpurascens (P4)	2	6	3	
		Jacksonia jackson (P2)			7	
		Mirbelia depressa			2	
		Mirbelia sp. Helena & Aurora(B.J.Lepschi 2003)		9	1	3
		Swainsona kingii		1		
		Swainsona oliveri		1		
		Swainsona sp. carn		1		
		Templetonia sulcata	3	1		
GERANIACEAE	•	*Erodium botrys*			1	
	•	*Erodium cicutarium*		1		
		Erodium cygnorum subsp. *cygnorum*		13		
OXALIDACEAE		*Oxalis perennans*		1		
	•	*Oxalis* sp. scps		2		
ZYGOPHYLLACEAE		*Zygophyllum eremaeum*		5		2
		Zygophyllum fruticulosum	11	2	17	2
		Zygophyllum ovatum		12		
RUTACEAE		*Phebalium canaliculatum*	4	4		1
		Phebalium filifolium			1	
		Phebalium lepidotum			1	
		Phebalium tuberculosum		1		

APPENDIX D – FLORA SPECIES LIST

FAMILY	Species	RC	BU	MJ	WIN
	Philotheca brucei subsp. *brucei*	3	21	19	10
	Philotheca tomentella	1	1		
TREMANDRACEAE	*Tetratheca aphylla* (R, V)		7		
	Tetratheca harperi (R, V)			2	
	Tetratheca paynterae (R, E)				3
POLYGALACEAE	*Comesperma calymega*	1			
	Comesperma integerrimum		11	2	2
EUPHORBIACEAE	*Beyeria brevifolia* var. *brevifolia*			1	
	Beyeria lechenaultii var. *drummondii*	1		1	
	Calycopeplus paucifolius	1	17	11	
	Monotaxis occidentalis		1		
	Ricinocarpos brevis (P1)			6	9
SAPINDACEAE	*Dodonaea bursariifolia*			1	
	Dodonaea inaequifolia		2	4	
	Dodonaea lobulata	1	6	5	7
	Dodonaea microzyga		2		
	Dodonaea microzyga var. *acrolobata*		1	3	7
	Dodonaea pinifolia		1		3
	Dodonaea rigida	3		1	6
	Dodonaea viscosa		2		
	Dodonaea viscosa subsp. *angustissima*	1			
	Dodonaea viscosa subsp. *mucronata*			2	8
	Dodonaea sp. (LM/187/999)			1	
	Dodonaea sp. (LM/J41/180)	1			
RHAMNACEAE	*Stenanthemum intricatum*		1		
	Stenanthemum newbeyi (P1)		11		
	Stenanthemum stipulosum		12	6	
	Trymalium myrtillus subsp. *myrtillus*		2		
MALVACEAE	*Abutilon oxycarpum*				2
	Lawrencia repens		1		
	Sida calyxhymenia		2	18	23
	Sida excedentifolia			1	4
STERCULIACEAE	*Brachychiton gregorii*		2	7	2
	Hannafordia quadrivalvis	1			
	Keraudrenia integrifolia	6		8	
DILLENIACEAE	*Hibbertia exasperata*	1	19	20	4
	Hibbertia rostellata			2	
	Hibbertia sp. aff. rostellata			4	
FRANKENIACEAE	*Frankenia setosa*	1			
THYMELAEACEAE	*Pimelea spiculigera* var. *thesioides*			1	
MYRTACEAE	*Aluta appressa*		2	2	
	Aluta aspera	1			
	Baeckea elderiana		2	1	
	Calothamnus gilesii			1	
	Calytrix aff. *strigosa*	2			
	Eucalyptus calycogona subsp. *calycogona*			1	1
	Eucalyptus capillosa subsp. *capillosa*		3		
	Eucalyptus celastroides		1		
	Eucalyptus clelandii			1	
	Eucalyptus corrugata	4	17	5	4
	Eucalyptus ebbanoensis		23		
MYRTACEAE cont.	*Eucalyptus ebbanoensis* subsp. *ebbanoensis*	1	15	7	
	Eucalyptus eremicola subsp. *eremicola*			7	8

FAMILY	Species	RC	BU	MJ	WIN
	Eucalyptus ewartiana			5	
	Eucalyptus griffithsii	1			
	Eucalyptus hypochlamydea subsp. *hypochlamydea*		2		
	Eucalyptus longicornis	2	3	6	
	Eucalyptus loxophleba subsp. *lissophloia*	1	3		1
	Eucalyptus loxophleba subsp. *loxophleba*	2			
	Eucalyptus oldfieldii	3			
	Eucalyptus oleosa				1
	Eucalyptus aff. *oleosa caperg*		1		
	Eucalyptus pileata	1		4	
	Eucalyptus ravida	3	1		
	Eucalyptus salmonophloia	3	3	1	
	Eucalyptus salubris	4	2	9	
	Eucalyptus sheathiana		4	2	
	Eucalyptus transcontinentalis	1	2	1	
	Eucalyptus yilgarnensis		2		
	Eucalyptus sp. (BR/W137/999)				1
	Eucalyptus sp. (PGA/153/054)		1		
	Homalocalyx thryptomenoides	2			
	Leptospermum fastigiatum	1			
	Leptospermum roei		1		
	Malleostemon roseus	1			
	Melaleuca leiocarpa	1	11	10	17
	Melaleuca nematophylla		12		
	Melaleuca radula			3	
	Melaleuca uncinata	1	7	3	
	Micromyrtus obovata			1	
	Rinzia carnosa		1		
	Thryptomene kochii	3		1	
HALORAGACEAE	*Glischrocaryon aureum* var. *angustifolium*	2		1	
	Gonocarpus confertifolius var. *confertifolius*	2		1	
	Gonocarpus nodulosus		1		
	Haloragis gossei		4		
	Haloragis trigonocarpa	1	1	5	1
APIACEAE	*Daucus glochidiatus*	2	23	5	4
	Hydrocotyle rugulosa		10		
	Trachymene ceratocarpa		5		
	Trachymene ornata	1	30	1	1
	Trachymene pilosa		4		
EPACRIDACEAE	*Leucopogon* sp. Clyde Hill (M.A.Burgman)	2	15	13	
LOGANIACEAE	*Phyllangium paradoxum*		9	1	
APOCYNACEAE	*Alyxia buxifolia*	1	21	13	1
ASCLEPIADACEAE	*Marsdenia australis*		1	3	
	Rhyncharrhena linearis		3	2	
CUSCUTACEAE	*Cuscuta* sp.				1
BORAGINACEAE	*Halgania cyanea* var. *tuberculosa*	1			
	Halgania viscosa			1	
CHLOANTHACEAE	*Cyanostegia angustifolia*	2			
	Hemiphora elderi		1		
	Lachnostachys coolgardiensis	1			
	Pityrodia lepidota	1			
	Spartothamnella puberula (P2)		1		
	Spartothamnella teucriiflora			2	6

FAMILY	Species	RC	BU	MJ	WIN
LAMIACEAE	*Prostanthera althoferi* subsp. *althoferi*	1		3	3
	Prostanthera campbellii	1		2	
	Prostanthera grylloana		6	4	5
	Prostanthera magnifica		2	2	
	Prostanthera aff. *striatiflora*			7	
	Prostanthera sp. (LM/174/240)			2	
	Prostanthera sp. (LM/177/320)			1	
	Prostanthera sp. (LM/190/999)			1	
	Westringia cephalantha	3	10	12	28
	Westringia rigida	1			
	Wrixonia prostantheroides				4
SOLANACEAE	*Duboisia hopwoodii*	2			
	Nicotiana occidentalis		3		
	Nicotiana ?rotundifolia			1	
	Solanum cleistogamum	1		3	
	Solanum ellipticum				
	Solanum lasiophyllum		1	7	17
	Solanum nummularium	1			1
	Solanum orbiculatum	2	1	7	3
	Solanum orbiculatum subsp. *orbiculatum*		4		
	Solanum petrophilum				1
	Solanum terraneum	1		3	
MYOPORACEAE	*Eremophila alternifolia*	1			
	Eremophila caperata	2			
	Eremophila clarkei		11	10	15
	Eremophila compacta subsp. *compacta*			3	11
	Eremophila decipiens subsp. *decipiens*	1	9	1	
	Eremophila drummondii	1	4	3	
	Eremophila georgei		1		
	Eremophila gibbosa		2		
	Eremophila glabra subsp. *glabra*			1	
	Eremophila glabra subsp. *tomentosa*	7	1	9	16
	Eremophila granitica	1	10		
	Eremophila interstans		2		
	Eremophila interstans subsp. *interstans*	1		1	
	Eremophila ionantha	1	4		
	Eremophila latrobei		2		
	Eremophila latrobei subsp. *latrobei*			6	9
	Eremophila oldfieldii		1		
	Eremophila oldfieldii subsp. *angustifolia*	4		17	26
	Eremophila oppositifolia		11		
	Eremophila oppositifolia subsp. *oppositifolia*	1	1	4	2
	Eremophila paisleyi			1	
	Eremophila sp. Mt Jackson (G.J. Keighery) (P1)				
	Eremophila pantonii	2		2	
	Eremophila racemosa (P4)				1
	Eremophila rugosa		6		
	Eremophila scoparia	5	6	13	
	Eremophila serrulata			2	
	Eremophila viscida (R, E)				
MYOPORACEAE cont.	*Eremophila ?viscida*			1	
	Eremophila sp.		2		
	Eremophila sp. (LM/169/115)		1		

FAMILY	Species	RC	BU	MJ	WIN
	Eremophila sp. (LM/174/218)			1	
	Eremophila sp. (LM/175/251)			1	
	Eremophila sp. (LM/176/272)			1	
	Eremophila sp. (LM/176/282)			1	
	Eremophila sp. (LM/177/314)			1	
	Eremophila sp. (LM/180/366)			1	
	Eremophila sp. (LM/180/377)			1	
	Eremophila sp. (LM/187/487)			1	
	Eremophila sp. (LM/198/661)			1	
	Eremophila sp. (LM/J29/050)	1			
	Eremophila sp. (LM/J36/101)	1			
	Eremophila sp. (PGA/154/086)		1		
	Eremophila sp. (PGA/156/143)		1		
	Eremophila sp. (PGA/165/203)		1		
	Eremophila sp. (PGA/166/225)		1		
	Eremophila sp. indet gold		1		
PLANTAGINACEAE	*Plantago* aff. *hispidula* ng & ml CARN AHB		9		
	Plantago drummondii		1		
	Plantago turrifera		1		
RUBIACEAE	• *Galium murale*		2		
	Psydrax attenuata			1	
	Psydrax suaveolens				1
CAMPANULACEAE	*Wahlenbergia* sp. carn		1		
	Wahlenbergia tumidifructa		5		
LOBELIACEAE	*Isotoma petraea*	1		2	4
	Lobelia gibbosa		1		
	Lobelia winfridae				1
	Lobelia sp. (PGA/165/218)		1		
	Lobeliaceae sp. (LM/167/088)		1		
GOODENIACEAE	*Brunonia australis*	1	13	9	
	Dampiera lavandulacea	1	1		
	Goodenia berardiana		8		1
	Goodenia caerulea	1			
	Goodenia elderi	1			
	Goodenia havilandii		1	1	
	Goodenia mimuloides		1		
	Goodenia occidentalis		10		
	Goodenia sp. (BR/J1/003)			8	22
	Goodenia sp. (LM/J32/077)	1			
	Goodenia sp. scps		5		
	Scaevola spinescens	10	19	30	31
	Velleia cycnopotamica	3	1	16	18
	Velleia discophora	1			
	Velleia rosea	3	16	6	
ASTERACEAE	*Actinobole uliginosum*		2		
	Bellida graminea		4		
	Blennospora drummondii		5		
	Brachyscome ciliaris		3		
	Brachyscome ciliaris var. *lanuginosa*	2	1		2
	Brachyscome perpusilla		1		
ASTERACEAE cont.	*Brachyscome* sp. scps		2		
	Calotis hispidula		8		
	• *Centaurea melitensis*	1	2	1	

FAMILY	Species	RC	BU	MJ	WIN
	Cephalipterum drummondii	2	4	5	
	Ceratogyne obionoides		5		
	Chthonocephalus pseudevax		1		
	Erymophyllum ramosum subsp. *ramosum*	7		8	3
	Gilberta tenuifolia		10	1	1
	Gilruthia osbornei		8	2	
	Gnephosis arachnoidea	1	1		1
	Gnephosis tenuissima	1			
	Hyalosperma demissum		2		
	Hyalosperma glutinosum subsp. *glutinosum*		5		
•	*Hypochaeris glabra*	2	4	3	5
	Isoetopsis graminifolia		3		
	Lawrencella davenportii		1		
	Lawrencella rosea		16		2
	Lemooria burkittii		1		
	Leucochrysum fitzgibbonii	6	12	13	
	Millotia myosotidifolia		11		4
	Minuria cunninghamii		1		
	Olearia decurrens		1		
	Olearia exiguifolia		1	2	1
	Olearia humilis		1	3	
	Olearia muelleri	9	36	22	10
	Olearia pimeleoides	9	21	14	27
	Olearia stuartii		3	14	2
	Podolepis canescens	2	11	15	18
	Podolepis capillaris	5	3	2	2
	Podolepis lessonii	9	3	9	12
	Podotheca gnaphalioides		1	1	
	Pogonolepis stricta		3		
	Pogonolepis sp. (LM/188/502)			1	
	Rhodanthe battii	1		2	26
	Rhodanthe chlorocephala subsp. *rosea*		3	5	2
	Rhodanthe citrina	7	6	17	
	Rhodanthe laevis		19		
	Rhodanthe manglesii		1		
	Rhodanthe oppositifolia		8		
	Rhodanthe pygmaea		1		
	Rhodanthe rubella		3		
	Rhodanthe stricta		2		
	Rhodanthe sp. (LM/168/141)		1		
	Schoenia cassiniana	4	8	12	17
	Senecio glossanthus		11		
	Senecio quadridentatus		4		
•	*Sonchus asper*			1	
•	*Sonchus oleraceus*		6		5
	Streptoglossa liatroides		1		
	Trichanthodium skirrophorum		7		
	Triptilodiscus pygmaeus		2		
	Vittadinia sp. (LM/J26/008)	2		8	1
	Waitzia acuminata	4	35	30	36
	Asteraceae sp. (BR/W124/002)				1
	Asteraceae sp. (LM/189/552)			1	
	Asteraceae sp. (PGA/156/136)		1		

E1 FROGS AND REPTILES

E2 BIRDS

E3 MAMMALS

Study Areas:

MJ = Mt Jackson

WIN = Windarling

BU = Bungalbin

RC =Transportation Corridor

X = recorded during current surveys

M = Biological Survey of the Eastern Goldfields (CALM/WAM data)

U = Bungalbin (UWA data)

FROGS	MJ	WIN	BU	TC
Neobatrachus kunapalari			U	
Neobatrachus sutor			M	
Pseudophryne occidentalis	M		U	

REPTILES	MJ	WIN	BU	TC
Skinks				
Cryptoblepharus carnabyi	X	X	XM	X
Cryptoblepharus plagiocephalus	M		XMU	X
Ctenotus atlas	M		MU	X
Ctenotus brooksi			U	
Ctenotus mimetes	M		U	X
Ctenotus leonhardii			MU	
Ctenotus pantherinus			U	
Ctenotus schomburgkii	M		MU	X
Ctenotus uber	XM	X	XMU	X
Ctenotus xenopleura			MU	
Cyclodomorphus melanops	M		XM	X
Egernia depressa	M	X		
Egernia formosa				X
Egernia inornata	M		MU	X
Eremiascincus richardsonii	X		XU	X
Hemiergis initialis	XM	X	XM	
Lerista gerrardii	M			X
Lerista macropisthopus	XM	X	MU	
Lerista muelleri	XM	X	XM	X
Menetia greyii	XM	X	XMU	X
Morethia butleri	XM	X	XMU	X
Morethia obscura			U	
Tiliqua occipitalis			MU	
Tiliqua rugosa				X

REPTILES	MJ	WIN	BU	TC
Agamids (Dragons)				
Ctenophorus cristatus	XM		MU	X
Ctenophorus fordi			MU	
Ctenophorus isolepis			MU	
Ctenophorus maculatus			U	
Ctenophorus reticulatus	M	X	MX	X
Ctenophorus scutulatus	M		XMU	
Moloch horridus	M		MU	X
Pogona minor	XM	X	XMU	X
Tympanocryptis cephalus	M		XM	
Varanids (Goannas)				
Varanus caudolineatus		X		
Varanus giganteus	XM	X	XM	
Varanus gouldii	XM		MU	X
Varanus tristis	XM		X	X
Geckos				
Crenadactylus ocellatus			XMU	X
Diplodactylus (Strophurus) assimilis	M		XMU	
Diplodactylus (Strophurus) elderi			MU	
Diplodactylus granariensis	XM	X	XMU	X
Diplodactylus maini	M		MU	X
Diplodactylus pulcher	XM	X	XMU	X
Diplodactylus stenodactylus			MU	
Gehyra variegata	XM	X	XMU	X
Heteronotia binoei	XM	X	XMU	X
Nephrurus stellatus			MU	
Nephrurus vertebralis	M			
Oedura reticulata	XM		XM	X
Rhynchoedura ornata	XM		XMU	
Underwoodisaurus milii	XM	X	XM	X
Pygopods (Legless lizards)				
Aprasia repens			U	
Delma australis	XM	X	M	X
Delma butleri			XU	X
Delma nasuta	M		M	
Lialis burtonis	M		U	
Pygopus lepidopodus		X	X	
Pygopus nigriceps	M		U	
Blind snakes				
Ramphotyphlops australis	X		XMU	
Ramphotyphlops bituberculatus			X	
Ramphotyphlops hamatus		X	M	
Pythons				
Liasis stimsoni	M			
Morelia spilota imbricata		X		
Elapid snakes			X	
Furina ornata	M		U	X
Pseudechis australis				X
Pseudonaja affinis	X		U	
Pseudonaja modesta				X
Pseudonaja nuchalis	XM		U	
Rhinoplocephalus (Parasuta) monachus	M		XMU	X
Simoselaps bertholdi	M		U	
Simoselaps fasciolatus	XM		MU	
Simoselaps (Brachyurophis) semifasciatus				

BIRDS	MJ	WIN	BU	TC
Non-passerines				
Emu Dromaius novaehollandiae	XM	X	XU	X
White-necked Heron Ardea pacifica	M			
Square-tailed Kite Lophoictinia isura	XM		U	X
Brown Goshawk Accipiter fasciatus	X		U	X
Collared Sparrowhawk Accipiter cirrocephalus	M	X	U	
Wedge-tailed Eagle Aquila audax	XM	X	XMU	X
Little Eagle Hieraeetus morphnoides	M		MU	X
Peregrine Falcon Falco peregrinus	M	X	MU	
Australian Hobby Falco longipennis	M		U	
Brown Falcon Falco berigora	XM	X	MU	X
Nankeen Kestrel Falco cenchroides	M	X	XMU	X
Malleefowl Leipoa ocellata	XM		MU	X
Australian Bustard Ardeotis australis	XM			
Little Button-quail Turnix velox	M	X	U	
Black-fronted Dotterel Elseyornis melanops	M			
Common Bronzewing Phaps chalcoptera	XM	X	MU	X
Galah Cacatua roseicapilla	XM	X	MU	
Pink Cockatoo Cacatua leadbeateri	X		U	X
Red-tailed Black Cockatoo Calyptorhynchus magnificus	XM		M	
Cockatiel Nymphicus hollandicus			U	
Purple-crowned Lorikeet Glossopsitta porphyrecephala	XM	X	XMU	X
Regent Parrot Polytelis anthopeplus	XM	X	U	
Budgerigar Melopsittacus undulatus			U	
Australian Ringneck Barnardius zonarius	XM	X	XMU	X
Western Rosella Platycercus icterotis	M			
Mulga Parrot Psephotus varius		X	U	
Pallid Cuckoo Cuculus pallidus			U	
Fan-tailed Cuckoo Cuculus flabelliformis			U	
Black-eared Cuckoo Chrysococcyx osculans	M		U	
Horsfield's Cuckoo Chrysococcyx basalis			U	
Southern Boobook Ninox novaeseelandiae	M		XMU	X
Barn Owl Tyto alba	X			X
Tawny Frogmouth Podargus strigoides	M		MU	X
Australian Owlet-nightjar Aegotheles cristatus	XM		MU	X
Spotted Nightjar Eurostopodus argus	XM		XMU	X
Red-backed Kingfisher Todiramphus pyrrhopygia	X	X	XU	X
Rainbow Bee-eater Merops ornatus	XM	X	XMU	X
Passerines				
Black-faced Cuckoo-shrike Coracina novaehollandiae	XM	X	XMU	X
Ground Cuckoo-shrike Coracina maxima			XU	
White-winged Triller Lalage sueurii	M		U	
Southern Scrub-robin Drymodes brunneopygia	M		XU	
Red-capped Robin Petroica goodenovii	XM		XMU	X
Hooded Robin Melanodryas cucullatus	XM	X	XMU	
Western Yellow Robin Eopsaltria griseogularis			XMU	
Jacky Winter Microeca leucophaea	XM	X	XMU	X
Gilbert's Whistler Pachycephala inornata	M		U	
Golden Whistler Pachycephala pectoralis	M		MU	
Rufous Whistler Pachycephala rufiventris	XM	X	XMU	X
Grey Shrike-thrush Colluricincla harmonica	XM	X	XMU	X
Crested Bellbird Oreoica gutturalis	XM	X	XMU	X
Magpie-lark Grallina cyanoleuca	M			
Grey Fantail Rhipidura fuliginosa	X		MU	
White-tailed Fantail Rhipidura albicauda	M	X	U	
Willie Wagtail Rhipidura leucophrys	XM	X	XMU	X

BIRDS	MJ	WIN	BU	TC
Chestnut Quail-thrush Cinclosoma castanotum	XM	X	XMU	X
White-browed Babbler Pomatostomus superciliosus	XM	X	MU	X
Rufous Songlark Cinclorhamphus mathewsi	M		U	
Splendid Fairy-wren Malurus splendens	XM	X	MU	X
Blue-breasted Fairy-wren Malurus pulcherrimus			XMU	
White-winged Fairy-wren Malurus leucopterus	XM		U	
Shy Heathwren Hylacola cauta	X		MU	X
Redthroat Pyrrholaemus brunneus	XM	X	XMU	X
Rufous Fieldwren Calamanthus campestris		X	MU	
Weebill Smicrornis brevirostris	XM		XMU	X
Western Gerygone Gerygone fusca	M		MU	
Inland Thornbill Acanthiza apicalis	XM	X	XMU	X
Chestnut-rumped Thornbill Acanthiza uropygialis	XM	X	XMU	X
Slaty-backed Thornbill Acanthiza robustirostris		X	U	X
Yellow-rumped Thornbill Acanthiza chrysorrhoa	XM	X	XMU	X
Southern Whiteface Aphelocephala leucopsis	M	X	MU	X
Striated Pardalote Pardalotus striatus	XM	X	XMU	X
Varied Sittella Daphoenositta chrysoptera	M		XMU	X
White-browed Treecreeper Climacteris affinis	X	X		
Rufous Treecreeper Climacteris rufa	M	X	XMU	X
Red Wattlebird Anthochaera carunculata	XM	X	XMU	X
Spiny-cheeked Honeyeater Acanthagenys rufogularis	XM	X	XMU	X
Yellow-throated Miner Manorina flavigula	XM	X	XMU	X
Singing Honeyeater Lichenostomus virescens	XM	X	XMU	X
White-eared Honeyeater Lichenostomus leucotis	XM	X	XMU	X
Yellow-plumed Honeyeater Lichenostomus ornatus	XM	X	XMU	X
Brown-headed Honeyeater Melithreptus brevirostris	XM	X	XMU	X
Brown Honeyeater Lichmera indistincta	XM		XMU	X
White-fronted Honeyeater Phylidonyris albifrons	XM		MU	X
Tawny-crowned Honeyeater Phylidonyris melanops			U	
Black Honeyeater Certhionyx niger			U	
Pied Honeyeater Certhionyx variegatus			U	
White-fronted Chat Epthianura albifrons			U	
Crimson Chat Epthianura tricolor	M			X
Mistletoebird Dicaeum hirundinaceum	XM	X	XMU	
Zebra Finch Taeniopygia guttata	XM		MU	
Masked Woodswallow Artamus personatus			U	
Black-faced Woodswallow Artamus cinereus			MU	X
Dusky Woodswallow Artamus cyanopterus	XM		XMU	
Little Woodswallow Artamus minor	XM	X	XMU	
Grey Butcherbird Cracticus torquatus	XM	X	XMU	X
Pied Butcherbird Cracticus nigrogularis	XM	X	XMU	X
Magpie Gymnorhina tibicen	XM	X	XMU	X
Grey Currawong Strepera versicolor	XM	X	XMU	X
Australian Raven Corvus coronoides	XM		X	X
Little Crow Corvus bennettii	M		XMU	X
Torresian Crow Corvus orru			MU	
Richard's Pipit Anthus novaeseelandiae	M		M	X
White-backed Swallow Cheramoeca leucosternum	X			X
Welcome Swallow Hirundo neoxena	X		X	
Fairy Martin Hirundo ariel		X		
Tree Martin Cecropis nigrican	XM	X	XMU	X

MAMMALS	MJ	WIN	BU	TC
Native species				
Monotremes				
Echidna Tachyglossus aculeatus	SM	S	S	S
Marsupials				
Pseudantechinus Pseudantechinus woolleyae	X(S)		X	
Ningaui Ningaui ridei			MU	
Ningaui Ningaui yvonnae			XMU	
Dunnart Sminthopsis crassicaudata	M			
Dunnart Sminthopsis dolichura	XM	X	XMU	X
Dunnart Sminthopsis hirtipes			MU	
Pygmy Possum Cercartetus concinnus	XM	X	XMU	X
Grey Kangaroo Macropus fuliginosus	XM		MU	X
Euro Macropus robustus	XMS	XS	XMU	
Red Kangaroo Macropus rufus	XM		U	
Bats				
Mormopterus planiceps	M			
Nyctinomus australis	XM		M	
Chalinolobus gouldii	M		M	
Chalinolobus morio			M	
Nyctophilus geoffroyi	XM		MU	
Nyctophilus cf. gouldi	M		MU	
Scotorepens balstoni	M		M	
Vespadelus baverstocki		X		
Vespadelus regulus	XM		M	X
Rodents				
Native Mouse Pseudomys albocinereus			MU	X
Native Mouse Pseudomys bolami			U	
Native Mouse Pseudomys hermannsburgensis	XM		XMU	X
Hopping Mouse Notomys alexis			MU	
Hopping Mouse Notomys mitchelli	M		MU	
Introduced species				
Recent invaders				
Dingo Canis familiaris dingo	XM	XS	XM	X
Naturalised				
House Mouse Mus musculus	XM	X	XMU	
Rabbit Oryctolagus cuniculus	XM	X	XMU	
Feral				
Cattle Bos taurus		X		
Goat Capra hircus	XMS		X	
Feral Cat Felis catus	XM			
Fox Vulpes vulpes	XM		M	

DRAFT MEMORANDUM OF UNDERSTANDING

ON

COLLABORATIVE LAND MANAGEMENT IN THE WINDARLING, MT JACKSON RANGE & HELENA – AURORA RANGE AREA

1. PREAMBLE

1.1 This Memorandum of Understanding (the MOU) is between the Western Australian Department of Conservation and Land Management (CALM) as managers of the Mt Manning Nature Reserve and adjacent access of UCL (former pastoral leases) and Portman Iron Ore Limited (Portman) as holders of various mining and exploration leases adjacent to the Nature Reserve.

1.2 This MOU recognises the desire of CALM and Portman for areas proposed as reserves and to progress conservation tenure arrangements, to integrate management practices for the subject land to enhance the conservation, values of the area whilst permitting a variety of land uses (including mining). It does not in any way detract from legal requirements binding either party in their operations or planning.

2. MANAGEMENT GOALS

2.1 Management will recognise the value of the area's physical and biological resources for supporting multiple uses, including conservation, mineral production, and cultural activities.

2.2 Management goals for the area will incorporate the facilitation of uses that are compatible within the subject land. Management will recognise that where uses are unable to be managed compatibly, the priority use(s) will prevail. The relative priority of uses will vary spatially and over time, and the parties will consult regularly in determining such priorities.

2.3 The parties will consult and aim for compatible management practices of issues relating to cross-boundary effects – especially those issues of cultural, fire and threatened species and community management, weed and feral animal control, and tourism.

3. SCOPE

3.1 The initial scope of the MOU will be to facilitate cooperation/operation between CALM and Portman in:

i) land management;
ii) research and monitoring;
iii) education;
iv) publicity; and
v) progressing conservation tenure arrangements.

3.2 The area covered by the MOU will include the Management Area encompassed by the exploration and mining leases held by Portman (see Schedule 1) on Mt Jackson and Diemals pastoral leases, Unallocated Crown Land (UCL) and the adjoining Mt Manning Range nature reserve marked in blue on the attached map. Management priorities within these areas will vary as described in clause 2.2.

4. MANAGEMENT PLANS

4.1 Management plans will be prepared for the Management Area by Portman. Sections of these plans with implications for this MOU will be developed in consultation with, and for agreement between Portman and CALM.

4.2 Management plans to be developed will include:

- Biodiversity Management Plan;
- Mining Environmental Management Plan;
- Threatened Flora Management & Conservation Plan;
- Mallefowl Conservation Plan; and
- Conservation Tenure Implementation Plan.

5. ADMINISTRATION

5.1 Each party will bear their own costs of administration and management activities undertaken in support of this agreement, but may identify and implement projects which have been agreed to be funded jointly.

5.2 A Management Advisory Group consisting of two representatives from each party will be established. Regular and ad hoc meetings of this group will produce recommendations for approval by senior management from each party. The management advisory group may co-opt staff or external advisors to assist in their deliberations.

5.3 Both parties will work together to facilitate the involvement of other stakeholders in decisions regarding the management and tenure of the area.

6. RESEARCH, MONITORING & EDUCATION

6.1 Both parties will encourage, support and undertake research into effectiveness of management practices in meeting management goals and in the development of new management techniques.

6.2 Annual monitoring of the success of management will be undertaken by both parties using a compatible format to be coordinated through the Management Advisory Group.

6.3 The results of research and management will be made available to the broader public through demonstration and education projects supported by the two parties. This will be extended as an awareness course to cover personnel from operating mines and exploration projects.

7. LONG-TERM GOALS

7.1 Following the operation of this MOU for a period of five (5) years, the management arrangements will be reviewed jointly by both parties with the intent of examining the suitability of placing this MOU within a wider programme such as the "Man and the Biosphere" programme of the United Nations.

8. REVIEW AND TERMINATION

8.1 The MOU, the area it covers, and its terms will be review annually to determine whether it remains applicable and useful.

8.2 The MOU may be terminated by either party through three month's written notice.

SCHEDULE 1

The mining and exploration leases held by Portman Iron Ore Limited and related companies which will be subject to this Memorandum of Understanding are:

Lease No.	Location

APPENDIX G1: SUMMARY OF RARE AND PRIORITY FLORA RECORDED IN THE LOCAL AND REGIONAL CONTEXT BY WAHERB, GIBSON, ECOLOGIA AND MATTISKE CONSULTING PTY LTD.

SCC - State Conservation Code (based on Wildlife Conservation Act 1950)

FCC - Federal Conservation Code EPBCAct 1999

WAH - Number of records extracted from WAHERB (October 2001)

GIB - Number of records from Gibson et al. (1997a, b, c and d), including collections in text and not in plots

ECOL - Number of records extracted from Ecologia studies at Koolyanobbing and Highclere Hills

MCPL - Number of records extracted from Mattiske Consulting Pty Ltd at Helena and Aurora Ranges (Bungalbin), Mt Jackson Ranges, Windarling, Die Hardy Ranges, Mt Manning and on the corridors

(1) - Includes only those species recorded in the plots

(2) - Includes those populations in both the plots and from other observations and recordings in the project area

SPECIES	SCC	FCC	WAH	GIB	ECO (1)	ECO (2)	MCPL (1)	MCPL (2)
Acacia acanthoclada subsp. *glaucescens*	P3	-	2	2	1	2	2	6
Acacia adinophylla	P1	-	15	4	-	-	3	3
Acacia ascendens	P2	-	21	-	-	-	-	-
Acacia crenulata	P3	-	4	-	-	-	-	-
Acacia cylindrica	P3	-	5	1	-	-	-	-
Acacia formidabilis	P3	-	2	-	-	-	-	-
Acacia lobulata	R	E	21	-	-	-	-	-
Acacia subrigida	P2	-	1	-	-	-	-	-
Alyxia tetanifolia	P3	-	1	-	-	-	-	-
Astartea sp. Bungalbin Hill (K.R. Newbey 8989)	P3	-	5	-	-	-	-	-
Astartea sp. Mt Dimer (C.McChesney TRL4/72)	P1	-	1	-	-	-	-	-
Austrostipa blackii	P3	-	8	2	-	-	-	-
Banksia lullfitzii	P3	-	1	-	-	-	-	-
Brachyscome halophila	P3	-	1	-	-	-	-	-
Brachysola halganiacea	P2	-	1	-	-	-	-	-
Calothamnus superbus	P1	-	1	-	-	-	-	-
Calytrix creswellii	P1	-	13	1	-	-	-	-
Calytrix plumulosa	P3	-	2	-	-	-	-	-
Chamelaucium paynterae	P1	-	4	-	-	-	-	-
Darwinia acerosa	R	E	2	-	-	-	-	-
Darwinia sp. Chiddarcooping (S.D.Hopper 6944)	P4	-	1	-	-	-	-	-
Daviesia microphylla	P4	-	1	-	-	-	-	-
Daviesia purpurascens	P4	-	6	5	-	-	6	6
Echinopogon ovatus subsp. *pubiglumis*	P1	-	1	1	-	-	-	-
Elachanthus pusillus	P2	-	1	1	-	-	-	-
Eremophila adenotricha	P1	-	2	-	-	-	-	-
Eremophila caerulea subsp. *merrallii* ms	P4	-	5	1	-	-	-	-

SPECIES	SCC	FCC	WAH	GIB	ECO (1)	ECO (2)	MCPL (1)	MCPL (2)
Eremophila complanata	P2	–	1	–	–	–	–	–
Eremophila racemosa	P4	–	–	–	–	–	–	1
Eremophila virens	R	E	4	–	–	–	–	–
Eremophila viscida	R	E	7	–	2	2	–	–
Eremophila ?viscida	R	E	–	–	–	–	–	1
Eremophila sp. Mt Jackson (G.J.Keighery 4372)	P1	–	3	2	–	–	–	–
Eucalyptus brevipes	R	E	5	–	–	–	–	–
Eucalyptus caesia	P4	–	20	–	–	–	–	–
Eucalyptus formanii	P4	–	39	5	1	1	6	19
Eucalyptus olivacea	R	V	1	–	–	–	–	–
Euryomyrtus leptospermoides	P3	–	1	–	–	–	–	–
Frankenia brachyphylla	P2	–	1	–	–	–	–	–
Gnephosis intonsa	P1	–	1	1	–	–	–	–
Gnephosis sp. Norseman (KRN 8096) Gold	P1	–	1	1	–	–	–	–
Gompholobium asperulum	P3	–	2	–	–	–	–	–
Grevillea erectiloba	P4	–	16	2	–	–	1	1
Grevillea eriobotrya	P3	–	1	–	–	–	–	–
Grevillea georgeana	P3	–	24	6	3	3	18	19
Grevillea tetrapleura	P4	–	5	–	–	–	–	–
Gunniopsis rubra	P3	–	2	–	–	–	–	–
Haegiela tatei	P2	–	1	–	–	–	–	–
Hakea rigida	P2	–	1	–	–	–	–	–
Halosarcia flabelliformis	P1	–	1	–	–	–	–	–
Hibbertia graniticola	P3	–	8	–	–	–	–	–
Homalocalyx grandiflorus	P1	–	3	–	–	–	–	–
Jacksonia jackson	P2	–	4	–	–	–	7	10
Labichea eremaea	P1	–	1	–	–	–	–	–
Lepidium genistoides	P2	–	2	–	1	1	1	1
Lepidium merrallii	P2	–	1	–	–	–	–	–
Leptospermum macgillivrayi	P1	–	1	–	–	–	–	1
Leucopogon sp. Helena and Aurora Range (B.J. Lepschi 2077)	P1	–	2	1	–	–	–	3
Leucopogon sp. Kau Rock (M.A.Burgman 1126)	P1	–	1	–	–	–	–	–
Leucopogon sp. Marvel Loch (R.J.Cranfield & P. Spencer 7790)	P2	–	3	1	–	–	–	–
Malleostemon sp. Adelong (G.J. Keighery 11825)	P2	–	1	–	–	–	–	–
Mirbelia densiflora	P1	–	–	1	–	–	–	–
Microcorys lenticularis	P2	–	1	–	–	–	–	–
Myriophyllum lapidicola	R	E	3	–	–	–	–	–
Myriophyllum petraeum	P4	–	1	–	–	–	–	–
Persoonia leucopogon	P1	–	2	–	–	–	–	–
Phlegmatospermum eremaeum	P2	–	2	–	–	–	–	–
Philotheca langei	P1	–	5	–	–	–	–	–
Pityrodia scabra	R	E	2	–	–	–	–	–
Ricinocarpos brevis	P1	–	3	–	–	–	15	25
Sowerbaea muliticaulis	P4	–	5	–	–	–	1	2
Spartothamnella puberula	P2	–	–	–	–	–	1	3
Stenanthemum newbeyi	P1	–	9	11	2	4	8	11
Stylidium chiddarcoopingense	P2	–	1	–	–	–	–	–

SPECIES	SCC	FCC	WAH	GIB	ECO (1)	ECO (2)	MCPL (1)	MCPL (2)
Stylidium choreanthum	P2	–	6	–	–	–	–	–
Stylidium merrallii	R	V	5	–	–	–	–	–
Stylidium neglectum	P3	–	1	–	–	–	–	–
Stylidium rhipidium	P3	–	1	–	–	–	–	–
Tetratheca aphylla	R	V	9	3	–	–	4	35
Tetratheca harperi	R	V	8	–	–	–	2	20
Tetratheca paynterae	R	E	7	–	–	–	3	7
Tetratheca ?aff. *paynterae*	?	?	–	–	–	–	2	11
Tricoryne tuberosa	P1	–	1	2	–	–	–	–
Verticordia mitoides	P3	–	4	–	–	–	–	–
Verticordia pulchella	P2	–	1	–	–	–	–	–
Verticordia stenopetala	P3	–	1	–	–	–	–	–
Wurmbea murchisoniana	P4	–	1	–	–	–	–	–

APPENDIX G2: SUMMARY OF OTHER SIGNIFICANT FLORA IN THE RESPECTIVE LOCALITIES

Context by WAHERB, Gibson, Ecologia and Mattiske Consulting Pty Ltd.

Other Significant Species	CORR	DHR	HA	HH	HYW	KOOL	MJ	MM	WIN	Local	Regional
Geographically Restricted and Taxa in need of further Taxonomic Investigations											
Acacia sp. (EB/J47/02)		+								+	
Chthonocephalus sp. 'gold' is an unconfirmed identification								+		+	
Lepidosperma aff. *angustatum*			+				+			+	
Lepidosperma sp. (LM/180/373)							+			+	
Lepidosperma sp. (PGA/154/103)			+							+	
Lepidosperma sp. (PGA/155/119)			+							+	
Neurachne sp. Helena and Aurora (K.R. Newbey 8972)			+							+	
Philotheca deserti				+						+	
Tetratheca ?aff.*paynterae*		+								+	
Southern and South-western Extensions											
Abutilon otocarpum								+			+
Abutilon oxycarpum				+				+	+		+
Acacia coolgardiensis subsp. *effusa*			+	+				+	+		+
Allocasuarina acutivalvis subsp. *prinsepiana*		+									+
Aluta aspera subsp. *aspera*	+							+			+
Cheilanthes brownii			+								+
Dampiera roycei								+			+
Eremophila compacta subsp. *compacta*							+		+		+
Eremophila georgei			+			+					+
Eremophila glabra subsp. *tomentosa*	+		+				+		+		+
Gnephosis arachnoidea	+	+	+	+					+		+
Lepidium muelleri-ferdinandii					+						+
Nicotiana occidentalis			+	+	+			+			+
Olearia decurrens			+								+
Ptilotus leucocoma								+			+
Stenopetalum pedicellare								+			+
Stylobasium spathulatum				+							+
Trachymene ceratocarpa			+	+							+
Northern Extensions											
Acacia pachypoda					+						+
Caesia occidentalis				+							+
* *Cerastium glomeratum*			+	+							+
Comesperma calymega	+										+
Cryptandra graniticola		+									+
Drosera menziesii				+		+		+			+
Eucalyptus loxophleba subsp. *loxophleba*	+										+
Goodenia caerulea	+										+
Halgania rigida						+					+
* *Heliophila pusilla*				+							+
Isopogon gardneri							+				+
Micromyrtus imbricata					+						+

Other Significant Species	CORR	DHR	HA	HH	HYW	KOOL	MJ	MM	WIN	Local	Regional
Northern Extensions (continued)											
Monotaxis occidentalis			+		+						+
Stenanthemum intricatum			+								+
Stylidium repens		+						+			+
Eastern and South-eastern Extension											
Acacia xerophila var. *brevior*				+		+					+
Acacia xerophila var. *xerophila*		+									+
Angianthus milnei				+							+
Atriplex amnicola	+						+				+
Brachyscome ciliaris var. *lanuginosa*	+	+	+	+					+		+
* *Bromus diandrus*			+	+		+	+		+		+
Dampiera oligophylla						+					+
Hannafordia quadrivalvis	+										+
Hibbertia spicata								+			+
Hyalosperma cotula				+							+
Stylidium induratum								+			+
Triglochin calcitrapa					+						+
* *Urospermum picroides*				+							+