PUBLIC**ENVIRONMENTAL****REVIEW**

invitation to make a submission

Invitation to make a submission

Invitation

The Environmental Protection Authority (EPA) invites people to make a submission on this proposal. Both electronic and hard copy submissions are most welcome.

Karara Mining Limited (KML), a company being used by the joint venture between Gindalbie Metals Ltd and Anshan Iron and Steel Group, proposes to develop the Karara Iron Ore Project (KIOP) based on its mineral deposits at the Mid-West Regions of Western Australia.

The KIOP will consist of open-cut mining of iron ore, on-site processing to produce magnetite concentrate, and transport via rail to the Port of Geraldton for export to international markets. The project will include the construction of an accommodation village and airstrip at the minesite, and a linear infrastructure corridor containing a process water pipeline between the proposed borefield at Twin Hills groundwater sub-area near Mingenew and the minesite. Access to the minesite will be provided by upgrading an existing road between Morawa and the minesite.

Process water will be sourced from a borefield near Mingenew and piped to the minesite. Approval to abstract groundwater is being sought by KML under the *Rights in Water and Irrigation Act 1916*. As such, issues associated with development of the borefield are not addressed in this PER. Rail services will be supplied by a third party rail service provider, and electricity will be supplied by Western Power. Any approvals that may be required for this infrastructure will be sought by the relevant proponents supplying the services. KML has addressed the establishment of a high voltage electricity transmission powerline connection to Western Power's South West Interconnected System in the Mungada Iron Ore Project proposal also being assessed by the EPA.

In accordance with the *Environmental Protection Act 1986*, a Public Environmental Review (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 4 weeks from 15 September 2008, closing on 13 October 2008.

Comments from government agencies and from the public will assist 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 1992*, (FOI 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 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 proposal. 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 environmentally more 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; and
- 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; and
- 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
- Whether you want your submission to be confidential and the reason why you want your submission to be confidential

The closing date for submissions is: **13 October 2008**

The EPA prefers submissions to be made electronically using one of the following:

- The submission form on the EPA's website: www.epa.wa.gov.au/submissions.asp;
- By email to submissions.eia@dec.wa.gov.au.

Alternatively submissions can be:

Posted to:

Chairman
Environmental Protection Authority
Locked Bag 33
CLOISTERS SQUARE WA 6850
Attention: Nyomi Bowers

Delivered to:

Environmental Protection Authority
Level 4, The Atrium
168 St Georges Terrace
PERTH WA 6000
Attention : Nyomi Bowers

Faxed to:

(08) 6467 5562
Attention: Nyomi Bowers

If you have any questions on how to make a submission, please ring the EPA assessment officer, Nyomi Bowers on (08) 6467 5000.

CONTENTS

CONTENTS

CONTENTS

CONTENTS

CONTENTS

CONTENTS

CONTENTS

CONTENTS

CONTENTS

Figure List

CONTENTS

Figure List (cont'd)

CONTENTS

Plate List

CONTENTS

Table List

CONTENTS

Table List (cont'd)

Box List

i

PUBLIC**ENVIRONMENTAL****REVIEW**

executive summary

Executive Summary

1 Introduction

Karara Mining Limited (KML) is proposing to develop the Karara Iron Ore Project. KML is the company being used by the joint venture between Gindablie Metals Ltd (Gindalbie) and Anshan Iron and Steel Group Corporation (AnSteel) to implement the project. The proposed Karara minesite is located in the Mid-West Region of Western Australia, approximately 215 km east-southeast of Geraldton and 320 km north-northeast of Perth (Figure ES1).

Development of the Karara Mine, processing plant and associated infrastructure is referred to as the Karara Iron Ore Project or KIOP. Separate environmental approval is being sought to develop the Mungada Iron Ore Project (MIOP). The KIOP and MIOP together constitute the greater Karara Iron Ore Project. This Public Environmental Review (PER) document addresses the KIOP component of the greater Karara Iron Ore Project.

The cumulative impact of the KIOP, MIOP and the proposed Midwest Corporation redevelopment of the Blue Hills project are subject to a separate impact evaluation submitted to the Environmental Protection Authority (EPA) as an attachment to this PER (refer Volume 2).

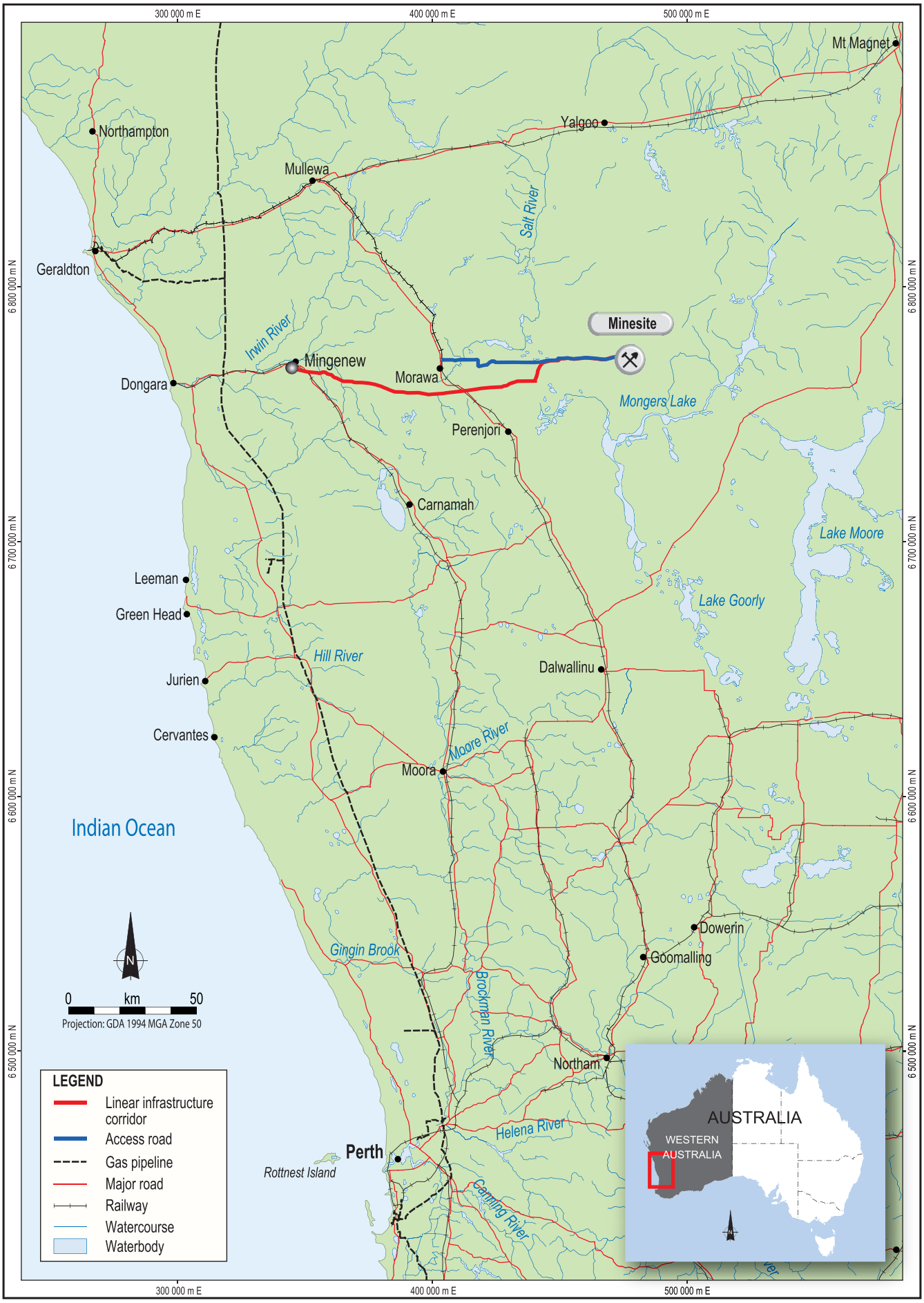
The KIOP magnetite reserve is currently estimated at 497 Mt and the additional resource at 929 Mt. Additional resources are expected following further resource definition, drilling and testing. The current mine design allows for a mine life of 40 years. It is planned to produce saleable magnetite concentrate at a rate of 12 Mtpa. Development of the iron ore mine will also produce approximately 0.8 Mt of saleable hematite ore.

The major components of the project are:

- construction and operation of a single large open pit and associated waste rock dump, processing plant to produce magnetite concentrate, tailings storage, and supporting services and infrastructure (minesite);
- development of a linear infrastructure corridor to accommodate a raw water pipeline and a fibre optic telecommunications cable (linear infrastructure corridor); and
- upgrading of an existing road between Morowa and the minesite to provide access to the mine (access road).

The Environmental Protection Authority (EPA) will assess the project by means of a PER. Accordingly, this document has been prepared to meet the requirements of Part IV, Division 1 of the *Environmental Protection Act 1986* (EP Act) and the EPA guidelines for the preparation of a PER.

Figure ES1 Project location



2 Proponent

KML (ACN 070 871 831) is the company being used by the joint venture between Gindalbie and AnSteel to develop, manage and operate the KIOP. The proponent contact details are provided in Table ES1.

Table ES1 Proponent contact details

Karara Mining Limited

Location
Level 9, London House 216 St Georges Terrace Perth Western Australia 6000

Postal Address
PO Box 7200, Cloisters Square Perth Western Australia 6000 Telephone: (08) 9480 8700 Facsimile: (08) 9480 8799 Contact: Greg Kaeding Community Relations and Environment Manager Telephone: (08) 9480 8700 Facsimile: (08) 9480 8799 greg.kaeding@gindalbie.com.au

Gindalbie (formerly Gindalbie Gold NL) was listed on the Australian Stock Exchange in April 1994 and has established itself as a successful minerals explorer and producer.

AnSteel is listed as China's second largest, and the world's eighth largest, steel producer. The Chinese Central Government considers AnSteel to be one of the country's key growth companies and strongly supports securing new long-term sources of iron ore through international investment. AnSteel reports that the China National Development Bank financially supports its investments.

3 Project Rationale

3.1 Demand for Iron Ore and Regional Development

Australia is the world's third largest producer of iron ore and the largest exporter, exporting primarily to steel producers in Northeast Asia and Western Europe. Production of iron ore is important to the economy of Western Australia (accounting for more than 20% of the Gross State Product) and a major contributor to the national economy. Western Australia produces over 90% of Australia's iron ore.

High demand from China's rapidly growing steel industry is expected to fuel growth of the Western Australian iron ore industry to predicted production levels of 520 million tonnes by 2015.

The Mid-West Region is set to become the second highest iron ore producing region in Western Australia. The top producing region, the Pilbara, is expected to produce 340 million tonnes this year. Future production from the Mid-West Region is projected to grow from 75 to 80 Mtpa with defined resources worth over $70 billion (Webb, DoIR Project Manager, pers. comm., 12 December 2006).

The KIOP will supply magnetite concentrate as feedstock to AnSteel's steel-making facilities in China which will incorporate a proposed jointly owned pellet plant. AnSteel is developing a new, fully integrated steelworks at Bayuquan near the Port of Yingkou, located on the northeast coast of China. AnSteel is also significantly enhancing the operational performance of its current steelworks at Anshan City, 100 km inland from Yingkou.

The main factors driving the KIOP are summarised below, all of which reflect those mentioned in the Government of Western Australia's "Strategic Review of the Conservation and Resources Values of the Banded Iron Formation of the Yilgarn Craton" (Government of Western Australia 2007).

- The Karara iron ore deposit is substantial and of high quality - thus maximising long-term production and economic benefits relative to the investment and environmental impacts incurred.
- The demand for iron ore is rapidly expanding in the Chinese steel industry. This demand arises from sustained, strong economic growth within China as well as a robust export market for steel. A large proportion of the Western Australian iron ore industry was predominantly driven by the strong demand from China's rapidly growing steel industry. In 2007 alone, Western Australia produced over 250 Mt of iron ore, accounting for 98% of Australia's production (DoIR 2007). It is predicted that demand will continue to increase and will drive the Western Australian iron ore industry to continue to expand capacity (The Economist 2008).
- AnSteel's desire to diversify the supply of iron ore to its steel-making facilities.
- AnSteel's desire to develop a long-term, reliable customer/supplier relationship with a well-positioned, strategic partner. Although Australia is currently the third largest producer of iron ore, behind China and Brazil, it still maintains a major advantage over its main competitors through its large, high quality, accessible deposits, a stable legal and political environment and proximity to major markets in Northeast Asia (Commonwealth of Australia 2006; DITR 2006).

3.2 Benefits of the Proposal

The KIOP will involve a number of impacts (both positive and negative) to the biological, physical and socio-economic environment of the project area, the region and the nation. The project has been designed to minimise or avoid potential adverse impacts, and to optimise benefits as outlined in this PER document. The predicted benefits of the project are summarised below.

Increase in employment

The construction phase will require a workforce of approximately 1,500 people. The operations phase employment is estimated to be approximately 500 people plus up to an additional 80 people during periods of maintenance shutdown. These will result in a flow-on effect and boost employment in the businesses that provide goods and services to the different phases of the project in the Mid-West Region.

Increase in Gross State and Regional Product

Economic modelling predicts an increase in Gross Regional Product (GRP) for the Mid-West Region. In the 2008-09 financial year, it is estimated that the project will contribute $113 million rising to $636 million by 2019-20. The forecast increase in Gross State Product (GSP) for Western Australia due to the project is $181 million (for the 2008-09 financial year) rising to $736 million by 2019-20.

Economic Diversity

At the local level, the development will broaden the economic base of the Shires of Perenjori and Morawa, which currently rely predominantly on agriculture. The proposed development will also broaden business and employment opportunities within the Mid-West Region, and will diversify the State's industrial and economic base away from the Perth Metropolitan, Goldfields, South West and Pilbara regions.

Government Revenue

Revenue to local shires will increase through direct and indirect effects, such as an increase in local population leading to increases in rate revenue, over and above the direct payment of rates associated with the project infrastructure. The key revenue benefits are at the State level, with the Western Australian Government likely to receive in the order of $43 million per annum in royalties and approximately $4 million per annum in payroll tax, as well as other state taxes and charges. The Commonwealth Government will also receive a boost to revenue primarily in the form of company taxes, income taxes and goods and services tax (GST).

4 Regulatory Context

4.1 Environmental Assessment

The EP Act is the primary legislation for environmental impact assessment and protection in Western Australia. As the project has the potential to cause significant environmental impacts, it requires assessment under Part IV and Part V of the EP Act. The key Commonwealth legislation for environmental impact assessment and protection for matters of national significance is the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

KML has prepared this PER, outlining the potential environmental impacts that may occur as a result of the construction and operation of the project, and the measures that will be put in place to avoid, mitigate, and manage these impacts. The PER document will be released for public review and comment for four weeks, after which the proponent will be required to respond to issues raised.

The EPA will assess the PER document, any stakeholder submissions and the proponent's response to these submissions, then prepare a report to the Minister for the Environment. The Minister's decision will be set out in a Ministerial Statement, which, if approval is granted, will include conditions of operation.

Under Part V of the EP Act, any prescribed premise requires a works approval from the Department of Environment and Conservation (DEC) before construction can commence. Some examples of prescribed premises within the project are:

- Ore processing facilities
- Sewage treatment facility
- Landfill facility
- Bulk chemical storage
- Mine dewatering

Near the completion of construction, a works approval compliance document, addressing compliance with the works approval conditions, will be submitted to the DEC. Following completion of construction and acceptance of the compliance document the operating licence can be issued by DEC.

On 25 August 2006, the project was referred to the Commonwealth Department for the Environment, Water, Heritage and the Arts (DEWHA) for a determination as to whether the project may affect matters of national environmental significance and thereby, trigger the EPBC Act.

On 22 September 2006, the DEWHA provided advice that the project was a controlled action and therefore, approval is required under Part 9 of the EPBC Act. The controlling provision is "Listed Threatened Species and Communities".

Under the Bilateral Agreement between the State of Western Australia and the Commonwealth Government, assessment of the proposal will be delegated to the Western Australian EPA under a PER level of assessment. While the assessment will be at the State level, separate consent from the Commonwealth under the EPBC Act is a prerequisite for the project to proceed.

4.2 Mining Approvals

The *Mining Act 1978* (Mining Act) requires that a Mining Proposal be submitted to the Department of Industry and Resources (DoIR) for approval prior to mining activities being undertaken on a mining tenement.

The Mining Proposal provides detailed information on the identification, evaluation and management of significant environmental impacts relating to a proposed mining development and the surrounding environment. The PER document will augment the Mining Proposal.

4.3 Additional Approvals

In addition to the environmental and mining approvals, an extensive array of permits and approvals are required for various elements of the project prior to either construction or operation. These are outlined in Chapter 1.

5 Project Description

The project entails: mining of magnetite ore; on-site crushing, screening and processing of magnetite ore to produce magnetite concentrate; and transport of the product by rail to the Port of Geraldton for export. In the early stages, direct shipping ore (DSO), may be transported to Tilley East rail siding by truck until the rail spur between this siding and the Karara minesite is established.

The location of the minesite, the access road, and the linear infrastructure corridor containing the raw water supply pipeline, are shown in Figure ES1. The Karara minesite layout is shown in Figure ES2.

5.1 Project Overview

The elements of the project covered by this PER, as discussed in detail in Chapter 2 are:

- mining of 30 Mtpa of magnetite ore from the Karara Pit;
- disposal of 15 Mtpa of rock waste in a waste rock dump adjacent to the pit;
- processing plant for magnetite ore to produce 12 Mtpa of magnetite concentrate and 18 Mtpa of tailings;
- disposal of tailings in a dry-stack tailings storage facility (TSF);
- minesite infrastructure such as emergency and start-up power generation, workshops, laboratory, fuel storage area, magazines, administration buildings, communication systems, and water and wastewater treatment plants;
- airstrip;
- accommodation village to house fly-in/fly-out or drive in/drive out workforce, and associated potable water treatment facilities and wastewater treatment plant;
- linear infrastructure corridor containing a raw water pipeline to supply water to the minesite; and
- access road to Morawa.

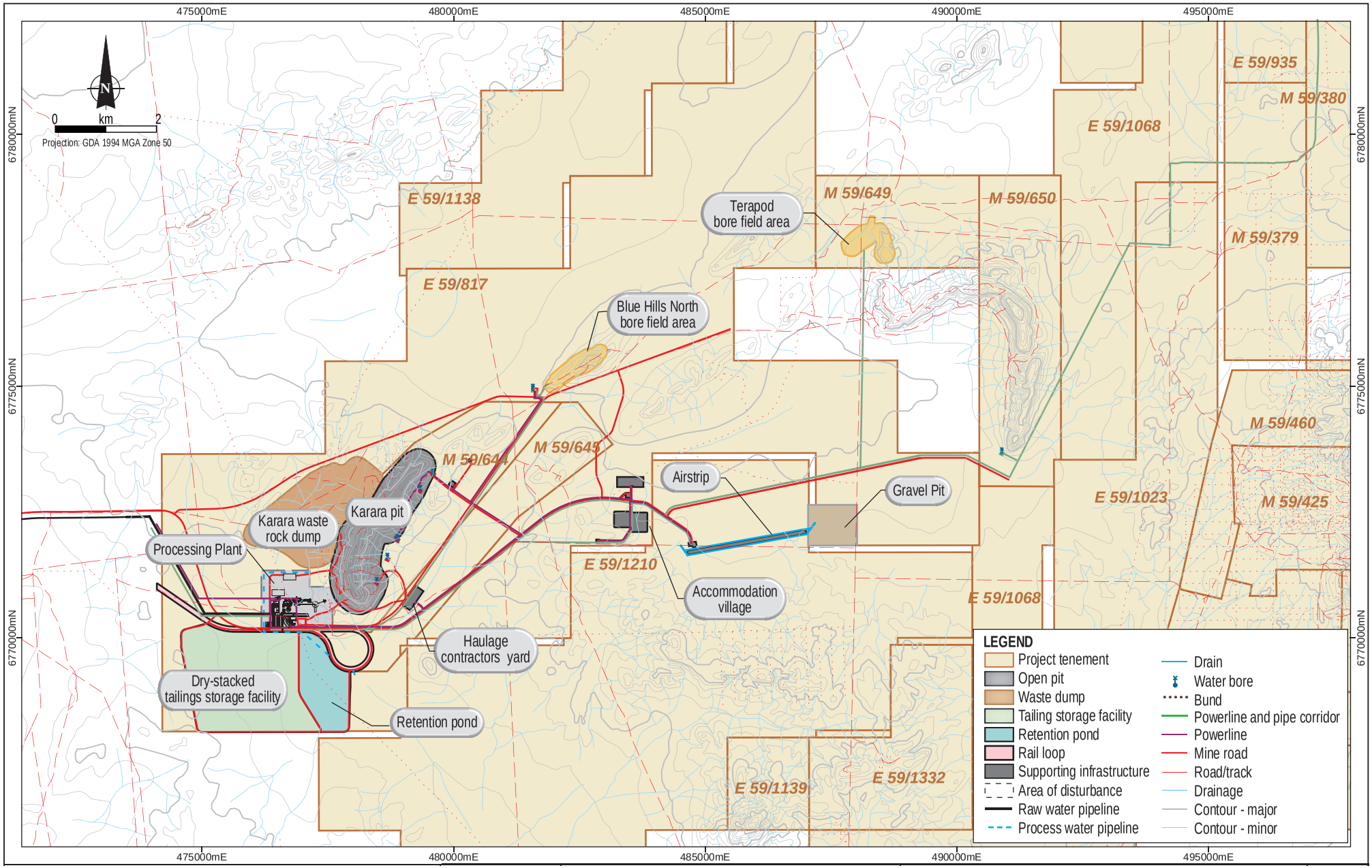


Figure ES2 General minesite layout

Other elements of the project which are not covered by this PER because they are to be provided by others under contract, are:

- electrical power transmission from Southwest Integrated System (SWIS) – Western Power;
- product transport by rail – WestNet Rail on existing rail and an operator yet to be determined on the spur line to Karara from Tilley East rail siding; and
- export facilities – Geraldton Port Authority, and marine contract and charter service providers.

The contractors/service providers will be required to gain any necessary environmental and other approvals for these elements.

Approval is currently being sought from the Department of Water (DoW) to establish a borefield to supply process water to the minesite under the *Rights in Water and Irrigation Act 1914*. As such, the borefield is not addressed in this PER.

A summary of the key project characteristics is provided in Table ES2.

Table ES2 Key project characteristics

Aspect	Project Element	Detail
General	Project life	Greater than 40 years.
	Resource	Estimated 497 Mt of magnetite reserve. Estimated 929 Mt of magnetite resource.
	Timing	Construction to commence within 2 months of environmental approvals.
	Production rate	12 Mtpa of magnetite concentrate.
Land Disturbance	Minesite	1,723 ha.
	Linear infrastructure corridor	405 ha.
	Access road	200 ha.
	Total disturbance	2,330 ha.
Mining	Method	Conventional open pit.
	Operations	24 hours per day, 7 days per week.
	Total mining rate	45 Mtpa (average over project life).
	Ore mining rate	30 Mtpa.
	Waste rock mining rate	15 Mtpa.
	Waste rock management	Waste rock dump with potentially acid-forming material stored in isolation cells.
	Mineralised waste storage	Stored in a combined facility with the waste rock.
Ore Processing	Processing magnetite	Run-of-mine (ROM) pad. Crushing / screening / grinding. Magnetic separation. Reverse flotation. Tailings thickener. Concentrate thickener. Filter plant.
Tailings	Tailings production rate	18 Mtpa (average over project life).
	Tailings storage	Dry-stacked tailings storage facility (TSF).
Product Transport	Product transport	Load product onto trains at minesite and transport to Port of Geraldton via proposed upgraded rail network.

Table ES2 Key project characteristics (cont'd)

Aspect	Project Element	Detail
Supporting infrastructure	Additional minesite facilities	Workshops. Hardstand areas. Bulk fuel storage and refuelling pads. Explosive compound and magazine. Waste water treatment plants. Access roads. Administration buildings. Minesite laboratory.
	Accommodation Village	1,500 personnel during construction.
	Airstrip	Built at minesite for transport of fly-in/fly-out workforce.
	Landfill	Putrescible waste.
Water Supply (construction)	Source	Bores at the minesite and pit dewatering from Silverstone Mine.
	Requirement	Up to 2.3 GL over 18 months.
Water Supply (operations)	Source	Borefield near Mingenew and bores at the minesite. Note: Approval will be sought under the *Rights in Water and Irrigation Act 1914* and is not addressed in this PER.
	Processing requirement	Approximately 6.6 GLpa of process water to produce 12 Mtpa of concentrate, and supply all potable water (accommodation village, offices and workshops).
	Dust suppression	Supplied from pit dewatering, bores at the minesite, and other low-quality sources.

5.2 Timing

The project is scheduled to commence construction within two months of gaining all necessary approvals. Construction of components for mining, processing and exporting magnetite concentrate is expected to be complete within 24 months.

Mining is expected to continue for at least 40 years based on the current resource estimates. The project life may be extended if exploration establishes further resources or project economic factors improve.

It is anticipated final site closure and rehabilitation work will take approximately 18 months after the completion of mining.

5.3 Project Alternatives

A number of alternatives were initially investigated to identify the most sustainable minesite design. The minesite design and alternative operational establishment options considered are presented below.

Minesite Location

The minesite is located within a tenement area that KML has secured. The mine pit is located at the economic concentration of iron ore on the Karara Ridge. This and other regional ridges exist due to the fact that they are a hard Banded Iron Formation (BIF) surrounded by softer shale rock. The BIF units contain varying amounts of iron ore, some being of sufficiently high concentrations of contained iron to be economically viable to mine.

Open-cut Mining or Deep Mining

Open-cut mining is the preferred method of extracting the Karara iron ore deposit, as the iron ore occurs relatively close to surface. Underground mining is not an economically viable alternative at this time.

Water Supply Options

The KIOP requires a reliable supply of fresh water, which cannot be sourced in the immediate project area. Consideration was given to the possibility of an alliance with an adjacent iron ore developer in the region, Asia Iron, to obtain water from a borefield in the Tathra sub-area of the Arrowsmith Groundwater Area. However, there was insufficient water to be allocated to both projects. Following advice from the Department of Water (DoW), KML investigated locations in the Twin Hills and Mingenew sub-areas of the Arrowsmith Groundwater Area. DoW has since advised that in line with potential changes to its water allocation policies, the department will only consider allocation of water from the Twin Hills sub-area to support KIOP's full water requirements. Consequently, KML is now focussing efforts on securing water from the Twin Hills sub-area.

Ore Transportation by Road or Slurry Pipeline or Rail

While capital outlay for rail and slurry pipeline are similar and the operating cost of slurry transportation is significantly less than rail and road transport, rail transport has been selected for transport of product to the export Port for several reasons, including the:

- potential for rail to carry a variety of mineral products, whereas a slurry pipeline can only transport highly processed, finely ground product;
- ability of rail to provide incremental expansion in transportation capacity, where a slurry line is at or near its operational capacity upon construction; and
- potential for rail to provide regional benefits and possible use by others, where a slurry pipeline is an exclusive use option only.

Transportation of iron ore by road is the most expensive method and creates a significant impact for other road users (from dust, noise, accident risk and visual amenity) if used on a long term basis. It is therefore not considered as a viable long term option for this project.

Dry-stacked Tailings or Wet Tailings Disposal

In an endeavour to advance water consumption efficiency beyond prior industry achievements, KML intends to implement the best practice technique of dry-stacked tailings in lieu of conventional wet tailings disposal.

The advantages of dry-stacked tailings over wet disposal are:

- dry-stacked tailings is considerably more water efficient;
- dry-stacked tailings requires significantly less land area per tonne of tailings solids;
- dry-stacked tailings minimises or removes the infiltration issues of wet tailings; and
- dry-stacked tailings provides a stable land-form upon deposition.

Dry-stacked tailings disposal for iron ore tailings is new technology now in some use in the Americas. The practice is yet to be undertaken on a commercial basis in Australia and is yet to fully demonstrate water efficiencies and overall economic benefits when applied in the local geographical and climatic conditions. KML is confident in the ability of this technology to apply effectively to the KIOP conditions. However, KML maintains that the option of wet tailings disposal is the fall back position for tailings disposal for the project should dry-stacked tailings fail to be effective.

At the time of this PER preparation, KML is investigating the applicability of a conveyor system for transporting and stacking dewatered tailings in lieu of conventional truck transportation. The advantages of mechanised transportation and deposition is a significant reduction in diesel fuel use, total energy consumption, tyre consumption and greenhouse gas emissions through replacement of trucks with electrically-driven energy efficient conveyors.

Conveyor ore and rock transport and stacking systems are yet to be employed on a commercial basis in Australia. Mechanised stacking is a preferable option, however KML maintains that conventional truck transport is the fallback position for tailings transport, should mechanised transport and stacking prove inappropriate, or to be not technically or economically feasible.

Accommodation Village and Airstrip Location

Due to the relative isolation and scale of the KIOP, an accommodation village and airstrip are planned to be established in close proximity to the mine and processing plant. Consideration has been given to locating these facilities further from the mine, outside the area of former pastoral leases purchased by DEC for conservation purposes. Such siting was considered inferior when life of project, employee safety, logistics and economic considerations were considered.

After mining and processing ceases, the accommodation village and airstrip will be removed and rehabilitated unless an alternative arrangement for their retention is reached with the State Government and/or local Shire.

Power Supply Options

KML considered the use of gas-fired generators in the pre-selection process. It was found that the price of gas was prohibitive and that long term supply arrangements were not able to be secured, potentially compromising the future of operations. Additionally, the associated infrastructure needed for a gas-fired generation solution would require significant infrastructure and potential environmental impacts to connect to the Dampier/Bunbury Natural Gas Pipeline as the closest connection point is approximately 180 km from the project.

In-pit Crushing vs Haul Out of Pit

At the time of preparation of this PER, KML is investigating the applicability of moveable primary crushers within the pit and conveyors to the surface. In-pit crushing has the potential to improve both the economic and environmental performance of the operation, as it has the potential to be more energy-efficient than trucking. This method is being considered as an alternative to 'haul to surface' by truck.

The advantages of moveable crushers is a significant reduction in diesel fuel use, total energy consumption, tyre consumption and greenhouse gas emissions through the replacement of trucks with electrically-driven energy efficient conveyors.

The base case for the project involves truck haulage to a fixed crusher adjacent to the processing plant. KML will investigate the applicability of this technology as more detailed engineering design is undertaken.

6 Stakeholder Consultation

KML is committed to an open, transparent approval process. At each of the critical stages of the process, KML has consulted with regulators and other key stakeholders to provide opportunity for concerns to be raised and addressed.

Key stakeholders were identified early in the planning phase of the project and include:

- Interested groups and organisations
- Indigenous communities
- State and Commonwealth government agencies
- Local government authorities
- Neighbouring Landowners and tenement holders
- Local and regional services and businesses
- Utility and infrastructure owners
- Employee and industry groups
- Political representatives
- The wider community

Consultation with these stakeholders will continue for the life of the project to ensure due consideration of all project-related opportunities and concerns.

7 Existing Environment

Climate

The climate at the minesite is described as being extra-dry Mediterranean, characterised by seven to eight months of dry weather with cold, wet winters and hot, dry summers. Average daily temperatures during the drier months (November to April) are a minimum of 13°C and a maximum of 38°C, respectively, and during the cooler months (May to October) average daily temperatures are a minimum of 5°C and a maximum of 29°C respectively.

Average annual rainfall is 300 - 400 mm, ranging from an average monthly rainfall during October of 8 mm to 42.5 mm during July.

Landform and Soils

The land in the minesite area consists of steep hills to steep low hills surrounded by rolling low hills and undulating rises and plains. The upper slopes of the hills are steep with some scree slopes and cliff faces (Land System 1). The mid slopes are moderately inclined (Land System 2), and the lower slopes merge into the plains (Land System 3).

Minesite soils generally have low fertility and it appears that the local vegetation is well adapted to the existing surface soil pH and nutrient levels. Soils of Land System 1 are coarse, rocky soils, generally increasing in thickness down slope. Soils of Land System 2 are hard setting with coarse fragments occurring throughout. Soils of Land System 3 are more variable but are generally deeper than soils of the other Land Systems with a higher proportion of fine particles.

Flora and Fauna

The proposed minesite is located within the Yalgoo Bioregion of the Interim Biogeographic Regionalisation for Australia (IBRA) classification system. The floral and faunal richness of the project area is enhanced by its biogeographic location, in which elements from the South-western, Murchison and Arid bioregions effectively overlap.

This region is characterised by low woodlands to open woodlands of *Eucalyptus* and *Acacia* spp. Within the project area, a total of 514 plant taxa were identified, of which 488 were native species, and 26 were introduced species. The vegetation of the project area was noted to be in good condition, although past grazing by stock is apparent as several relatively large areas have not yet started to regenerate.

A total of 24 species of conservation significance occur within or near the minesite area. This includes 1 Declared Rare Flora (DRF) species, 21 Priority Flora species and two additional species of interest. These are potentially new species thought to be geographically restricted. Thirty-three fauna species of conservation significance and four habitats of local significance have been identified in the minesite area.

A total of 1 DRF and 15 Priority Flora species are known to occur within 2 km of the linear infrastructure corridor route. There are also a number of significant fauna species listed as Schedule 1 / Priority 1 that could occur along the linear infrastructure corridor.

There are no wetlands or World Heritage properties in close proximity to the project area. Importantly, none of the habitats or ecosystems within the minesite area is listed as a threatened ecological community however, the Blue Hills Range (including Karara and Mungada) has been listed as a Priority Ecological Community, level 2.

The most distinctive fauna habitats in the minesite area are those associated with BIF ridges, which are prominent within the wider area. Four habitats in the minesite area have been identified as locally significant:

- BIF ridges (Land System 1);
- the mid to lower slopes of the BIF ridges (nominally Land System 2);
- temporary pools of fresh water in low-lying areas (Land System 3); and
- well-developed eucalypt woodlands (Land System 3).

Of these habitats, the mid to lower slopes of BIF ridges were observed to have the highest biodiversity, in terms of fauna.

Thirty-three vertebrate species of conservation significance occur, or potentially occur, in the minesite area (via database searches and results of field surveys). Of these, 11 were recorded at Karara or other nearby locations.

Socio-economic Aspects and Land Use

The project is located in the Mid-West Region of Western Australia and spans the Shires of Perenjori, Morawa, and Mingenew. Towns in the project area include Perenjori, approximately 65 km southwest of the minesite, Morawa, approximately 70 km west of the minesite, and Mingenew, approximately 130 km west of the minesite. Perenjori and Morawa are small towns each with populations less than 1,000.

Current land use in the Shire of Perenjori includes farming, mineral exploration and timber reserve. The proposed minesite is within Mining Leases M59/644, M59/645 and E59/817, which is under application for a tenure change to General Purpose Lease (G59/38 and G59/39). The land has been previously used for mineral exploration, mining and pastoral activities.

The nearest potentially sensitive receptors (buildings used for residential, commercial, educational or medical purposes) to the minesite are the accommodation village, located 4 km east of the Karara Pit, and Karara Homestead, located approximately 7 km southwest of the crushing facilities. The Karara Homestead is currently unoccupied.

The proposed linear infrastructure corridor will span across various land use areas including pastoral, wheat and sheep broad acre agriculture and wheat and cereal farming. There are 6 potentially sensitive receptors within 1.5 km of the linear infrastructure corridor between the minesite and Mingenew.

Indigenous Cultural Heritage

There are two unregistered claimants of Aboriginal heritage sites in the minesite, Widi Mob (unregistered WAG6193/98; WC97/072) and Widi Binyardi (unregistered WAD286/04; WC04/008). Members of the Widi Mob have confirmed that the Mt Karara site (Site Kar/02) is an important mythological site related to women's business. Other sites included mythological, artefacts, sources of ochre or natural features.

Eleven registered sites have been identified within 100 m of the linear infrastructure corridor. The sites contain mythological associations, artefacts, burials, a quarry, natural features and ceremonial sites. Clearance surveys have and will continue to be conducted to guide tactical realignments to avoid these sites wherever practicable.

The linear infrastructure corridor passes through registered native title claims held by the Amangu and Mullewa Wadjari Community. The Widi Mob and the Widi Binyardi also hold unregistered native title claims over a portion of this area.

8 Impact Assessment and Management

The scope of the environmental and social impact assessment has been defined following consultation with key stakeholders, and the resultant PER is based on a range of specialist studies. The full reports of the specialist studies are included as appendices to the main report.

Table ES3 summarises the environmental and social impact assessment, and identifies environmental management and mitigation measures introduced by the project to reduce environmental risk.

Table ES3 Summary of environmental factors and management

Environmental Factor	Relevant Project Area	Environmental Objective	Investigations and Existing Environment	Potential Impacts	Proposed Management	Key predicted outcomes
Principles of Environmental Protection						
Precaution Equity Conservation Valuation Waste minimisation	Minesite and associated infrastructure Linear Infrastructure Corridor Access Road	KIOP is designed to produce 12 Mtpa of magnetite concentrate over a design life of 40 years. The project is designed to optimise the following benefits, whilst minimising environmental impacts as far as possible: • Increase in employment • Increase in Gross State and Regional Product • Economic Diversity • Government Revenue KML, in planning and implementing the proposed Karara Iron Ore Project, will adopt the principles of environmental protection enunciated in Section 4A of the *Environmental Protection Act 1986* and expanded upon in EPA Position Statement No. 7.	A number of studies have been completed or will be completed. These studies include: • Flora/Vegetation • Terrestrial and subterranean fauna • Surface and groundwater • Air quality and Greenhouse gas • Geotechnical / geological • Aboriginal and non-Aboriginal Heritage • Geo-heritage as it applies to landform and flora and fauna • Noise • Water Efficiency and Management Refer Chapters 6 and 7	• Flora and fauna impacts • Air Quality and greenhouse gas emissions • Energy use and water demand • Disturbance of landform values • Safety security and efficiency of the mining • Impacts to the surface and groundwater • Impacts on Aboriginal and Non-Aboriginal heritage sites • Positive economic impacts	Refer Chapters 4, 7 and 8 of the PER. and Volume 2.	These principles underlie KML's approach to fulfilling its obligation to conduct its mining operations in a sustainable manner. (Refer to Chapter 4)
Physical						
Soil Quality and Landform	Minesite and associated infrastructure Linear Infrastructure Corridor Access Road	• Progressively establish a stable, sustainable landform consistent with surroundings during construction, operations and post mining. • Ensure that rehabilitation achieves an acceptable standard compatible with the intended land use, and consistent with appropriate criteria. • Minimise soil disturbance and maintain the integrity of the disturbed and surrounding soils as much as is practical.	Investigations were undertaken by Landloch Pty Ltd (Appendix 4) and Graeme Campbell & Associates (Appendices 1, 2 and 3). Relevant findings are summarised in Section 6.1.3 of the PER. The land in the minesite area consists of steep hills to steep low hills surrounded by rolling low hills and undulating rises and plains, which can be divided into three land systems: • Land System 1 - the steep upper slopes of the hills with some scree slopes and cliff faces; • Land System 2 - the moderately inclined mid slopes; and • Land System 3 - the lower slopes merging into the plains. Soils can also be distributed into three groups, and generally have low fertility. The LIC crosses 12 land systems with a variety of soils, while the access road crosses 15 land systems.	• Topsoil loss • Inversion of soil profiles • Subsidence • Compaction of soil • Soil contamination • Nutrient loss • Water-repellent soils • Inappropriate placement of soils in new locations • Poor revegetation potential Refer Section 7.2.1 of the PER.	KML will manage this factor in accordance with the Vegetation Clearance and Soils Management Plan which will be prepared prior to the commencement of site works and implemented for the life of the mine (Refer Section 8.7).	• Direct disturbance limited to the greatest extent practicable; • Greater success in rehabilitation due to careful topsoil harvesting and soil management.

Table ES3 Summary of environmental factors and management (cont'd)

Environmental Factor	Relevant Project Area	Environmental Objective	Investigations and Existing Environment	Potential Impacts	Proposed Management	Key predicted outcomes
Surface Water	Minesite and associated infrastructure Linear Infrastructure Corridor Access Road	• Maintain the quantity of water so that existing and potential environmental values, including ecosystem maintenance, are protected. • Ensure that emissions do not adversely affect environment values or the health, welfare and amenity of people and land uses by meeting statutory requirements and acceptable standards. • Maintain the integrity, ecological functions and environmental values of wetlands. • Identify and implement opportunities for reclamation and re-use of water.	Investigations were undertaken by MWH of surface water issues relevant to the project (Refer Section 6.1.4 and Appendix 5). • There are no permanent surface water features in the minesite area. • The Linear Infrastructure Corridor will cross two salt lake systems and numerous drainage lines. • The access road intersects ephemeral watercourses but does not cross any permanent water features. • The monthly average rainfall is 34 mm. • A one-in-100-year, 72-hour rainfall event can generate 160 mm. • Three drainage depressions, two claypans and a gilgai formation, collect surface water after heavy rainfall. A fourth drainage depression also occurs north of the minesite, outside of the catchments that are proposed to be disturbed. It is not known if these areas are underlain by a hydraulically isolated surficial aquifer or if the aquifer beneath these depressions is connected to the aquifer underlying the minesite as a whole.	• The open pit is not expected to alter the existing flow regime as it is located along a ridgeline with no upstream drainage into this area. • Sediment laden runoff from the waste rock dump could potentially impact downstream water quality if not properly managed. • Contaminated or sediment laden runoff could impact on water quality downstream of the tailings storage facility if not properly managed. • Diversion works upslope of the processing plant will be required to divert runoff around it, potentially affecting downstream flow regimes if not properly constructed and managed. • Diversion works upstream of the tailings storage facility could affect downstream flow regimes if not properly constructed and managed. Failure of the overflow during a storm event, would affect downstream water quality. • Poor design or construction of the Linear Infrastructure Corridor at a lake or drainage line crossing can potentially damage the ecological values at a site. If drainage morphology and hydraulics are significantly changed, downstream features can also be affected. • Subsidence of the backfilled pipeline trench could divert surface water and lead to erosion. (Refer Section 7.2.2)	A range of water management measures will be implemented as outlined in Section 7.2.2, which are combined into the Water Management Plan for the project. (Refer Section 8.6 and Volume 2). These management measures include but are not limited to: • implementation of drainage containment, diversion and management systems; • route and construction planning to ensure minimal impacts to surface water features from pipeline construction; and • the access road will be designed in accordance with Austroads design standards to minimise changes to local hydrology.	• Changes to surface water flows should be localised, temporary and of no overall detriment to the environment.

Table ES3 Summary of environmental factors and management (cont'd)

Environmental Factor	Relevant Project Area	Environmental Objective	Investigations and Existing Environment	Potential Impacts	Proposed Management	Key predicted outcomes
Groundwater	Minesite Linear Infrastructure Corridor (partial)	• Maintain the quantity of water so that existing and potential environmental values, including ecosystem maintenance, are protected; • Ensure that emissions do not adversely affect environment values (health, welfare and amenity of people and land uses). • Meet all statutory requirements and acceptable standards.	Investigations were undertaken by Rockwater of groundwater issues relevant to the project (Refer Section 6.2.1 and Appendix 6). • Groundwater yields are likely to be very low. • Pan evaporation exceeds rainfall in every month of the year. • Only two bores in the area (at Karara Station) are still in use. • Salinity of the deeper groundwater is expected to be in the range of 50,000 to 100,000 mg/L TDS. • There are three drainage depressions, two claypans and a gilgai formation, that collect surface water after heavy rainfall and are likely to have a shallow water table (approximately 5 m from the surface). It is not known if these areas are underlain by a hydraulically isolated surficial aquifer or if the aquifer beneath these depressions is connected to the aquifer underlying the minesite as a whole.	• Operations phase: Karara pit will intersect and draw down the local aquifer, which could reduce aquifer pressure and groundwater flow in the affected aquifer. • Groundwater drawdown has the potential to impact on groundwater-dependent vegetation in areas where the main aquifer is within 10 m to 15 m of the surface. • If highly saline groundwater is used for dust suppression, impacts on surrounding soil and surface water quality could occur. • Leakage from the tailings storage facility has the potential to result in localised contamination of groundwater. • Modelling indicates that the final pit void would cause a permanent depression of the local aquifer with the water level stabilising at 120 m below the surrounding plain. • Water in the final pit will be hypersaline over most of its operating life. • Modelling of the first 24 years of mining predicts groundwater drawdown to extend longitudinally approximately 5 km southwest of Karara and 3 km northeast of Terapod and around 1.5 km laterally to the northwest and southeast. • Groundwater drawdown associated with the 40-year pit will extend longitudinally/northeast along the ridge but will not extend any further laterally. • The maximum daily volume of ground water required to be pumped to dewater the pit was estimated to be 1,300 m^3/d. Refer Section 7.3.1.	A range of water management measures will be implemented as outlined in Section 7.3.1, which are combined into a Water Management Plan and Water Efficiency Management Plan for the project (Refer Section 8.6 and Volume 2). These management measures include but are not limited to: • monitor groundwater quality, drawdown and recharge; • monitoring in areas of groundwater-dependent vegetation to trigger initiation of contingency measures in the event of impact; and • implement water conservation and recycling measures to minimise abstraction requirements.	• Potential groundwater impacts largely limited to the minesite. • No impact anticipated on the two operating station bores. • No outflows from the final void that could affect groundwater quality post closure. • The two claypans and a gilgai formation collect surface water after heavy rainfall and are likely to have a shallow groundwater table, however this is unconfirmed.

Table ES3 Summary of environmental factors and management (cont'd)

Environmental Factor	Relevant Project Area	Environmental Objective	Investigations and Existing Environment	Potential Impacts	Proposed Management	Key predicted outcomes
Biophysical						
Vegetation and Flora	Minesite and associated infrastructure Linear Infrastructure Corridor Access Road	• Maintain the abundance, diversity, geographic distribution and productivity of flora at species and ecosystem levels through the avoidance or management of adverse impacts and improvement in knowledge. • Protect Declared Rare and Priority Flora, consistent with the provisions of the *Wildlife Conservation Act 1950*, through the avoidance, management or offsetting of adverse impacts. • Minimise the loss of locally and regionally significant vegetation associations and plant habitats. • Control the impact of clearing activities on the surrounding environment (i.e. flora and fauna habitats, landform and drainage systems) through adoption of a minimum disturbance policy. • Conserve and optimise reuse of vegetation and topsoil which contains seeds, nutrients, organic matter and micro-organisms required for establishing vegetation on rehabilitated areas.	Investigations were undertaken by Woodman Environmental Consulting on flora and vegetation issues relevant to the project (Refer Sections 6.2.2, 6.3.1, 6.4.1 and Appendices 12 to 15) • Vegetation at the minesite is generally in good condition. although previous grazing has reduced vegetation condition in some areas. • One DRF, 20 Priority Flora and 4 other taxa of conservation significance are known to occur. • The vegetation is divided into 23 floristic community types. • None of the floristic community types are currently listed as Threatened Ecological Communities however the Blue Hills Range (including Karara and Mungada) has been listed as a Priority Ecological Community, level 2. • Floristic community types have been ranked according to their conservation significance, based on the inferred extent of the preferred soil type, substrate and topographical position within the region, and the number of type of significant flora species known from each floristic community type.	• Up to 1,723 ha of native vegetation will be cleared at the minesite, 405 ha in the LIC and about 253 ha in the access road. • Approximately 76.7% of the total proposed disturbance area is within FCTs that have a conservation status of '1' or '2'. • There is no disturbance planned for FCTs of conservation status '3'. • Approximately 23.3% of the total proposed disturbance is within FCTs that have a conservation status of '4' or '5'. • The FCTs that will be most impacted by this proposal are FCT 14 and FCT 13 (65% and 53.9% respectively). • Of the 24 flora species of conservation significance, twelve will be impacted by this proposal. • The project will have a high local impact and either a moderate or high regional impact on *Acacia karina*, *Lepidosperma* sp. Blue Hills and *Millotia dimorpha* • Indirect impacts to flora that may occur as a result of the KIOP are a decrease in species health due to dust deposition on vegetation, reduction and/or possible contamination of the groundwater supply; and disruption to surface water flows. Refer Sections 7.3.2, 7.4.2, and 7.5.1.	A Flora Environmental Management Plan will be implemented as outlined in Section 8.3 and Volume 2. Management of related flora and vegetation issues will be carried out as per the Conceptual Mine Closure Environmental Management Plan (Section 8.5 and Volume 2), the Vegetation Clearance and Soils Management Plan (Section 8.7) and the Weed and Plant Pathogen Management Plan (Section 8.8)	• Up to 2,381 ha of native vegetation will be cleared in total. • Significant impacts to species and floristic community types of conservation significance (on minesite). • Offsets, management practices and rehabilitation will focus of taxa of conservation significance to reduce these impacts.

Table ES3 Summary of environmental factors and management (cont'd)

Environmental Factor	Relevant Project Area	Environmental Objective	Investigations and Existing Environment	Potential Impacts	Proposed Management	Key predicted outcomes
Fauna (terrestrial)	Minesite and associated infrastructure Linear Infrastructure Corridor Access Road	• Maintain the abundance, diversity, geographic distribution and productivity of fauna at species and ecosystem levels through the avoidance or management of adverse impacts and improvement in knowledge.	Investigations were undertaken by Bamford Consulting Ecologists and Coffey Environments (formerly ATA Environmental) on terrestrial fauna issues relevant to the project (Refer Sections 6.2.3, 6.3.2, 6.4.2 and Appendices 16, 17, 18, 19). • The faunal richness of the area is enhanced by its biogeographic location, as faunal elements from the Southwest, Murchison and Arid zones effectively overlap within the project area. • There are no wetlands or World Heritage properties in close proximity to the minesite. • None of the habitats or ecosystems within the minesite area are listed as threatened ecological communities (TECs) under the provisions of the EPBC Act. • Four habitats in the minesite area have been identified as locally significant: (BIF ridges, lower slopes of BIF, temporary wetlands and eucalypt woodlands). • Thirty three vertebrate fauna species of conservation significance were recorded within the minesite area or nearby. • Fauna habitat along the LIC varies from native habitat (for approximately the first 50 km to rural land for the remainder – approximately 90km) • A small number of fauna species of high conservation significance (listed under the WA *Wildlife Conservation Act, EPBC Act*, CALM priority list) are known from the access road area (Malleefowl, Major Mitchell's Cockatoo, Peregrine Falcon, Skink (*Cyclodomorphus branchialis*) and Western Spiny-tailed Skink.	• Loss of fauna habitat and potentially some faunal species due to vegetation clearance. • Loss of fauna species due to vehicle movement and machinery operations. • Development of the LIC and access road could cause fragmentation to some faunal species. • Thirteen of the fifteen vertebrate species recorded at the minesite may be affected. • All three invertebrate species recorded at the minesite may be affected. • A potential increase in the abundance of feral species due to opportunistically benefiting from any additional roadkill or human food waste. • Some short-term disturbance to fauna due to blasting. • Along the LIC, the project will have a direct impact on some fauna and faunal assemblages in the short term, however, there is unlikely to be a significant impact on the biodiversity value at the species and ecosystem levels in this region as a result of the LIC. • Cumulative impacts due to the concurrent operation of the Hematite Project and Midwest Corporation's Blue Hills Project. Refer Sections 7.3.3, 7.4.3, and 7.5.2.	A Fauna Environmental Management Plan will be implemented as outlined in Sections 8.4 and Volume 2, with other relevant management plans including the Vegetation Clearance and Soils Management Plan (8.7) and feral animal management plan (8.9). These management measures include but are not limited to: • minimise vegetation disturbance where practicable to reduce impacts on faunal biodiversity, specifically vegetation associated with Land System 2 (Section 8.7); • habitat corridors around the minesite will be retained where practicable; • natural regeneration rehabilitation will partially compensate for habitat loss associated with clearance activities; • active management of feral species (Section 8.9) • inductions for all KML employees and contractors (especially the significance of Malleefowl and Major Mitchell's Cockatoo); and • use of downward-directed lights, shrouded light units and locating lighting to limit overspill.	• Construction and operation activities at the minesite will result in some habitat loss. • Re-vegetation will reduce the extent of this loss over time. • There will be short-term direct impact on some fauna and faunal assemblages, however, there is unlikely to be significant impact on the biodiversity value at the species and ecosystem levels in this region.
Fauna (subterranean)	Minesite and surrounding dewatering cone of influence	• Identify presence, diversity and abundance of stygofauna and troglofauna, and monitor and report on impacts due to mining operations	Investigations were undertaken by Biota and Ecologia on subterranean fauna issues relevant to the project (Refer Section 6.2.3 and Appendices 20, 21, 22, 23) • 1 troglobytic specimen (juvenile pseudos) was collected from an early sampling program. at drill hole MGD198, but no further specimens were collected during subsequent surveys; and • No Stygofauna were collected within the KIOP impact area.	• No impacts are expected on Stygofauna as none was found during survey of the KIOP. • No impacts are expected on Troglofauna as only one specimen was found during early survey of the KIOP. Refer Section 7.2.3.	None	No impact.

Table ES3 Summary of environmental factors and management (cont'd)

Environmental Factor	Relevant Project Area	Environmental Objective	Investigations and Existing Environment	Potential Impacts	Proposed Management	Key predicted outcomes
Social Surroundings						
Visual Amenity and light overspill	Minesite Linear Infrastructure Corridor	• Ensure that aesthetic values are considered and measures are adopted to reduce visual impacts on the landscape as low as reasonably practicable. • Avoid or manage potential impacts from light overspill and comply with acceptable standards.	Modelling of visual amenity relevant to the project was undertaken by CAD Resources (Refer Section 6.1.5). • Ridges of banded iron formation (BIF) highlight the otherwise flat landscape. • The BIF and scrublands associated with them are in very good condition. • Evidence exists of past land uses in the area, including mining and pastoral. • The area is sparsely populated. • There is no artificial lighting in the area of the minesite. • The major land uses traversed by the LIC include pastoral, agricultural and former pastoral leases managed for conservation purposes. • There is occasional, localised artificial lighting along the Linear Infrastructure Corridor.	• Creation of mine pits, waste rock dumps and tailings storage facility altering the landform. • Clearing of native vegetation and ground disturbance associated with construction and minesite infrastructure development. • Movement of mobile equipment. • Generation of dust during construction and mining operations. • Generation of light during 24-hour mining operations. • Changes to the amenity of the Linear Infrastructure Corridor due to the presence of large construction equipment during the construction phase. • Long-term visual intrusion from above-ground crossing of waterways, presence of a pumping station, bores and associated infrastructure at the Mingenew borefield. Refer to Section 7.2.3.	Potential impacts on visual amenity management plan will be implemented as outlined in Sections 7.2.3. These management measures include but are not limited to: • Screening where practicable; • Clearing limited to areas that are required for construction and operations; • Construction sites will be maintained in accordance with good industry housekeeping practices; • Implementation of standard dust control measures; • Revegetation and regeneration; • Decommissioning and removal of project elements; • Light overspill managed in accordance with the AS 4282-1997: Control of the Obtrusive Effects of Outdoor Lighting. • Use of downward-directed lights, shrouding and the use of 'Bug Yellow' fluorescent lighting (or similar); and • The pipeline will be buried.	• Some permanent changes to the landscape at the minesite, which will be mitigated by design and rehabilitation to resemble the existing landscape as far as practicable. • The open pit will remain as a permanent change with few opportunities to mitigate visual amenity • The remoteness of the minesite and local terrain will limit the number of people affected. • Short term visual impacts from construction of the pipeline in the LIC. • Long term limited impact due to rehabilitation of the LIC and the fact that the majority of the route is within cleared agricultural land.
Recreation and Tourism	Minesite	• Ensure that existing and planned recreational uses are not compromised. • Promote new recreation and tourism opportunities (mining activities as a tourist attraction) through the changed landuse.	Review of aspects undertaken by ACIL Tasman (ACIL 2007) (Refer to Section 6.1.5.) Very few tourists visit the area. Tourist numbers peak during wildflower season (July to October).	• Tourists visiting the area will have reduced access. • Mining will become a tourist attraction in its own right and add a new market to the tourism industry. • Access in areas beyond the minesite will be affected by intermittent, temporary interruptions during upgrade of the access road and construction of the linear infrastructure. Refer to Section 7.2.4.	KML will work closely with local shires to ensure that recreation and tourism opportunities are not adversely impacted by the project. Refer to Section 7.2.4.	• Unlikely to be any significant adverse impacts. • Potential for positive impact through incorporation of mining as a tourist attraction.

Table ES3 Summary of environmental factors and management (cont'd)

Environmental Factor	Relevant Project Area	Environmental Objective	Investigations and Existing Environment	Potential Impacts	Proposed Management	Key predicted outcomes
Air Quality - Dust and Greenhouse Gases (GHG)	Minesite and associated infrastructure Linear Infrastructure Corridor Access Road	• Ensure that the dust levels generated by the proposal do not adversely impact upon the health, welfare, amenity comfort or wellbeing of any person. • Minimise GHG emissions to as low as reasonably practicable on an ongoing basis. • Mitigate GHG in accordance with the Framework Convention on Climate Change 1992 (UN 1992), and in accordance with established Commonwealth and State policies including EPA Interim Guidance No 12. and to meet acceptable standards and the requirements of Section 51 of the *Environmental Protection Act 1986* (all reasonable and practicable measures).	Heggies Pty Ltd have undertaken an Air Quality Impact Assessment for the minesite (refer to Section 6.1.5 and Appendix 7). • The existing air quality in the vicinity of the minesite is typical of an arid, rural environment. • The minesite is isolated. The nearest residence (Karara Station), currently unoccupied, is located approximately 8 km southwest of the minesite. • The Linear Infrastructure Corridor and access road mainly traverse agricultural land. Approximately 6 potential sensitive receptors have been identified within 1.5 km of the LIC.	• Wheel generated dust contributes most to the total estimated emissions (74% of TSP), followed by extraction activities, including blasting, (8.9%) and materials handling, including loading and unloading trucks and transfer of tailings to the TSF, (8.8%). • Modelling indicates that air quality criteria for PM_{10} will be met at the nearest sensitive receptor and at the accommodation village. • The prevailing winds at the site mean that the potential for PM_{10} impact is greatest to the south or to the west of the pit and dry-stacked tailings storage facility, depending on the season. • Modelling indicates that dust deposition criteria will be met at the nearest sensitive receptor and at the accommodation village. • Threshold levels for dust deposition that may affect the health of vegetation are unknown but literature indicates that the deposition predicted from KIOP is unlikely to be significant. • Dust emissions from construction of the LIC and access road will be transient and short-lived. • The LIC and access road are unlikely to have significant impacts on dust emissions during operations. • The use of electricity, diesel and explosives will result in the emission of approximately 1 Mt of CO_2-equivalent per annum, an increase of 0.19% and 2.3% from the 1990 Australian and Western Australian baseline respectively. Refer to Section 7.2.5.	A Dust Management Plan has been prepared and will be implemented prior to the start of construction works (refer to Section 8.11 and Volume 2). It will also apply during mine operations. A Greenhouse Gas Management Plan will be developed and implemented (refer to Section 8.12). The use of solar powered equipment will be investigated (for example, hot water services, lighting, telemetry systems and remote pump stations) and implemented where practicable. Renewable energy sources will be assessed, and utilised where practicable to minimise GHG emissions. Refer to Section 7.2.5.	• Air quality and dust deposition criteria at the nearest sensitive receptor (old Karara Homestead) will be met. • Short term dust emissions associated with construction of pipeline within the LIC and upgrade of access road. • The use of electricity, diesel and explosives will result in the emissions of approximately 1 Mt of CO_2 equivalent per annum.

Table ES3 Summary of environmental factors and management (cont'd)

Environmental Factor	Relevant Project Area	Environmental Objective	Investigations and Existing Environment	Potential Impacts	Proposed Management	Key predicted outcomes
Noise and Vibration	Minesite and associated infrastructure Linear Infrastructure Corridor Access Road	• Ensure noise levels are in accordance to statutory and legislative requirements and appropriate standards thereby protecting amenity of nearby residents and sensitive receptors. • Avoid damage to adjacent structures due to vibrational impacts from construction and operational activities.	Lloyd George Acoustics Pty Ltd have undertaken a noise impact assessment for the Karara Iron Ore Project (refer to Section 6.1.6 and Appendix 9) • The area is largely undisturbed and most noise sources are natural (birds, insects and wind). • The area around the minesite is a proposed conservation park and is currently managed for conservation purposes. • Existing noise and vibration levels are expected to be consistent with rural background levels.	• Short-term emissions during construction (day-time only) and longer-term emissions during operations. • The predicted noise level at the Karara Station from full operation of the mine is LA10 26 dB. This complies with the Environmental Protection (Noise) Regulations 1997. • The predicted noise level at the accommodation village is LA10 35 dB. This is equal to the noise criteria set by the Environmental Protection (Noise) Regulations 1997 for noise sensitive premises at night time and on weekends. With windows shut, this noise level is unlikely to be audible inside a building. With windows open, noise levels would be below those recommended for sleeping areas in AS2017-2000. • The predicted blasting noise levels at the Karara Station and the accommodation village are LA10 89 dB and LA10 92 dB respectively. These results are significantly below the assigned blasting noise levels under the Environmental Protection (Noise) Regulations 1997. Ground vibration, as a result of blasting, is unlikely to be detectable at the nearest sensitive receptor. • The maximum noise level at the accommodation village during aircraft takeoff and landing would be 67 dB(A) and 54 dB(A) respectively. These noise levels are considered acceptable by AS2021-2000. Refer to Section 7.2.6.	Develop and implement a Noise and Vibration Management Plan prior to the start of construction works (refer to Section 8.10). This plan shall also be in force during operations at all sites. Refer to Section 7.2.6.	• Predicted minesite noise and blasting ground vibration levels at the nearest receptors are predicted to comply with Government regulations. • Predicted noise and vibration levels from construction of the pipeline will be short term.
Public Safety	Minesite and associated infrastructure Linear Infrastructure Corridor Access Road	• Ensure, as far as practicable, that the construction, operation and closure phases of the project do not compromise public safety.	Refer Section 6.1.7. • The minesite area is isolated. The nearest occupied residence, the Karara Station, is approximately 8 km from the site. • The towns closest to the minesite are Perenjori, and Morawa (approximately 65 km southwest and 75 km west respectively). • The closest town to the LIC is Mingenew. • The closest town to the access road is Morawa. • Active mineral exploration is underway within the region and the public could gain access to these sites. • The site is Isolated from medical facilities in the event of an emergency.	• Unauthorised access to the minesite by non-inducted, inexperienced people could result in accidents, injury or property damage. • Increased vehicle numbers on local roads used for project-related traffic could potentially increase the chances of accidents, the development of dust, and injury or property damage. Refer to Section 7.2.7.	• Design the project to minimise areas of interaction with the public as much as practicable. • Installation of signage advising of excavations, mining activity and earthworks. • Implementing a security regime at site, including a single entry gate and security personnel. • Abandonment bunds constructed around the perimeter of the open pit will be left in place to prevent unintentional access. • The walls of the waste rock dump will be battered down to a safe, stable angle. • All mining infrastructure not in use will be removed and will therefore not pose a risk to public safety. Refer to Section 7.2.7.	• Adverse impacts on public safety will be avoided and risk maintained to as low as reasonably practicable through implementation of risk management systems throughout all phases of the project.

Table ES3 Summary of environmental factors and management (cont'd)

Environmental Factor	Relevant Project Area	Environmental Objective	Investigations and Existing Environment	Potential Impacts	Proposed Management	Key predicted outcomes
Socio-economic aspects	Minesite Linear Infrastructure Corridor	• To ensure that the social and economic value of the region is not adversely impacted. • Provide positive benefits for the region where practicable. • To ensure the community are informed about the project and feel empowered and involved through all project phases.	Review of aspects undertaken by ACIL Tasman (ACIL 2007) (Refer to Section 6.1.8). The project area is in the Mid-West Region of Western Australia and spans the shires of Perenjori, Morawa, Mingenew, Greenough, Irwin and the City of Geraldton. Population in the inland shires (Morawa and Perenjori) has been declining since 1999 (ACIL 2007).	• Temporary inconvenience to traffic users during the construction of the LIC and access road. • Temporary increased demand on local facilities (e.g., accommodation, schools, shops and hospitals) and infrastructure (e.g., electricity, water and transport network). • Temporary disruption to existing lifestyle and community well-being from project activities. • Temporary disruption to current farming practises during construction of the LIC and access road. • Increased employment opportunities for local communities. Job creation at approximately 1,500 jobs. 500 long-term, operational jobs. • Opportunities for training and education within local communities. • Increased economic activity within the community and Western Australia. • The mine will spend approximately $300 million each year on wages, goods and services. • $48 million in royalties and $3 million on payroll tax will be paid to government each year of operations (based on a production rate of 12 Mtpa) . • Annual gross revenues of approximately $600 million will be gained from the sale of product. This equates to $24 billion over the nominal 40 year mine life. • By contributing to sustained economic growth in the Mid-West Region due to creation of wealth, jobs and new infrastructure. Refer to Section 7.2.8.	Develop and implement a Stakeholder Consultation Management Plan to ensure that KML regularly communicates with the local communities (Refer Section 8.16). • Foster an 'open door' policy with the local community to ensure that community issues can be dealt with promptly and transparently. • Ensure that any interruptions to roads during construction works are advertised well in advance and that appropriate access is still maintained. • To maximise benefits to local communities, KML will, in addition to fly-in/fly-out (FIFO) jobs, offer positions to locals where practicable; and, the local workforce will be given equal employment opportunities. In addition, KML will endeavour to hire local contractors when appropriate services are available locally. • A traffic management plan will be prepared in consultation with relevant landholders and shires to manage and mitigate potential impacts relating to road traffic during the construction of linear infrastructure (refer to Section 8.14). Refer to Section 7.2.8.	• The project is anticipated to have positive economic impacts at the national, State and local levels through wealth creation, economic diversification, job creation and community well being. • Strong community and stakeholder engagement throughout the life of the project is expected to minimise any potential negative impacts.

Table ES3 Summary of environmental factors and management (cont'd)

Environmental Factor	Relevant Project Area	Environmental Objective	Investigations and Existing Environment	Potential Impacts	Proposed Management	Key predicted outcomes
Aboriginal Heritage	Minesite and associated infrastructure Linear Infrastructure Corridor Access Road	• Ensure that the proposal complies with the requirements of the *Aboriginal Heritage Act 1972* and *Native Title Act 1993*.	Australian Interactive Consultants have undertaken an archeological and ethnographic survey for the minesite and Linear Infrastructure Corridor (refer to Section 6.1.9 and Appendix 10 and Appendix 11). • The area is largely undisturbed. • Widi Mob and Widi Binyardi are the two groups that have unregistered native title claims over the minesite area. • Badimia is the only registered claimant group of a section at the Silverstone water pipeline. • There is one registered site within close proximity to the open pit: the Kar/02 site. • A new ethnographic site, consisting of an ochre source, rock shelter and creek feature has been identified. • Eleven registered sites are within 100 m of the LIC. • Amangu, Mullewa Wadjari, Widi Mob and Widi Bayardi have native claims over areas crossed by the LIC.	• Encroachment on sites with ethnographic and / or archaeological significance as a result of the mining activities. • The Kar/02, Mt Karara (Women's only site) (Site ID 21374) site will be removed. • The KIOP may potentially impact the Kar/01 (ochre source, rockshelter and creek), Kar/08 and Kar/10 sites. Refer to Section 7.2.9.	Develop and implement a Cultural Heritage Management Plan prior to the start of construction works (refer to Section 8.15). This plan shall also be in force during operations at all sites. These management measure include, but are not limited to: • Protect identified sites from disturbance during all phases of the project by relocation of infrastructure where feasible to avoid impact on them. • Undertake appropriate consultation with native title claimant groups throughout the design of the project. • Clearance under Section 18 under the *Aboriginal Heritage Act 1972*, for destruction/ impact on sites will be obtained where necessary. Refer to Section 7.2.9.	• Impacts to the Kar/02 site at the minesite are anticipated to be significant. Approval has been sought under the Aboriginal Heritage Act 1972. • Potential impact on the Kar 01, Kar 08 and Kar10 sites. These will be managed in consultation with the relevant stakeholders, and meet the requirements of the *Aboriginal Heritage Act 1972*.
Non-Aboriginal Heritage	Minesite and associated infrastructure Linear Infrastructure Corridor Access Road	• Ensure that changes to the biophysical environment do not adversely affect historical and cultural associations and comply with relevant heritage legislation.	Australian Interactive Consultants have undertaken an assessment of non-Aboriginal (i.e. European) heritage at the minesite (see Section 6.1.10 and Appendix 10. • There are no European heritage sites in the vicinity of the minesite. • There is one European heritage site within 100 m of the LIC. • There are no State Geoheritage Register-listed sites in the vicinity of the minesite or LIC.	• No impacts anticipated given the absence of European heritage sites in the vicinity of the minesite. • One European heritage site is directly intersected by the current LIC alignment - Rabbit Proof Fence No. 1 (Database Number 12080). Refer to Section 7.2.10.	• All activities will be undertaken in accordance with the *Heritage Act of Western Australia 1990*. • KML will liaise with the shire of Perenjori and the Heritage Council of Western Australia to minimise disturbance to any European heritage sites. • During construction of the LIC, the Rabbit Proof Fence will have temporary gates installed to permit access for the construction crew. Following the completion of construction, the gates will be removed, and the fence will be restored using the original materials to the extent practicable. Refer to Section 7.2.10.	• Minimal temporary impact on the Rabbit Proof Fence No. 1 during construction within the LIC. Managed under the *Heritage Act of Western Australia 1990*.

Table ES3 Summary of environmental factors and management (cont'd)

Environmental Factor	Relevant Project Area	Environmental Objective	Investigations and Existing Environment	Potential Impacts	Proposed Management	Key predicted outcomes
Non-process Waste	Minesite	• Manage non-process wastes generated by the project in a manner that minimises environmental impacts, and which is in compliance with the relevant standards and legislation.	Refer to Section 7.2.11. Non-Process wastes are expected from all phases of the project (construction, operation, closure) and include: • Hydrocarbons (liquid and solid) and hydrocarbon-contaminated material • Store/office cardboard (recyclable and non-recyclable) • Scrap steel • Tyres • Plastic (recyclable and non-recyclable) • Pallets • Construction waste • General domestic waste (e.g. food scraps, non-recyclable crib room rubbish) • Recyclable domestic waste (e.g. office paper) • Sewage related wastes • Greenhouse gases • Waste-water	• Contamination of the localised soils and/or groundwater system. • Fires can result from improper storage and disposal of flammable wastes (e.g. hydrocarbon-contaminated material). • Change in abundance of feral species and rodents and pests. • The presence of non-process wastes (e.g. paper, rags, plastic bags) in the natural environment will reduce the area's visual amenity. • Construction wastes such as scrap metal can cause worker injury and/or accidents if not contained or disposed of appropriately. Refer to Section 7.2.11.	Develop and implement a Waste Management Plan prior to the start of construction works (refer to Section 8.13). This plan shall also be in force during operations at all sites. Refer to Section 7.2.11.	• Non process wastes will be disposed of as required and managed in compliance with relevant standards and legislation, therefore minimal environmental impacts anticipated.
Mining and Process Waste	Minesite	• Manage mining and process waste such that environmental impacts from its disposal are as low as reasonably practicable. • Create a waste rock dump and tailings storage facility that is physically stable in the long term and can be successfully rehabilitated.	Graeme Campbell and Associates have undertaken a geochemical assessment of the waste rock and tailings that will be produced by the project (refer to Section 7.2.12 and Appendix 1 to 3). • The project is expected to produce 15 Mtpa of waste rock (20% of which is classified as PAF waste rock) and 18 Mtpa of tailings. • Waste rock is generally hard and 'blocky', except for Upper-saprolite zone oxides, and is likely to be resistant to erosion. • PAF waste rock contains relatively low amounts of sulphides – either trace (less than 1%) or accessory (greater than 1%) amounts – that can be highly reactive. • The weathering windows required to produce acid rock drainage are restricted to significant rainfall events (e.g., over 100 mm of rain) and will depend on the depth of the wetting front during a rainfall event. • Minor element solubility in acidic leachate is modest and reflects the abundance of metals in the waste rock samples. Sulphates of iron and aluminium dominate the major-ion chemistry with manganese, nickel, copper and zinc also present. • Tailings from this project are classified as NAF as the tailings contain only trace sulphides (less than 0.1%) with a slow, circum-neutral sulphide oxidation rate due to the buffering capacity of the tailings.	• The key potential impact for tailings management is the leaching of poor quality water from the tailings facility, release of suspended sediment laden runoff into the environment and excessive dust generation • The key potential impacts for waste rock management are acid rock drainage (ARD) and the release of suspended sediment laden runoff into the environment. Refer to Section 7.2.12	Waste rock and tailings will be managed according to the measures provided in Section 7.2.12. Detailed management measures will be submitted to DoIR for approval in the Mining Proposal. Refer to Section 7.2.12.	• Acid rock drainage and suspended sediment release to the environment will be managed through appropriate tailings disposal and drainage control, therefore impacts expected to be minimal.

9 Environmental Management Framework

9.1 Environmental Management System

KML is committed to developing and implementing an Environmental Management System (EMS) consistent with ISO 14001:2004 to promote excellence in environmental management and to ensure continual improvement.

In order to evaluate, minimise and manage risks to the community, the environment and the company, KML will apply the EMS to all aspects of the company's operations. The EMS sits within an environmental management framework that includes consideration of community attitudes towards sustainability, the precautionary principle (as incorporated in the EPBC Act) and the Mineral Council of Australia's policy on sustainability known as 'Enduring Value – The Australian Minerals Industry Framework for Sustainable Development'.

The EMS is a structured, documented approach to managing risks and potential environmental or social impacts arising from the project. The principle steps in the process are:

- an assessment of environmental or social risks (based on specialist studies and corporate knowledge and experience);
- identification of relevant government policy, law and guidelines;
- incorporation of conditions of approval, commitments and performance criteria;
- development and implementation of Environmental Management Plans;
- monitoring of environmental impacts and performance; and
- review of procedures and plans to ensure continual improvement.

In particular, the EMS has a strong emphasis on ensuring that conditions of operation and commitments made by KML are translated into defined actions or work practices with allocated responsibilities for work on the ground. In-built quality assurance practices help to ensure that the work is carried out as described in the PER and that there is continuous improvement in standards and outcomes.

The EMS will be implemented for the Karara Iron Ore Project and Mungada Iron Ore Project.

9.2 Offsets

KML recognises that the impacts identified in the PER relate to environmental attributes with apparently restricted distribution and for which there is restricted scientific knowledge.

The studies described in this PER have already contributed significantly to the expansion of that knowledge and the offsets listed below will further contribute to the state of knowledge.

The opportunity for direct offset through land acquisition for conservation in the immediate project area is unavailable to KML, as government already controls all such land in the immediate vicinity of the project, being former pastoral leases purchased but not yet reserved for conservation. The process of resolving the specific conservation categories of that land will be complex and take time. The Strategic Review (Government of Western Australia 2007) recognises the complexity of resolving the challenges of the State honouring existing tenement development whilst providing appropriate conservation protection, noting that it would be inappropriate at this stage to create reserve categories such as national park or Class A nature reserve over the entirety of this area.

KML therefore concludes that the most effective conservation offsets it can propose are likely to be achieved through cooperation with the State in delivering conservation objectives on the land surrounding the KML project that is, the State's strategic regional efforts will be supported and enhanced by KML's contribution. Having said that, KML is also proposing to explore offset actions it might take on other land under its control to achieve regional conservation initiatives.

KML has consulted with personnel of the Parks and Conservation Division of the Department of Conservation and Environment (DEC) (on a 'without prejudice' basis) on potential offsets and proposes to continue such dialogue during and following the EPA assessment, to ensure that KML's offset contribution to conservation is effective and coordinated with the conservation initiatives of others. However, the DEC has stated in writing (DEC 2007) that it will not endorse strategies for offsetting potentially significant impacts on critical assets until the significance is adequately determined and the EPA has determined whether the project is environmentally acceptable.

The complexity of this situation makes description of specific offsets difficult, if not impossible, at this time.

KML recognises that the offsets listed below are not as prescriptive as the EPA Principle G (EPA 2006a) states: that the offsets be clearly defined, transparent and enforceable. KML is strongly of the view that better biodiversity outcomes will be achieved by iteratively and adaptively defining certain offsets over time and that a mechanism can be developed that provides for both the optimum conservation outcome and confidence by all parties that KML will deliver its contribution.

KML proposes that, in cooperation with the State, it adopt and implement an offsets package throughout the life of the Karara Iron Ore Project based on ongoing consultation with DEC, addressing some or all of the conceptual offsets listed below (Table ES4), where reasonable and practicable to do so.

Table ES4 Conceptual Offsets for the Karara Iron Ore Project

Offset No.	Offset Description	Type of Offset
A1	Badja Station pastoral lease 3114/674 (Crown Lease 438/1966), 113,600 hectares in area, was purchased in 2007 by KIOP joint venture participant Gindalbie Metals Ltd, with the intention of managing the station, to protect and enhance significant local and regional conservation values impacted by pastoral practices and other threatening processes, as a means of offsetting significant unavoidable impacts of mining activities. Badja is in the bio-geographic region of the Karara Iron Ore Project, encompasses areas of BIF, and is contiguous with the pastoral lease areas controlled by DEC. It is proposed that following the necessary research and consultation with DEC and DoIR, areas identified as supporting suitable offset attributes will be considered for a Nature Conservation Covenant Program.	Direct A
A2	Establish an environmental trust fund that provides an additional funding source for research, management and management programs relevant to the enhancement of conservation values of the Mid West banded iron formation ranges, and more specifically the Blue Hills / Karara / Mungada region. (Refer to offsets A3 – A9 and B3). Such trust fund to be managed by a joint steering committee to be established in consultation with the DEC.	Contributing A
A3	Fund a position within the DEC dedicated to the field management of the DEC controlled land in the Blue Hills / Karara / Mungada region, for the life of extractive mining. (Funded from allocated trust fund monies - offset A2).	Contributing A
A4	Fund for a period of five-years, a position in the Western Australian Herbarium to research and catalogue the taxonomy of flora species specific to the BIFs of the Mid West Region. (Funded from allocated trust fund monies - offset A2).	Contributing A
A5	Facilitate and drive implementation of the systematic identification of existing degraded ecosystems in the region with the objective of selecting candidate sites for restoration or rehabilitation programs. [Funded from allocated trust fund monies - offset A2].	Contributing A
A6	To support field research, restoration and rehabilitation activities, KML will facilitate and drive the establishment of a field nursery with the capacity for trial seed propagation, translocation and production of rehabilitation stock for species of significance. [Offsite activity component to be funded from allocated trust fund monies – offset A2].	Contributing A
A7	In consultation with the DEC, KML will undertake feral animal control on lands managed by KML and will contribute to a regional feral animal control program with a view to increasing the population of native fauna. (Offsite activity component to be funded from allocated trust fund monies - offset A2).	Contributing A
A8	In consultation with the Department of Agriculture and the DEC, KML will undertake a weed and pathogen management program on lands managed by KML and will contribute to a regional program with the objective of protecting sensitive BIF ridges. (Offsite activity component to be funded from allocated trust fund monies – offset A2).	Contributing A
A9	In consultation with the DEC, KML will develop a fire management plan covering lands managed by KML and agreed regional areas with the objective of protecting sensitive BIF ridges. (Offsite activity component to be funded from allocated trust fund monies – offset A2).	Contributing A

Table ES4 Conceptual Offsets for the Karara Iron Ore Project (cont'd)

Offset No.	Offset Description	Type of Offset
B1	Offset the direct impacts of the project on the local populations of *Lepidosperma* sp. Blue Hills (A. Markey & S. Dillon 3468) by regeneration or re-establishment on suitable habitat outside the impact area of the project.	Direct B
B2	Implement a genetic variance study to taxonomically describe the *Lepidosperma* species within the project area and investigate applicable processes to conserve and restore *Lepidosperma* species. Specifically, KML will implement a research and recovery plan, in consultation with the DEC and relevant research agencies, which will evaluate: conservation and restoration genetics (provenance; mine footprint), propagation and restoration science, population and restoration ecology, ex-situ seed banking potential for long term security of the *Lepidosperma* species, and in-situ conservation and translocation.	Contributing B
B3	Fund the conduct of a taxonomic revision on significant *Acacia* species occurring within the project survey area, including *Acacia karina*, *Acacia woodmaniorum*, *Acacia* affin. *coolgardiensis* (A. Markey & S. Dillon 3313), *Acacia* affin. *subsessilis* and *Acacia* sp. nov 3 to determine the taxonomic status of these species, provide taxonomic descriptions of each of these if they are determined to be separate species. [Funded from allocated trust fund monies - offset A2].	Contributing B
B4	Undertake surveys over the BIF ridges adjacent to the Karara Iron Ore Project for the three years commencing spring 2008 to provide further information on the status of significant flora species and communities.	Contributing B
C1	KIOP joint venture participant Gindalbie Metals Ltd will, for the life of the project, contribute financially to the establishment and operation of a Mid West Biodiversity Institute, with a view to underpinning continued research and environmental management programs in support of regional biodiversity enhancement. [Funded from allocated trust fund monies - offset A2].	Contributing C

9.3 Environmental Commitments

KML's objective is to implement the KIOP in a sustainable manner, mitigating the project's environmental impacts to the extent reasonably practicable, by the application of appropriate management measures over the life of the project.

Fulfilment of that objective depends on sound environmental knowledge. Environmental studies commenced in 2004 and have informed early project planning and have identified aspects that will benefit from further investigation. KML has a substantial program of ongoing study to better understand the distribution, diversity and abundance of biological taxa, further contribute to project detailed design, construction, operation, progressive rehabilitation and ultimately closure of the operations. In order to confidently achieve the planned environmental outcomes, key aspects of the project will be subject to systematic management, documented in management plans within its Environmental Management System.

In order to demonstrate its intention of responsible environmental management, KML makes the following formal commitments.

Commitment 1: Environmental Management System

The KIOP will be established and operated under a management system with elements consistent with those specified by the most current version of AS/NZS ISO 14001.

Commitment 2: Management Plans

Documented management plans will be established, maintained and implemented in relation to environmental aspects that require documented controls in order to ensure achievement of the intended environmental outcomes. The following plans have been identified as required. KML will adopt an adaptive management strategy and develop additional management plans as required for issues identified through the ongoing investigations, operation and management of the project.

- Audit and Compliance Management Plan
- Flora Environmental Management Plan
- Fauna Environmental Management Plan
- Conceptual Mine Closure Environmental Management Plan (including Rehabilitation)
- Water Management Plan (incorporating Water Efficiency Management Plan)
- Vegetation Clearance and Soils Management Plan
- Weed and Plant Pathogen Management Plan
- Feral Animal Management Plan
- Noise and Vibration Management Plan
- Dust Environmental Management Plan
- Greenhouse Gas Management Plan
- Waste Management Plan
- Traffic Management Plan
- Cultural Heritage Management Plan
- Stakeholder Consultation Management Plan

Commitment 3: Environmental Offsets

Recognising that significant unavoidable impacts may result from implementation of the KIOP, KML will develop and action any of the conceptual environmental offsets (Table ES4) identified by the Minister for the Environment's statement as required for the proposal to be implemented.

Commitment 4: Aboriginal Consultation

KML will continue consulting with the relevant Aboriginal groups, particularly native title claimant groups, during the design of the project and with respect to any future changes to the project disturbance area.

Commitment 5: Further Survey Work

KML will undertake further survey work and research to improve the knowledge of the distribution, abundance and biology of key taxa in the Karara/Blue Hills ranges. This work will include:

- Further surveying for FCTs of conservation significance ranking '5' (FCT 8, 11, 12, and 13), will be undertaken involving establishment of monitoring quadrats (as per CALM 2006). Quadrats will be established on ranges within the vicinity of the Karara-Mungada survey area, not previously targeted by Markey and Dillon (Markey and Dillon 2006);

- Continued flora surveying to be undertaken to extend knowledge of the range and abundance of the following species:
  - *Acacia karina*
  - *Lepidosperma* sp. Blue Hills (A. Markey & S. Dillon 3468)
  - *Calotis* affin. *cuneifolia* (A. Markey & S. Dillon 3447) (season permitting)
  - *Millotia dimorpha* (season permitting)

- Continued fauna surveying to enhance knowledge of the on-site population and distribution of the following species:
  - *Leipoa ocellata*
  - *Ergenia stokesiibadia*

1

PUBLIC**ENVIRONMENTAL****REVIEW**

introduction

1 Introduction

1.1 Project Overview

Karara Mining Limited (KML) is proposing to develop the overall Karara Iron Ore Project (KIOP). KML is the company being used by the joint venture between Gindablie Metals Pty Ltd (Gindalbie) and Anshan Iron and Steel Group Corporation (AnSteel) to implement the project. The proposed Karara minesite is located in the Mid-West Region of Western Australia, approximately 215 km east-southeast of Geraldton and 320 km north-northeast of Perth (Figure 1.1).

The project area was originally explored and mined by Western Mining Corporation (WMC) between 1962 and 1973. During this period WMC commenced mining two open pits, known as Mungada and Mungada West, to complement the ore being extracted from its Koolanooka operations. Exploration activities undertaken during this time identified the Karara iron ore deposit and several other iron-rich areas.

Gindalbie acquired the Karara tenements in 2002 through a wholly owned subsidiary company (Lotus Minerals Ltd) and has since conducted an extensive exploration program. By 2006, sufficient resources were identified to undertake a feasibility study and to commence the project environmental approvals process.

Development of the Karara Mine, processing plant and associated infrastructure is referred to as the Karara Iron Ore Project or KIOP. Separate environmental approval is being sought to develop the Mungada Iron Ore Project (MIOP). The KIOP and MIOP together are known as the greater Karara Iron Ore Project. This Public Environmental Review (PER) document addresses the KIOP component of the greater Karara Iron Ore Project.

The cumulative impact of the KIOP, MIOP and the proposed Midwest Corporation redevelopment of the Blue Hills project are subject to a separate impact evaluation submitted to the Environmental Protection Authority (EPA) as an attachment to this PER (refer Volume 2).

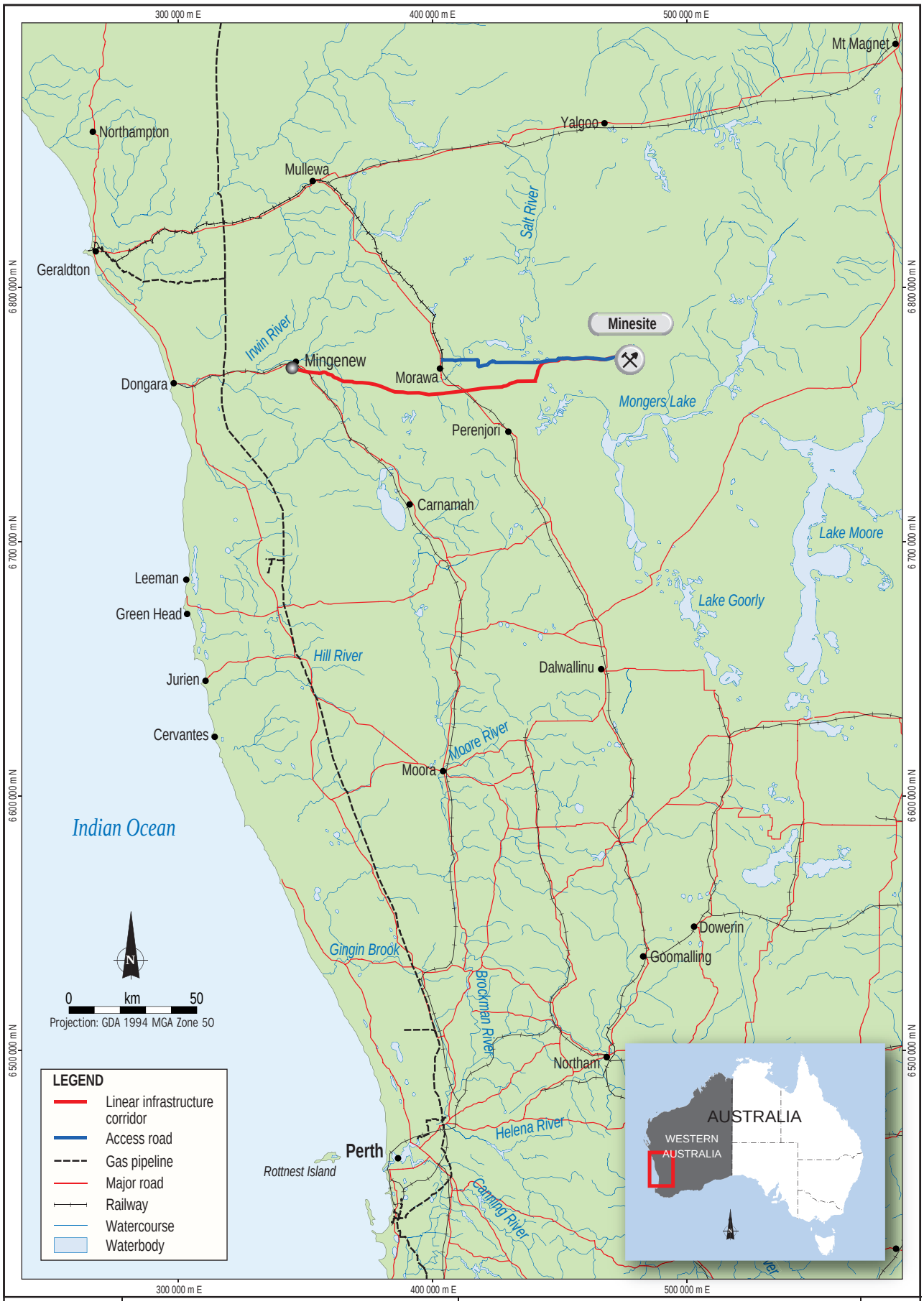
The KIOP magnetite reserve is currently estimated at 497 Mt and the additional resource at 929 Mt. Additional reserves are expected to be defined following further resource definition, drilling and testing. The current mine design allows for a mine life of 40 years. The exploration program indicates that the ore body extends deeper and wider than the currently designated Karara Pit.

The KIOP elements and activities are described in summary below. A full project description is provided in Chapter 2 of this document.

A sealed access road to the minesite will be provided from Morawa by upgrading an existing road. An accommodation village and airstrip will be constructed at the minesite.

Predominantly magnetite ore will be mined from the Karara Pit. The magnetite ore will be processed at the minesite by crushing, grinding, magnetic separation, reverse flotation, and dewatering to produce around 12 Mtpa of magnetite concentrate per annum (initial production capacity). Development of the iron ore mine will also produce approximately 0.8 Mt of saleable hematite ore.

Figure 1.1 Project location and elements



The concentrator process will produce both fine and coarse tailings, which will be combined and stored at a single, dry-stacked tailings storage facility (TSF). This facility will be situated southwest of the Karara Pit.

A waste rock dump will be located in close proximity to the north of the pit.

The magnetite concentrate and direct shipping ore (DSO) will be transported to the Port of Geraldton by rail using the existing WestNet Rail narrow gauge rail system. The existing rail system joins Perenjori and Morawa to Geraldton via Mullewa. WestNet Rail is upgrading this system.

The Karara minesite will be linked to the existing rail system by extending to the minesite an existing but disused iron ore rail spur between Tilley Siding (near Morawa) and the Koolanooka mine. The total rail distance between the minesite and Port of Geraldton is approximately 300 km. The distance between Tilley Siding and Koolanooka is approximately 15 km and between Koolanooka and the minesite approximately 60 km (see Figure 1.2).

The Tilley to Koolanooka rail spur is situated in an existing Public Transport Authority (PTA) rail corridor. This corridor is to be extended to the Karara minesite and made available to service the KIOP. The eastern part of the rail spur (from Koolanooka to the minesite) will adjoin the common infrastructure corridor that includes the mine access road and power line (which is being assessed as part of the MIOP and are not considered further in this PER) and a raw water pipeline. The western part of the rail spur will primarily traverse private agricultural land. An indicative alignment for these corridors is shown in Figure 1.3.

Extensive biological and heritage survey work has been undertaken along the common infrastructure corridor and these data is currently being expanded to cover the potential disturbance area of the rail spur alignment. This data will be available to ensure a timely environmental review of the Tilley to Karara rail spur.

Western Power will deliver electricity to the KIOP during the operating phase of the mine. Diesel generators will supply power to the various project components during construction.

WestNet Rail, Western Power and the Geraldton Port Authority will be the proponents responsible for obtaining environmental and other relevant approvals for the section of rail line upgrade from Tilley to the Port of Geraldton, power line upgrades and Port operation respectively. Approvals for the Tilley to Karara spur line will be obtained by a proponent yet to be finalised with the WA Government, under a separate environmental assessment approvals process. Therefore this infrastructure is not the subject of formal assessment in this PER.

Process water will be sourced from borefields in the Twin Hills groundwater sub-area near Mingenew and pumped to the minesite via a buried pipeline along the linear infrastructure corridor which runs from Mingenew to the minesite. Construction water will be sourced from borefields in the vicinity of the minesite and possibly a currently licensed supply at the Silverstone Mine. Applications for the sourcing and use of this water have been submitted to the Department of Water (DoW) and will be assessed under the relevant provisions of the *Rights in Water and Irrigation Act 1914*, and therefore are not discussed in detail in this PER.

The KIOP elements and activities described above in summary are presented in Figure 2.9.

The primary objective of the KIOP is to mine, process and transport iron ore on a profitable basis. This will be achieved within the project's environmental and social objectives, which are to:

- plan, construct, operate and decommission the project in a manner that is consistent with good industry practice and in compliance with the conditions and standards prescribed by the Western Australian Government and, where applicable, the Commonwealth Government; and
- develop the project in a climate of public participation and support, and in a manner that optimises positive impacts and minimises adverse impacts as practicable.

Figure 1.2 Railway alignment

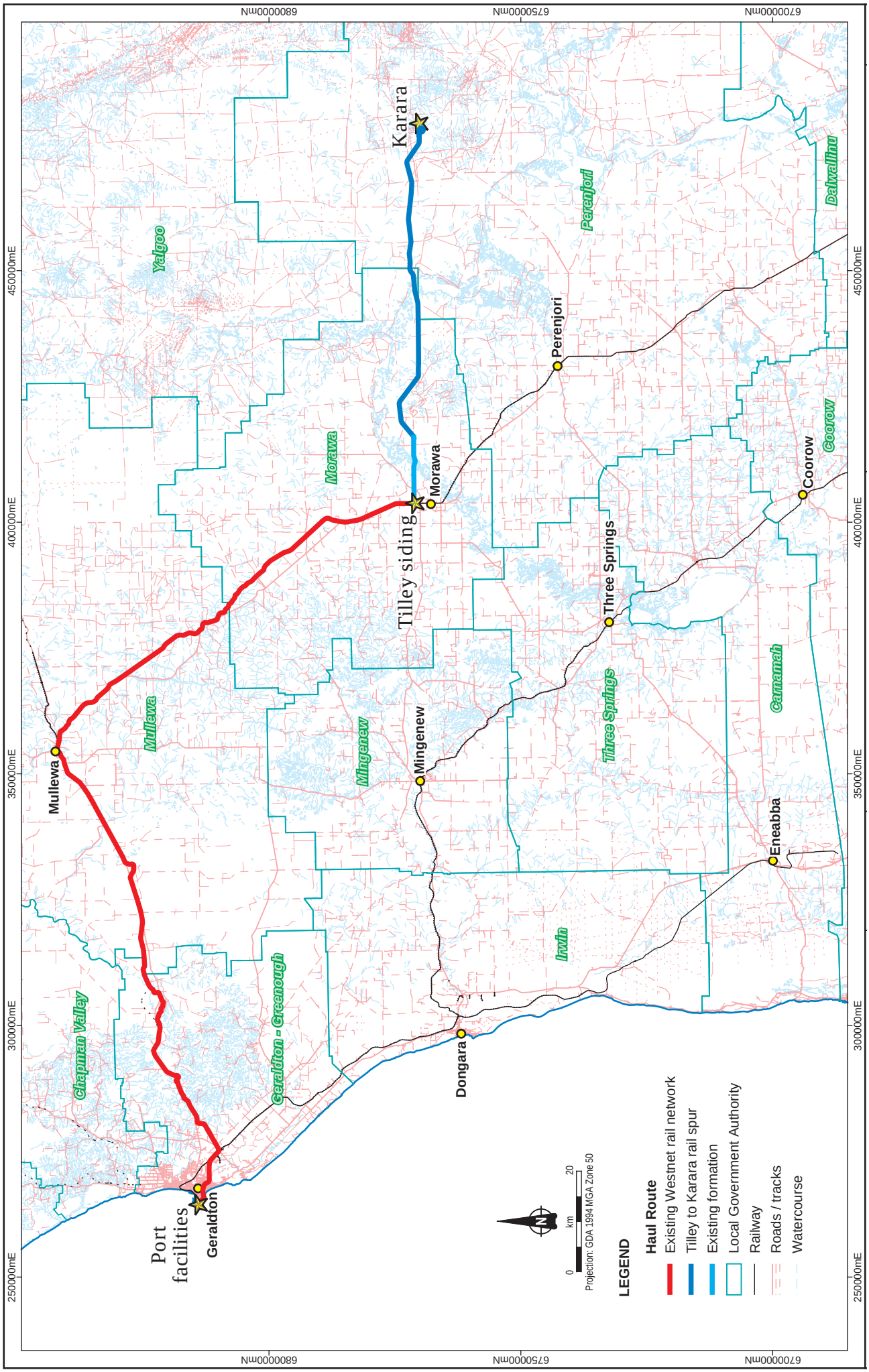
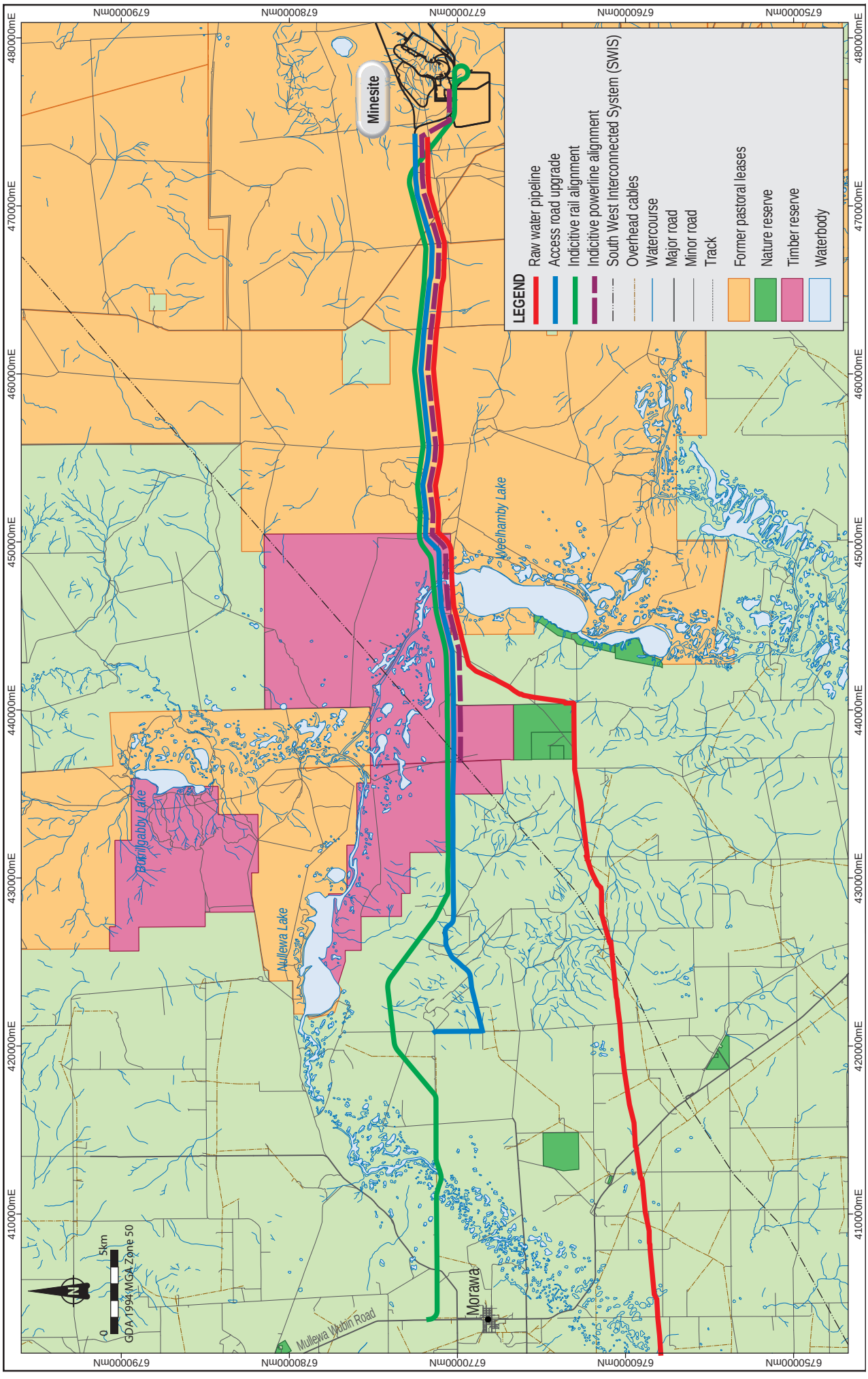


Figure 1.3 Infrastructure alignment



1.2 Project Proponent

KML (ACN 070 871 831) is the company being used by the joint venture between Gindalbie and AnSteel to develop, manage and operate the KIOP. The proponent contact details are provided in Table 1.1.

Table 1.1 Proponent contact details

Karara Mining Limited

Location
Level 9, London House 216 St Georges Terrace Perth Western Australia 6000

Postal Address
PO Box 7200, Cloisters Square Perth Western Australia 6000 Telephone: (08) 9480 8700 Facsimile: (08) 9480 8799 Contact: Greg Kaeding Community Relations and Environment Manager Telephone: (08) 9480 8700 Facsimile: (08) 9480 8799 greg.kaeding@gindalbie.com.au

Gindalbie (formerly Gindalbie Gold NL) was listed on the Australian Stock Exchange in April 1994 and has established itself as a successful minerals explorer and producer.

Gindalbie acquired 100% ownership of the tenements containing the Karara iron ore deposits as part of an expansion of ground holdings in the region of its Minjar gold mining operations during 2002 and 2003. Recognising the significant potential of the iron ore mineralisation contained within the tenements, Gindalbie underwent a strategic shift in focus to emerge as a dedicated iron ore exploration and development company.

AnSteel was established within the Liaoning Province of China in 1916. AnSteel is listed as China's second largest, and the world's eighth largest steel producer. AnSteel's crude steel production last year was 22 Mt.

In 2006, AnSteel merged with another Liaoning Province based company, Benxi Steel (BenSteel) and the two companies will operate under the name of Anben Steel Group Company (Anben). Anben is expected to have a total steel production capacity of 30 Mtpa by 2010.

The Chinese Central Government considers AnSteel to be one of the country's key growth companies and strongly supports securing new long-term sources of iron ore through international investment. AnSteel reports that the China National Development Bank financially supports its investments.

1.3 Document Purpose and Structure

On 4 September 2006, the Western Australian EPA determined that the KIOP required assessment under the *Environmental Protection Act 1986* (EP Act) (refer Section 1.4.1), and set the level of assessment for the project at the PER level.

A PER is required for projects of local or regional significance that raise a number of significant environmental factors, some of which are considered complex and require detailed assessment. The EPA requires a formal public review and compliance with the EP Act to ensure that such proposals are implemented and managed in an environmentally acceptable manner. This PER document outlines the potential environmental impacts related to construction and operation of the KIOP, and details the relevant management measures to eliminate or minimise these impacts.

This document has been prepared in accordance with the EPA guidelines for the preparation of a PER (EPA 2006a). The objectives stated in the guidelines are to:

- place the project in the context of the local and regional environment;
- describe all components of the project for which approval is sought;
- provide the basis for the project's environmental management program and outline the management strategies to minimise the anticipated environmental and cumulative impacts;
- communicate clearly with stakeholders (including the public and government agencies), so the EPA can obtain informed comment and provide informed advice to the Government; and
- demonstrate to the EPA and the Minister for the Environment that the project can be managed in a manner that is environmentally acceptable.

This PER is structured as follows:

- an executive summary;
- the main report (Volume 1, comprising 12 Chapters), which is intended to be independently understood without reference to supporting technical reports;
- the Cumulative Impact Assessment and Environmental Management Plans (Volume 2); and
- appendices (Volumes 3 to 6) containing a series of supporting technical studies, the key elements of which are summarised in the main report as relevant.

1.4 Legislative Approvals and Policy Framework

1.4.1 Western Australian *Environmental Protection Act 1986*

The EP Act is the primary legislation that governs environmental impact assessment and protection in Western Australia. Approvals can be required under two parts of the EP Act: Part IV and Part V. Projects with the potential to significantly impact on the environment are assessed under Part IV, while prescribed premises (as listed under Schedule 1) must be approved under Part V. The KIOP requires assessment and approval under both Part IV and Part V.

Environmental Impact Assessment under Part IV of the EP Act

As stated above, Part IV of the EP Act relates to the environmental assessment of proposals that have the potential to have significant impact on the environment. Under Part IV of the EP Act, the EPA can adopt one of five levels of assessment for a proposal. The level of assessment is determined by the potential for environmental impacts and their significance, and the predicted extent of public interest in the project.

The EPA determined that the KIOP was to be assessed at the level of PER.

Assessment of a project by the EPA under Part IV at the level of PER requires proponents to:

- prepare and obtain approval from the EPA for an environmental scoping document to outline the proposed scope of work for environmental and social impact assessment studies, incorporating the advice of other decision making authorities. This was completed in June 2007 for this project;
- undertake the relevant studies and investigations;
- prepare a PER document which outlines the project, its potential impacts and proposed management measures to eliminate, minimise or mitigate these impacts (this document);
- make the document available for public review (after the EPA is satisfied that it is adequate for public release); and
- respond to issues raised in public submissions received.

In undertaking the PER, KML is cognisant that relevant environmental policies and guidelines need to be addressed. The relevant policies and guidelines for the assessment of environmental factors include:

Statement	Number	Title
Draft Guidance Statements	No.8	Environmental Noise
	No 19	Environmental Offsets
	No 54a	Sampling methods and survey considerations for subterranean fauna in Western Australia
Final Guidance Statements	No 3	Separation Distances between Industrial and Sensitive Land Uses
	No 6	Rehabilitation of Terrestrial Ecosystems
	No 12	Minimising Greenhouse Gases
	No 34	Linkage between EPA Assessment and Management Strategies, Policies, Scientific Criteria, Guidelines, Standards and Measures Adopted by National Councils
	No 41	Assessment of Aboriginal Heritage
	No 51	Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia
	No 54	Sampling of subterranean fauna in groundwater and caves
	No 55	Implementing best practice in proposals submitted to the environment impact assessment process
	No 56	Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia
Position Statements	No 2	Environmental Protection of Native Vegetation in Western Australia
	No 3	Terrestrial Biological Surveys as an Element of Biodiversity Protection
	No 5	Environmental Protection and Ecological Sustainability of the Rangelands in Western Australia
	No 6	Towards Sustainability
	No 7	Principles of Environmental Protection
	No 8	Environmental Protection in Natural Resource Management
	No 9	Environmental Offsets
Environment Protection Policies		Ambient Air Quality (NEPM) (in development)

In assessing the project's environmental impact, the EPA considers the PER document, the public submissions and the proponent's response to these. During project assessment the EPA may also seek independent advice from other appropriate persons or decision-making authorities.

The EPA then prepares an assessment report, which is made publicly available both as a printed bulletin and on the EPA website. The content of EPA's report and recommendations can be appealed by any party within 14 days of its publication.

The Minister for the Environment makes the final decision on project approval and any conditions that are to be set on the project. The Ministerial conditions of approval are set in collaboration with other decision-making authorities. The Minister's decision and the conditions set can be appealed by the proponent within 14 days of release.

Environmental Assessment under Part V of the EP Act

Under Part V of the EP Act, premises listed as 'prescribed' under Schedule 1 of the Environmental Protection Regulations 1987 require a Department of Environment and Conservation (DEC) Works Approval for construction. "Prescribed premises" associated with the KIOP will de dependant upon final detailed design. Potentially this will include:

- ore processing facilities;
- sewage treatment facility;
- landfill facility;
- bulk chemical storage; and
- mine dewatering.

A Works Approval cannot be issued by DEC until after assessment of the project by the EPA under Part IV of the EP Act is complete, and the Minister for the Environment has made a decision that the project is environmentally acceptable.

In addition to a Works Approval to construct the project, a Licence is required to operate prescribed premises. To minimise delays, DEC will accept applications for Licences to operate prior to the completion of construction of a project. After construction is complete and the proponent has satisfied the conditions outlined in the Works Approval, DEC will issue an operating Licence. This PER will be the basis for the applications for Works Approval and Licence for the project.

1.4.2 Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*

The Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) is administered by the Commonwealth Department of the Environment, Water, Heritage and the Arts (DEWHA). If the impacts of a project have the potential to significantly impact on a matter of national environmental significance, the project is to be referred to the Commonwealth for a decision on whether the matter is a 'controlled action' (therefore requiring assessment).

The project was referred to the then Commonwealth Department of Environment and Heritage (DEH) on 25 August 2006. It was determined that the project was a controlled action requiring approval under Part 9 of the EPBC Act on 22 September 2006. The controlling provision for action is "Listed threatened species and communities".

Under the Bilateral Agreement between the State of Western Australia and the Commonwealth Government, assessment of the project by the Commonwealth at the level of PER was delegated to the Western Australian EPA. This process requires that the State provide the Commonwealth Environment Minister with an assessment report on the project. The Commonwealth Environment Minister remains responsible for approving the project under the EPBC Act.

1.4.3 Western Australian *Mining Act 1978*

Under the Western Australian *Mining Act 1978* (Mining Act) the proponent must submit a Mining Proposal to the Department of Industry and Resources (DoIR) prior to the commencement of mining activities. A Mining Proposal details the identification, evaluation and management of any potential environmental impacts associated with the proposed mining development.

All Mining Proposals submitted to DoIR are made publicly available via the DoIR website. A Mining Proposal includes the pit, waste rock dump, tailings storage facility and other important infrastructure design information and makes reference to the associated potential for environmental impact.

The Environment Division of DoIR assesses the environmental acceptability of the Mining Proposal and then communicates the operational conditions of the mining tenement to the Mineral and Title Services Division of DoIR.

The Mining Proposal will be a stand-alone document but DoIR will receive this PER as supporting information. DoIR is precluded from granting project approval under the Mining Act until the project is approved by the Minister for the Environment under the EP Act.

Environmental commitments made in the Mining Proposal become legally binding obligations once the Mining Proposal is approved. Commitments are included as a tenement condition through Section 84 of the *Mining Act 1978.*

1.4.4 Other Legislative Approvals

KML recognises that a range of other approvals, licences and permits are required for the project to proceed. In many cases, the information in this PER will provide the basic information for the relevant applications, but many require specialised information directly relevant to that legislation. KML is aware of its obligations in this regard.

The decision-making authorities for these approvals may contribute to the EPA assessment process, and may commence processing of applications, but cannot make decisions on project approval under their own legislation until after the issuing of the approval for the project by the Minister for the Environment under the EP Act. Such decisions must comply with all relevant Ministerial Conditions set in this approval.

KML will not be responsible for obtaining all approvals required as some of these will be obtained by others, e.g. service providers, as necessary. Table 1.2 provides a summary of approval requirements.

Table 1.2 Summary of approval requirements

Project Element	Legislation	Approval Required[1]	Supporting Document(s)	Agency
Approval process required for elements of the KIOP	*Aboriginal Heritage Act 1972*	Approval from Minister for Indigenous Affairs	Section 18 Notice and Survey Reports	Department of Indigenous Affairs
	Environment Protection and Biodiversity Conservation Act 1999	Approval from Commonwealth Minister for Environment	PER[2]	Department of Environment, Water Heritage and the Arts
	Environmental Protection Act 1986, Part IV	Approval from Minister for Environment	PER	Environmental Protection Authority
	Environmental Protection Act 1986, Part V	Works Approval Licence (to operate)	Works Approval Application Licence Application	Department of Environment and Conservation
	Mining Act 1978	Approval from Director of the Environment Division of DoIR	Mining Proposal	Department of Industry and Resources
	Planning and Development Act 2005	Development Approval	Development Application	Shire of Perenjori
		Potential requirement for Approval of Subdivision by the Western Australian Planning Commission (WAPC)	Subdivision Application	Western Australian Planning Commission
		Potential requirement for Planning Approval-zoning for all components yet to be fully identified	PER	Western Australian Planning Commission
	Local Government (Miscellaneous Provisions) Act 1960	Building Licence	Application for Building Licence	Shire of Perenjori
	Wildlife Conservation Act 1950	Potential requirement for Approval of to Take Declared Rare Flora (DRF) by Minister for the Environment	Application for Approval to take DRF Form Rare Flora Report Form	Department of Environment and Conservation

1 Not all of the approvals listed in this table are to be obtained by KML.

2 The Commonwealth Government, under the Bilateral Agreement, has accredited the State assessment process.

Table 1.2 Summary of approval requirements (cont'd)

Project Element	Legislation	Approval Required[1]	Supporting Document(s)	Agency
Mining tenure	*Mining Act 1978*	Mining Lease	Mining Lease Application Mining Proposal	Department of Industry and Resources
		General Purpose Lease/Miscellaneous Licence	General Purpose Lease/ Miscellaneous Licence Application	Department of Industry and Resources
Minesite	*Mine Safety and Inspection Act 1994*	Project Management Plan	Project Management Plan	Department of Consumer and Employment Protection
	Mining Act 1978 (through Mining Lease conditions)	Approval to commence mining operations by Director, Environment, DoIR	Mining Proposal	Department of Industry and Resources
Mining operations	*Dangerous Goods Safety Act 2004*	Licence to Store Explosives	Application for Licence to Store Explosives	Department of Consumer and Employment Protection
		Licence to Store Dangerous Goods	Application for Licence to Store Dangerous Goods	Department of Consumer and Employment Protection
	Dangerous Goods Regulations 2007	Licence for Transport of Dangerous Goods	Application for a Bulk Dangerous Goods Vehicle Licence	Department of Consumer and Employment Protection
Mine dewatering	*Environmental Protection Act 1986*	Works Approval	Application for Works Approval	Department of Environment and Conservation
		Operating Licence	Application for Operating Licence	
Ore processing and tailings storage facilities	*Environmental Protection Act 1986*	Works Approval	Application for Works Approval	Department of Environment and Conservation
		Operating Licence	Application for Operating Licence	
Water supply for ore processing	*Rights in Water and Irrigation Act 1914*	Licence to Take Water Licence to Construct/ Alter Well	5C Water Licence Application 26D Licence Application	Department of Water
Process water pipeline	*Mining Act 1978*	Miscellaneous Licence	Miscellaneous Licence Form	Department of Industry and Resources
	Rights in Water and Irrigation Act 1914	Licence to interfere with watercourse (permit to interfere with bed and banks)	Form H	Department of Water
	Planning and Development Act 2005	Potential requirement for Development Approval (for areas outside miscellaneous licence, if any)	Development Application	Shire of Mingenew

[1] Not all of the approvals listed in this table are to be obtained by KML.

Table 1.2 Summary of approval requirements (cont'd)

Project Element	Legislation	Approval Required[1]	Supporting Document(s)	Agency
Accommodation village	*Mining Act 1978*	Mining Lease	Mining Lease Application & Mining Proposal	Department of Industry and Resources
	Local Government (Miscellaneous Provisions) Act 1960	Building Licence	Application for Building Licence	Shire of Perenjori
Sewage treatment facilities	*Health Act 1911* *Health (Treatment of Sewage and Disposal of Effluent and Liquid Waste) Regulations 1974*	Approval to construct or install an apparatus for the treatment of sewage	Application to construct or install an apparatus for the treatment of sewage	Shire of Perenjori Department of Health
	Environment Protection Act 1986	Works Approval Operating Licence	Application for Works Approval Application for Operating Licence	Department of Environment and Conservation
Airstrip	*Civil Aviation Act 1988 and Civil Aviation Safety Regulations 1998*	Certify or Register the airstrip	Registration or Certification Application	Civil Aviation Safety Authority
	Local Government Act 1995	Planning Approval	Planning Submission	Shire of Perenjori Department for Planning and Infrastructure
	Mining Act 1978	Miscellaneous Licence	Miscellaneous Licence Application	Department of Industry and Resources
Borefield and process water staging facilities	*Rights in Water and Irrigation Act 1914*	Licence to Take Water Licence to Construct/ Alter Well	5C Water Licence Application 26D Licence Application	Department of Water
	Environmental Protection Act 1986	Potential requirement for Works Approval	Application for Works Approval	Department of Environment and Conservation
		Operating Licence	Application for Operating Licence	
	Planning and Development Act 2005	Potential requirement for Development Approval	Development Application	Shire of Perenjori
Miscellaneous (i.e. Borrow pits for Linear Infrastructure Corridor and haul road if required)	*Environmental Protection Act 1986*	Native Vegetation Clearing permit (if not addressed in PER)	Application for Clearing Permit as required	Department of Environment and Conservation
Other approvals	*Local Government Act 1995*	Potential requirements for approvals under local laws	Various	Relevant Shire
	Environment Protection (Controlled Wastes) Regulations 2004	Potential requirement for Licence to transport controlled waste	Application for Licence	Department of Environment and Conservation

[1] Not all of the approvals listed in this table are to be obtained by KML.

Table 1.2 Summary of approval requirements (cont'd)

Project Element	Legislation	Approval Required[1]	Supporting Document(s)	Agency
Other approvals (cont'd)	*Poisons Act 1964*	Potential requirement for Permit to purchase Poisons for industrial purposes	Application for Permit	Department of Consumer and Employment Protection
	Radiation Safety Act 1975	Potential requirement for licence to use a radioactive substance	Application for Licence	Radiation Safety Council
	Rights in Water and Irrigation Act 1914	Potential requirement for Permit to interfere with a watercourse	Form H	Department of Water

[1] Not all of the approvals listed in this table are to be obtained by KML.

1.4.5 Midwest Strategic Review

A key strategy document relevant to this project and its assessment is the "Strategic Review of the Conservation and Resources Values of the Banded Iron Formation of the Yilgarn Craton", released by the Western Australian Government in September 2007 (Government of Western Australia 2007).

The review consists of a DEC report on the biodiversity values and conservation requirements of the region, a DoIR report on the iron ore industry in the region (focussing on the Midwest) and a Government endorsed Executive Summary and Actions Arising from the review.

The strategic review was undertaken to provide information to government on the banded iron formation (BIF) ranges to allow for a strategic approach to resource utilisation and biodiversity conservation decision making processes. This recognised that there is a need to balance the economic, social and regional development benefits against the high conservation values of the region, and that this cannot be achieved by the EPA alone as it is limited to assessing only the environmental aspects of proposals, on a project by project basis.

Major findings of this review, as relevant to the KIOP, are:

> '*The Mt Karara, Mungada/Blue Hills and Koolanooka projects are likely to sustain the economic viability of Oakajee.*' (New Port facility for the region).
> (p. 8)

> '*The BIF ranges located within the 'south west' cluster (i.e. Mt Karara/Blue Hills/Mungada, Mt Gibson and Koolanooka) have very high biodiversity conservation values, as well as advanced highly prospective project development proposals and strategic interests in regional development terms. Proposals relating to the Mt Karara, Mungada and Blue Hills range system are currently in the Environmental Protection Act 1986 assessment process and Government will need to consider the economic and social benefits in the final decision making process.*'
> (p. 8)

The Government *'indicates a predisposition that in the interests of sustainable economic development in the highly biodiverse Karara/Mungada Blue Hills area, to allow the development of the identified magnetite resource in the south west section of the range but the Government is not predisposed to the extraction of the hematite deposits of the area.'* (p. 9)

'*Further, the Government will draw to the EPA's attention the Government's pre-disposition, as set out above, that exploitation of appropriate iron ore resources should be carried out sustainably by ensuring that critical thresholds for conservation of biodiversity are recognised in the consideration of development proposals and that best practice environmental management and mitigation programs are committed to by developers.*' (p. 9)

KML is of the view that this PER addresses the issues identified in the strategic assessment of the banded iron formation ranges. Discussion of these issues is addressed as relevant in Chapters 4 (Sustainability, Environmental Protection and Management), 6 (Existing Environment), 7 (Environmental and Social Impact Assessment), 8 (Environmental Management Framework) and 9 (Environmental and Social Management Commitments and Offsets).

KML has already responded to the findings of the BIF strategic review by withdrawing its proposal to mine the ore bodies on the Mungada Ridge as part of the greater Karara Iron Ore Project through modification of the scope of its MIOP. KML is of the view that its KIOP is consistent with the findings of the strategic review.

2

PUBLIC**ENVIRONMENTAL****REVIEW**

project description

2 Project Description

2.1 Project Summary

2.1.1 Project Location

The Karara Iron Ore Project (KIOP) is a greenfield mining project which is designed to produce 12 Mtpa of magnetite concentrate. The design life of the project is 40 years based on an estimated magnetite reserve of 497 Mt and an estimated resource of 929 Mt.

The project entails mining of magnetite ore; on-site crushing, screening and processing of magnetite ore to produce magnetite concentrate; and transport of the product to the Port of Geraldton for export.

Geographically, the KIOP can be divided into three main components as shown in Figure 1.1:

- minesite - located in the Mid-West Region of Western Australia, approximately 215 km east-southeast of Geraldton and 320 km north-northeast of Perth;
- transport for export - product will be transported by rail[1] to the Port of Geraldton for export; and
- water supply - facilities include a borefield near Mingenew and a raw water pipeline to the minesite.

The Karara Minesite layout is shown in Figure 2.1.

2.1.2 Project Overview

The elements of the project covered by this Public Environmental Review (PER) are:

- mining of 30 Mtpa of magnetite ore from the Karara Pit;
- disposal of 15 Mtpa of rock waste in a waste rock dump adjacent to the pit;
- processing plant for magnetite ore to produce 12 Mtpa of magnetite concentrate and 18 Mtpa of tailings;
- disposal of tailings in a dry-stack tailings storage facility (TSF);
- minesite infrastructure such as emergency and start-up power generation, workshops, laboratory, fuel storage area, magazines, administration buildings, communication systems, and water and wastewater treatment plants;
- airstrip;
- accommodation village to house fly-in/fly-out or drive in/drive out workforce, and associated potable water treatment facilities and wastewater treatment plant;
- linear infrastructure corridor containing a raw water pipeline to supply water to the minesite, and access road to Morawa.

The above elements are described in detail in the following sections.

[1] It is planned that product will be railed from the minesite to the regional rail network at Morawa via a spur line. If the spur line is not available when product is available to be exported, product will be hauled by road to a siding at Morawa.

Other elements of the project which are not covered by this PER because they are to be provided by others under contract, are:

- electrical power transmission from Southwest Integrated System (SWIS) – Western Power;
- product transport by rail – WestNet Rail on existing rail and an operator yet to be determined on the spurline extension to Karara; and
- export facilities – Geraldton Port Authority (GPA); marine contract and charter service providers.

The contractors will be required to achieve any necessary environmental and other approvals for these elements.

Approval is currently being sought from DoW to establish a borefield to supply process water to the minesite under the *Rights in Water and Irrigation Act 1914*. As such, the borefield is not addressed in this PER.

A summary of the key project characteristics is provided in Table 2.1.

Table 2.1 Key project characteristics

Aspect	Project Element	Detail
General	Project life	Greater than 40 years
	Resource	Estimated 497 Mt of magnetite reserve Estimated 929 Mt of magnetite resource
	Timing	Construction to commence within 2 months of environmental approvals First shipment of magnetite concentrate within 24 months of gaining environmental approvals
	Production rate	12 Mtpa of magnetite concentrate
Land Disturbance	Minesite	1,723 ha
	Linear Infrastructure Corridor	405 ha
	Access Road	200 ha
	Total disturbance	2,330 ha
Mining	Method	Conventional open pit
	Operations	24 hours per day, 7 days per week
	Total mining rate	45 Mtpa (average over project life)
	Ore mining rate	30 Mtpa
	Waste rock mining rate	15 Mtpa
	Waste rock management	Waste rock dump with potentially acid-forming material stored in isolation cells
	Mineralised waste storage	Stored in a combined facility with the waste rock

Table 2.1 Key project characteristics (cont'd)

Aspect	Project Element	Detail
Tailings	Tailings production rate	18 Mtpa (average over project life)
	Tailings storage	Dry-stacked tailings storage facility (TSF)
Product Transport	Product transport	Load product onto trains at minesite and transport to Port of Geraldton via proposed upgraded standard gauge rail network
Supporting Infrastructure	Additional minesite facilities	Workshops Hardstand areas Bulk fuel storage and refuelling pads Explosive compound and magazine Waste water treatment plants Access Roads Administration buildings Minesite laboratory
	Accommodation Village	1,500 personnel during construction 500 personnel during operations
Water Supply (construction)	Source	Bores at the minesite and pit dewatering from Silverstone Mine.
	Requirement	Up to 2.3 GL over 18 months.
Water Supply (operations)	Source	Borefield near Mingenew and bores at the minesite Note: Approval will be sought under the *Rights in Water and Irrigation Act 1914* and is not addressed in this PER
	Processing requirement	Approximately 6.6 GLpa of process water to produce 12 Mtpa of concentrate, and supply all potable water (accommodation village, offices and workshops)
	Dust suppression	Supplied from pit dewatering, bores at the minesite, and other low-quality sources

2.1.3 Timing

The project is scheduled to commence construction within two months of gaining all necessary approvals. A conceptual construction schedule is provided in Figure 2.2. Construction of components for mining, processing and exporting magnetite concentrate is expected to be complete within 24 months.

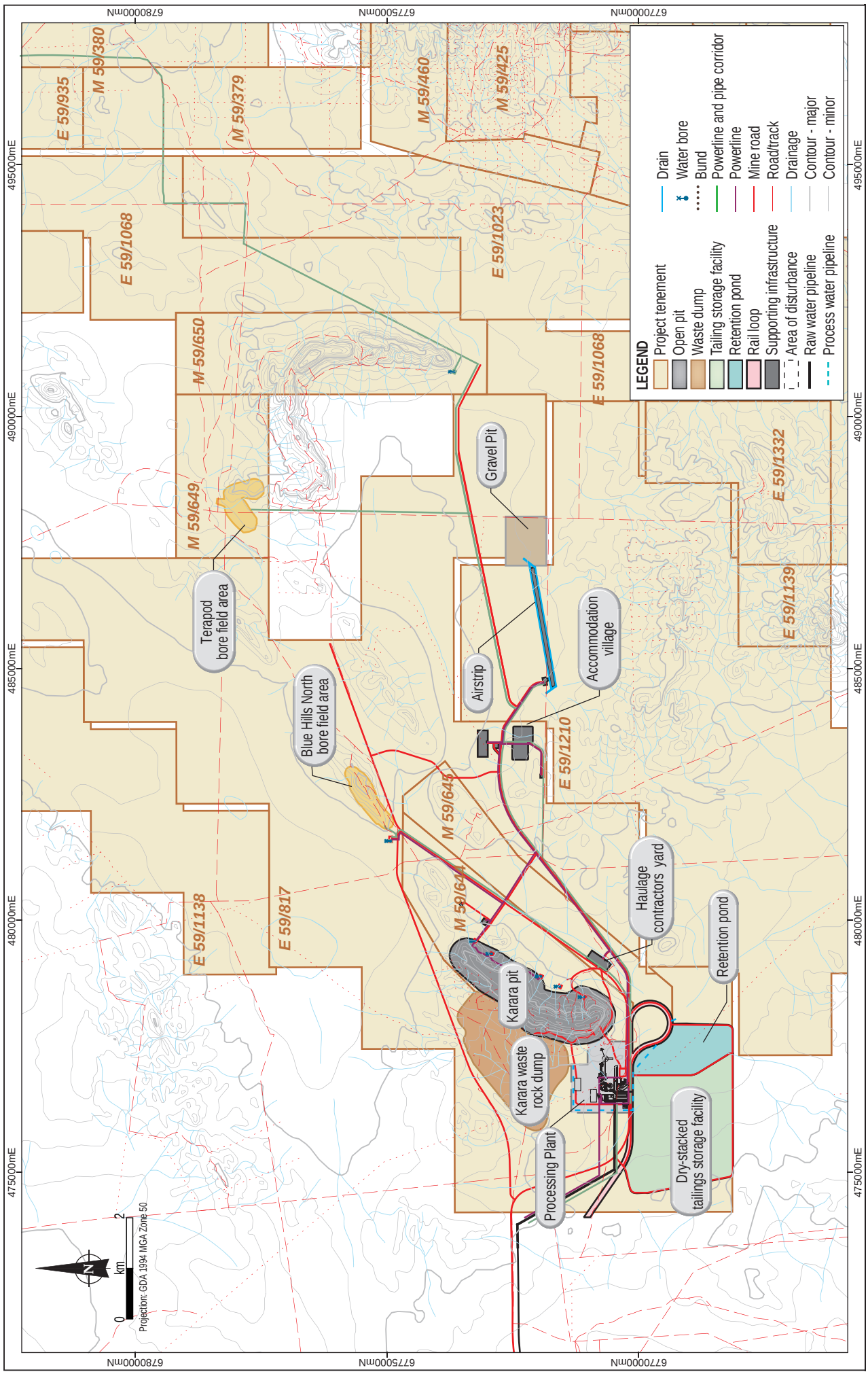
Mining is expected to continue for at least 40 years based on the current resource estimates. The project life may be extended if exploration establishes further resources or project economic factors improve.

It is anticipated final site closure and rehabilitation work will take approximately 18 months after the completion of mining.

2.1.4 Tenure

The minesite is located entirely within unallocated Crown land, managed by the Department of Environment and Conservation (DEC) for conservation purposes under Section 33(2) of the *Conservation and Land Management Act 1984*. Karara Mining Limited (KML) and its corporate related parties have been granted a number of mining tenements under the *Western Australian Mining Act 1978* (Mining Act). Table 2.2 identifies the relevant existing tenure and ownership arrangements and also the proposed changes for major project components. These mining tenements are also shown on Figure 2.1.

Figure 2.1 General minesite layout



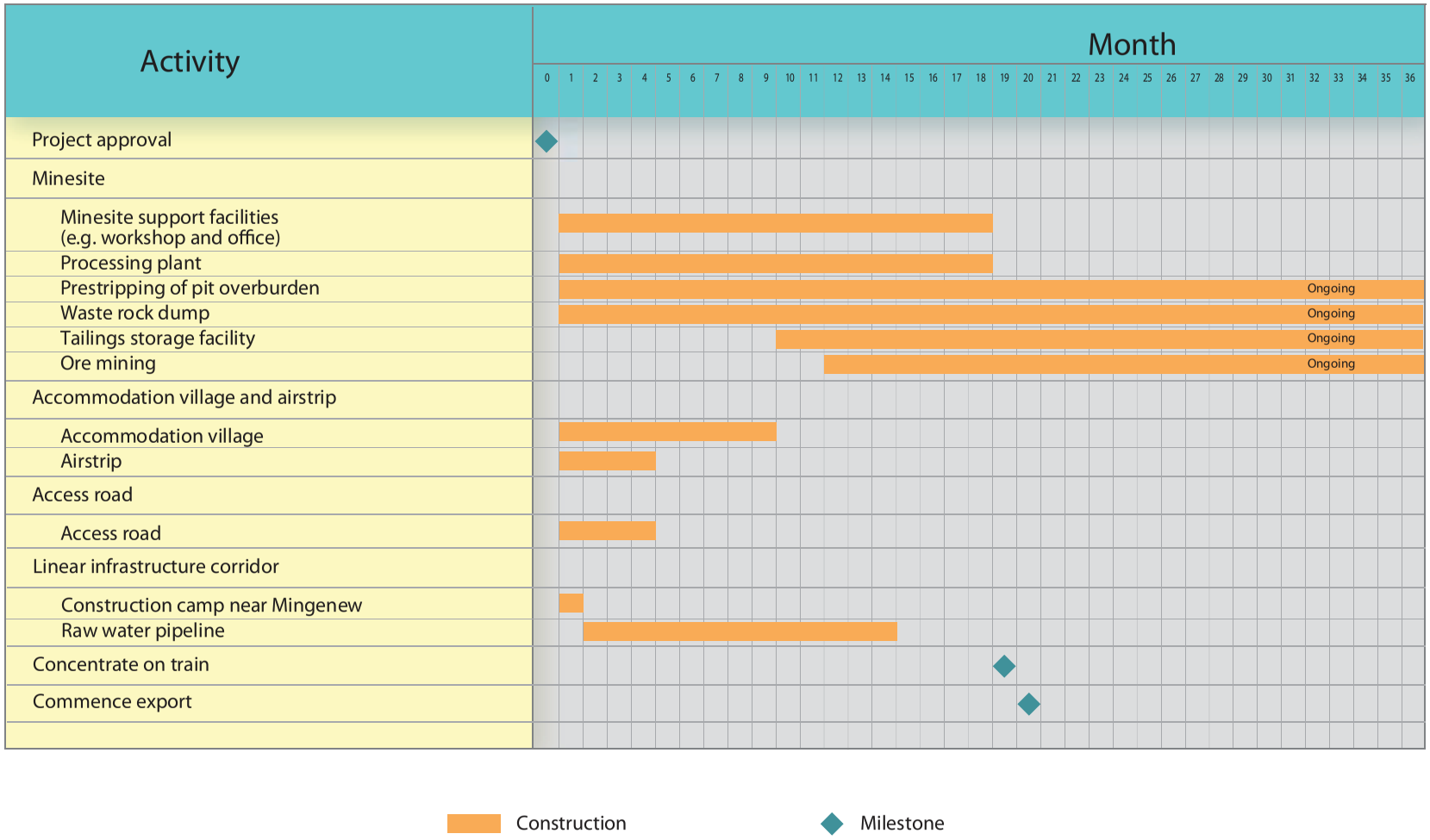


Figure 2.2 Proposed project construction schedule

Table 2.2 Project component area, land ownership and tenure

Component	Existing Ownership	Existing Tenure	Proposed Changes to Tenure
Minesite			
Karara Pit	Unallocated Crown land	Mining Lease M59/644-I.	Tenement granted.
Karara Waste Rock Dump	Unallocated Crown land	Mining Lease M59/644-I and General Purpose Lease G59/38.	G59/38 has been recommended for approval.
Processing Plant area	Unallocated Crown land	Mining Lease M59/644-I and General Purpose Lease G59/38.	G59/38 - see above.
Dry-stacked TSF	Unallocated Crown land	General Purpose Lease G59/38.	G59/38 - see above.
Airstrip	Unallocated Crown land	Miscellaneous Lease L59/74 and L59/77.	L59/74 and L59/77 are currently under application. These proposed tenements are on exploration tenement E59/1210, currently held by Minjar Gold. Gindalbie is currently in negotiations with Minjar Gold to purchase this tenement.
Accommodation Village	Unallocated Crown land	General Purpose Lease G59/39.	G59/39 is currently under application. Tenement has been advertised for the 4 month Native Title period and granting is expected in August 2008.
Mine Haul Road	Unallocated Crown land	General Purpose Lease G59/38, exploration licence E59/817 and mining lease M59/721.	KML is in the process of securing an access agreement with Midwest Corporation Limited (Midwest Corporation) for the small portion of the road that passes through Midwest Corporation's tenement M59/595-I. Note: Tenement E59/817 is granted, and M59/721 is an application over parts of E59/817.
Mine Access Road (minesite to Tilley)	Unallocated Crown land and freehold	Miscellaneous Lease L59/76.	L59/76 is currently under application. Land access agreements are being negotiated with tenement holders.
Water supply facilities and transfer infrastructure			
Silverstone South Pit		Minjar Gold (M59/421).	Gindalbie has a land access agreement for its pit dewatering activities, and will seek a land access agreement with the new owner of the tenement (Aard Metals).
Silverstone water transfer pipeline	Various, including unallocated crown land	A combination of vacant Crown land, road reserves, pastoral leases and free hold.	A Miscellaneous Licence will be applied for once the pipeline route is finalised.
Linear Infrastructure Corridor (raw water pipeline)	Various, including private freehold	A combination of vacant Crown land, road reserves, pastoral leases and free hold.	A combination of easements and miscellaneous licences will be applied for to allow access through freehold land, vacant Crown land, pastoral leases and road reserves. Land access agreements are being sought from land owners and various parties.

Table 2.2 Project component area, land ownership and tenure (cont'd)

Component	Existing Ownership	Existing Tenure	Proposed Changes to Tenure
Powerline			
Take off from Golden Grove line at Koolanooka to feed Karara spurline	Various, including private freehold	Various	A combination of easements and miscellaneous licences will be applied for to allow access through freehold land, vacant Crown land, pastoral leases and road reserves. Western Power responsibility.

2.2 Materials to be Mined

2.2.1 Mineral Resources

The KIOP will entail the extraction of magnetite ore resources, topsoil and waste materials using conventional open pit techniques. The magnetite resources considered in the project are located in a banded iron formation (BIF) outcrop, which is an expression of the Wingdaning formation of the regional Murchison Supergroup. Figure 2.3 is a magnetic image depicting prospectivity within Gindalbie's tenements.

The Karara deposit consists essentially of a massive banded magnetite BIF unit extending over a strike length greater than 3 km. The western limb is structurally thickened to a width greater than 400 m and to a depth in excess of 350 m. The current estimated resource is 929 Mt and 497 Mt reserve with a content of about 36% natural iron and 43% silica. The narrower eastern limb outcrops as a series of hills approximately 100 m in width containing hematite enrichment adjacent to a north-south trending fault. A minor hematite-goethite resource (0.83 Mt) exists within the Karara Pit shell, which will be mined as part of the pre-stripping of the oxidised waste rock.

Drilling results were modelled to produce a JORC-compliant resource estimate. The grade and tonnage estimates are tabulated in Table 2.3 and are shown graphically in Figure 2.4.

Table 2.3 Iron ore resources and head grades

Prospect	Reserve Classification	Tonnage (Mt)	Fe (%)	SiO_2 (%)	Al_2O_3 (%)	P (%)	LOI (%)	S (%)
Karara magnetite	Probable	497	36.3	42.71	0.89	0.089	-0.74	0.119
	Resource Classification							
	Indicated	158	36.4	42.65	0.82	0.091	-0.69	0.119
	Inferred	771	36.2	42.76	0.94	0.087	-0.79	0.119
	Subtotal	929	36.3	42.71	0.89	0.089	-0.74	0.119

Notes: 1. DTR Mass Recovery > 20% and Sulphur < 0.25%; Excluding Western Mafic / Shale Units
2. Resources are exclusive of Reserves

Figure 2.3 Regional prospectivity shown by magnetic response

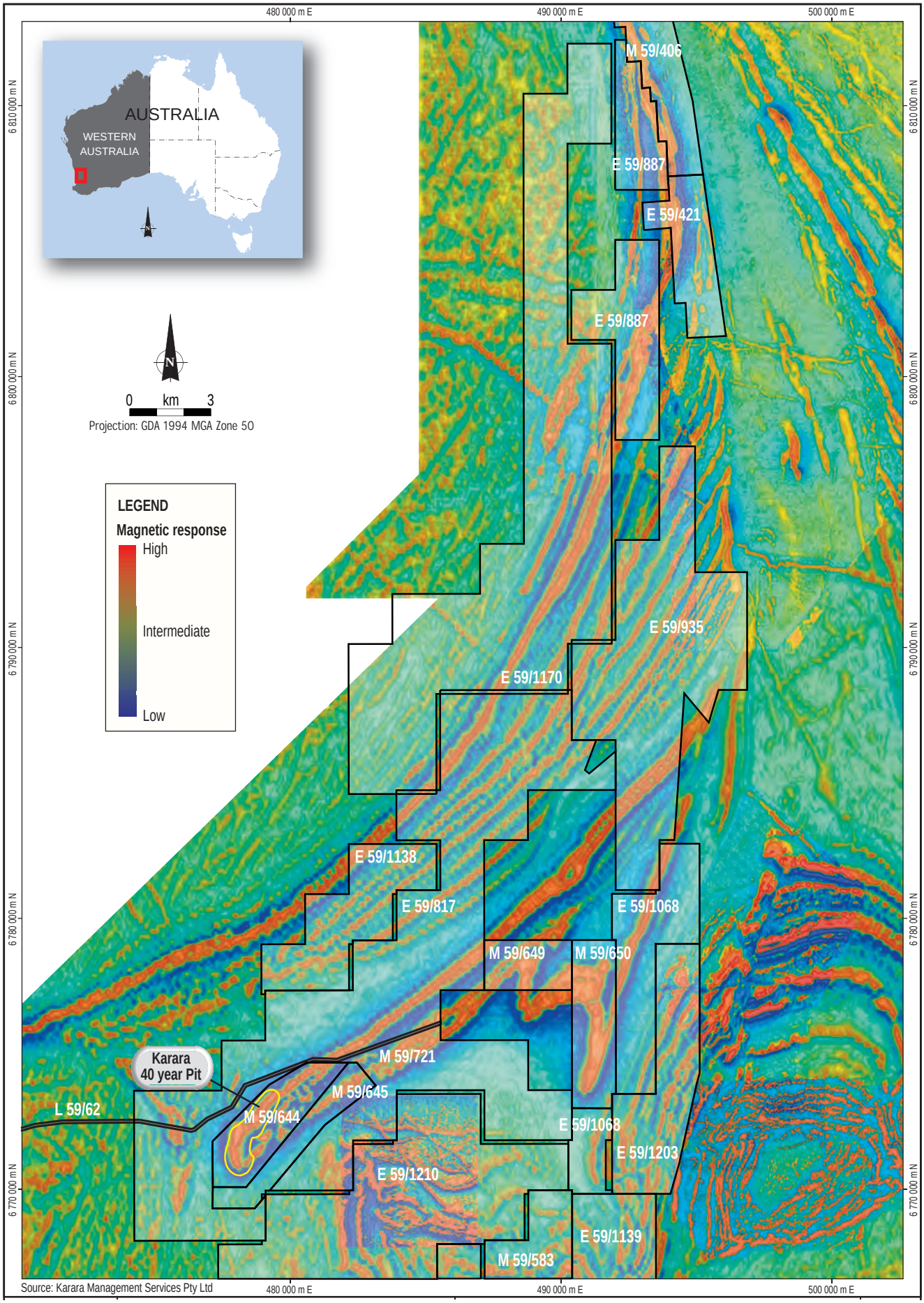
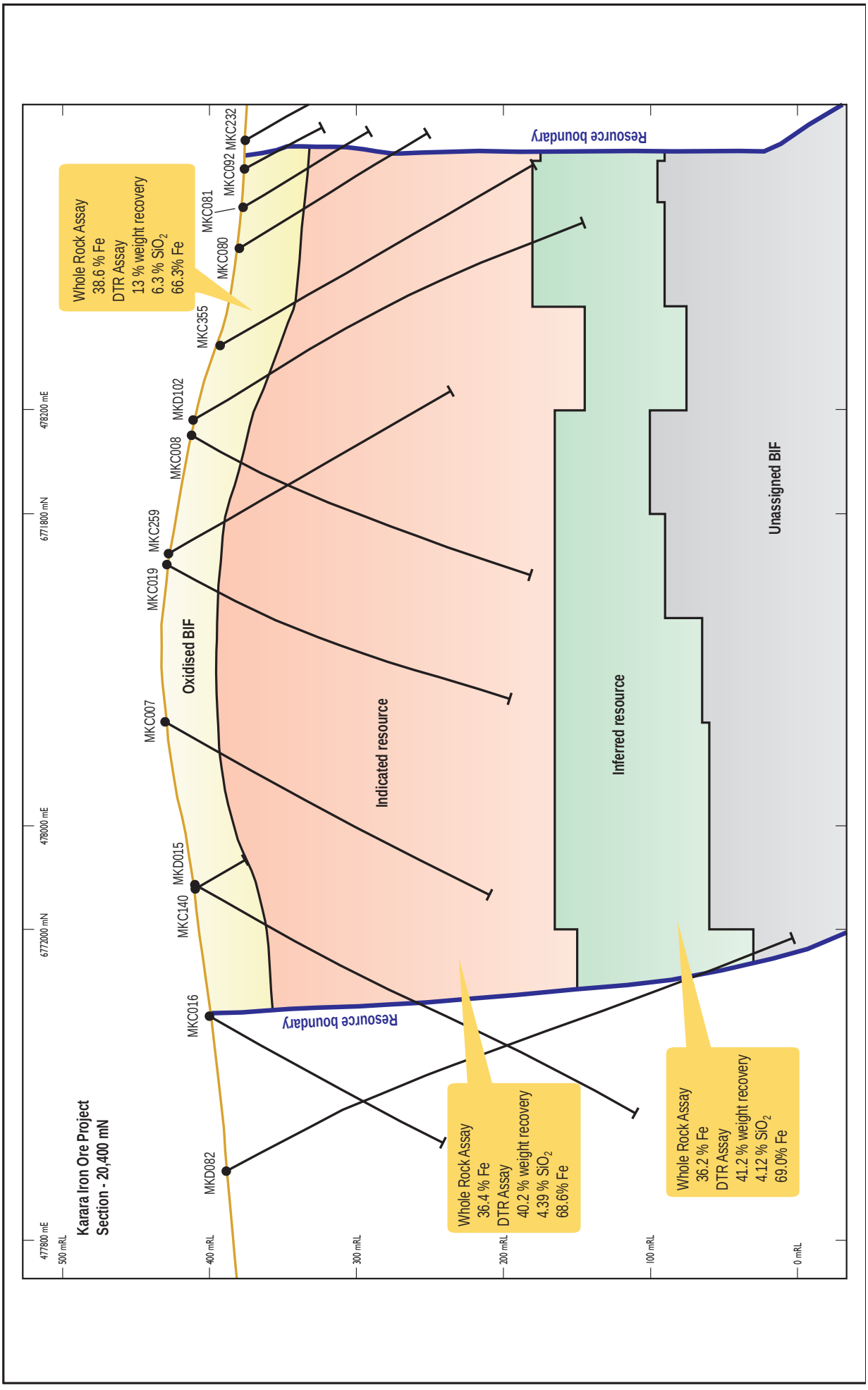


Figure 2.4 **Geological cross section of Karara magnetite deposit showing inferred resource area**



2.2.2 Topsoil Resources

Topsoil stripped from areas scheduled for development is an important resource for site rehabilitation programs. To facilitate management of topsoils and other soil resources, Landloch Pty Ltd was commissioned to complete a broad soil quality assessment over the KIOP in September 2006 (refer Appendix 4). Soils were found to be suitable as rooting media for native vegetation endemic to the minesite. They are also a source of humus material and seeds. Soils will be managed to ensure appropriate replacement on disturbed areas during rehabilitation. Characterisation and management of topsoil and subsoil are further discussed in Sections 6.1.3, 7.2.1 and 8.7 respectively.

2.2.3 Waste Materials

The mining operation will produce waste regolith, waste bedrock and low grade ore (mineralised waste). The low grade ore has an iron content that is below current market requirements or has excessive impurities. Changes in price or processing technology may mean that this ore becomes economical to process in the future, so it is to be stored in an accessible location.

Graeme Campbell and Associates Pty Ltd (GCA) was commissioned to carry out the geochemical characterisation of the materials to be mined by the project (refer Appendices 1 and 3).

Physical Characterisation

The preliminary physical characterisation of waste materials derived from the Karara Pit has been qualitatively described in Table 2.4. Physical characteristics will continue to be monitored during mine operation as part of the ongoing waste rock management strategy.

Geochemical Characterisation

Waste Regolith

The waste regolith units defined over the Karara Pit are listed in Table 2.4. Ferruginous (iron bearing) duricrust, BIF regolith and shale regolith are geochemically similar to topsoil. They are categorised as mildly acidic, heavily leached, devoid of sulphide and carbonate minerals and non-acid forming (NAF).

Waste Bedrock

92% of the waste bedrock at the Karara Pit is NAF material. Due to the targeted sampling of potentially acid forming (PAF) material, no samples of benign waste-bedrocks were tested.

The remaining 8%, which is PAF material was analysed and three types identified:

- pyroxenite waste bedrocks;
- sulphidic BIF waste bedrocks; and
- shale waste bedrocks.

Pyroxenite waste bedrock is classified as PAF-short lag. These waste bedrocks have very little reactive carbonate to buffer sulphide oxidation and prevent the production of acid. Little, if any, of this pyroxenite waste bedrock is expected to be produced during open pit mining.

Table 2.4 Physical and chemical characteristics of Waste Materials

Material Type	Material Units	Physical Characteristics	Chemical Characteristics
Waste regolith	Ferruginous duricrust	Moderately hard and moderately competent. Particle size will range from silt to large cobbles. Resistance to erosion is expected to be moderate to high. Moisture retention capacity is likely to be low-to-moderate.	Mildly acidic, heavily leached, devoid of sulphide and carbonate minerals and NAF.
	Non BIF-ferruginised saprolite	Soft, plastic, and non-competent. Particle size will range from clay to pebbles. Resistance to erosion is expected to be low. Moisture retention capacity is likely to be moderate to high.	Similar to Ferruginous duricrust.
	Non BIF-saprolite	Soft, plastic, and non-competent. Particle size will range from clay to silt. Resistance to erosion is expected to be low. Moisture retention capacity is likely to be moderate to high.	Mostly NAF. Some graphitic-pyritic shale units PAF, but restricted to lower-saprolite zone.
	Non BIF-ferruginised saprock	Soft to moderately hard and non-competent. Particle size will range from clay to pebbles. Resistance to erosion is expected to be low. Moisture retention capacity is likely to be moderate to high.	PAF, especially adjacent to carbonaceous shale-regolith.
	BIF	Very hard, very competent and blocky. Particle size will likely range from silty sand to very large boulders. High resistance to slaking (i.e. breaking apart due to weathering). Resistance to erosion is expected to be high to very high. Moisture retention capacity is likely to be low.	NAF.
Waste bedrock	BIF	Very hard, very competent, and blocky. Particle size will likely range from silty sand to very large boulders. High resistance to slaking. Resistance to erosion is expected to be high to very high. Moisture retention capacity is likely to be low.	Mostly NAF, but locally PAF near shale-BIF contact zones.
	Pyroxenite	Very hard, very competent, and blocky. Particle size will likely range from silty sand to very large boulders. Resistance to erosion is expected to be high albeit subject to oxidation of sulphide minerals. Moisture retention capacity is likely to be low.	PAF where admixed with pyritic graphitic shales.
	Shale	Hard, moderately competent, and slabby. Particle size will range from silt to large boulders. Resistance to erosion is expected to be moderate to high. Moisture retention capacity is likely to be low to moderate.	PAF in vicinity of shale-BIF contact zones.
Mineralised waste	BIF	Very hard, very competent, and blocky. Particle size will range from silty sand to very large boulders. Resistance to erosion is expected to be high to very high. Moisture retention capacity is likely to be low to moderate.	NAF.

Sulphidic BIF waste bedrock and shale waste bedrock found are classified as PAF-long lag. Initial analysis suggests that sulphidic BIF waste bedrock and shale waste bedrock have enough reactive carbonate to buffer acid produced during sulphide oxidation; however this will be further verified with kinetic testing. At present, modelling is being undertaken to establish appropriate PAF material exposure times, which will be incorporated into the mining schedule and waste rock management procedures.

Low Grade Ore

Constraints on the sulphur content of ore-grade materials indicate that the low grade ore should have total sulphur values less than 0.1% and is expected to be NAF. Accordingly, if low grade ore stockpiles remain at mine closure, then no geochemical concerns are foreseen for their longer-term management, and rehabilitation will be undertaken. The management of mineralised waste is discussed in Section 2.4.1.

Site Applications

Waste Regolith

Geochemical testing of representative samples of ferruginous duricrust and regolith derived from the weathering of BIF found that these materials are typically low in leachable salt and trace metals, are non-acid generating and have similar pH values to topsoil (Refer Appendix 1). Although the exchangeable sodium percentage of the regolith materials was relatively high (in the order of 25%), the materials are unlikely to show dispersive characteristics due to the low proportion of clay minerals present in the material (as evidenced by the low cation exchange capacity of the materials and semi-quantitative information from X-ray diffraction analysis). Accordingly, the ferruginous duricrust and BIF regolith are considered likely to provide a suitable growth medium if mixed with topsoil and should be recovered for use in site rehabilitation works.

The geochemical properties of regolith derived from the weathering of shale are broadly similar to those of the ferruginous duricrust and BIF regolith, however the samples of shale regolith tested during baseline studies showed somewhat higher proportions of clay minerals and a slightly higher cation exchange capacity than did the ferruginous duricrust and BIF regolith. The average exchangeable sodium percentage of the shale regolith was similar to that of the BIF regolith. Further testing will be required to evaluate the long term suitability of shale regolith as a plant growth medium. Specifically, some further testing will be required to assess the susceptibility of this material to dispersion, slaking or crusting. For the purpose of preliminary planning it has been assumed that the shale regolith will not be used as a surface growth medium, but rather will be used in the construction of upper and lower seepage barriers in the waste rock dump "Isolation Cells" for reactive waste bedrocks.

BIF regolith and shale pose no water quality concerns for either runoff/drainage waters or pore fluids within rooting zones of vegetation. BIF regolith tends to be chunky in nature and durable, making it ideal for use in rock armouring of erosion prone areas.

BIF regolith and shale pose no water quality concerns for either runoff/drainage waters or pore fluids within rooting zones of vegetation. BIF regolith tends to be chunky in nature and durable, making it ideal for use in rock armouring of erosion prone areas.

Graphitic-pyritic shale units within the saprolite and ferruginised saprock are considered PAF, and will require specific management. GCA (refer Appendix 1) reports that the former has the potential to be acidic 'ex-pit'. Management of this material is detailed in Section 2.4.1.

Waste Bedrock

NAF waste bedrock will be handled as a Universal NAF Waste Product (ROM) operation and can be employed as rock armour for erosion control, construction of safety-bunds around pits at mine closure or crushed for use as road base.

2.2.4 Schedule of Mined Material

Mining will produce six materials: magnetite ore, hematite ore, topsoil, waste regolith, waste bedrock (both NAF and PAF) and mineralised waste. The mining locations within the pit will be selected to ensure the production rate of the required grade of magnetite concentrate, and to optimise the use of the mining equipment. In general, topsoil will be removed initially, followed by waste regoliths and waste bedrock. Details will be finalised during operation, but an indicative schedule is shown in Table 2.5.

Table 2.5 Karara indicative mining schedule

Year	Total Volume [Mt/a]	Ore [Mt/a]	Waste [Mt/a]	Waste Components	
				NAF [Mt/a]	PAF [Mt/a]
1	30	1	29	28.5	0.5
2	45	15	30	29	1
3	45	30	15	14	1
4	45	30	15	14	1
5	45	30	15	14	1
6-10	45	30	15	12	3
11-15	45	30	15	11	4
16-35	45	30	15	11	4
36-40	35.5	30	5.5	3.5	2
TOTAL Year 1 – 40 inclusive	**1,737.5**	**1,156**	**581.5**	**452**	**129.5**

The preliminary mining schedule shows that the Karara Pit will produce mainly NAF material for the first ten years of waste rock generation. As the pit deepens, the proportion of PAF waste rock will become higher; however, the overall tonnage of waste rock being produced will decrease. The anticipated annual quantities of PAF and NAF waste rock being produced are presented in Table 2.5.

It is likely that the trend, of an increasing proportion of PAF material with pit depth, will result in a requirement to stockpile NAF material in the initial years of operation to ensure proper encapsulation of PAF material in later years (see Section 2.4.1).

2.3 Mining

2.3.1 Pit Arrangement

The mine will be a conventional open pit, constructed through standard drill and blast, and load and haul operations.

The pit will have an adjoining waste rock dump, and is linked to the ROM pad and processing pad by haul roads. The spatial arrangement of the pit and waste rock dump is illustrated in Figure 2.1.

2.3.2 Pit Design

The open pit site will be progressively stripped of topsoil and overburden to allow access to the ore. Topsoil and overburden either will be stored in the waste rock dump footprint adjacent to the pit (see Section 2.4), or will be dumped directly onto pre-formed dump slopes.

The following three-stage pit design was selected for the Karara Pit based on practical push-back dimensions, ore production rate, containment requirements for PAF wastes and minimising stripping requirements early in the mine life:

- **Stage 1** – Focus on mining near the surface at the southern end of the ore body;
- **Stage 2** – Extend the pit north and deepen the southern portions of the pit; and
- **Stage 3** – Deepening entire pit to final pit design.

Aspects of the open pit design are outlined in Table 2.6.

Table 2.6 Open Pit parameters

Parameters	Karara Pit Values
Length[1]	3,400 m
Width[1]	1,300 m
Depth[1]	300 m
Interberm Slope Angle (all walls)	70º
Berm Width	8 m
Batter Height	20 m
Ramp Width	30 m
Ramp Gradient	1:10
Minimum Mining Width	75 m

[1] The length, width and depth are the pit's maximum dimensions during 40-year mine life.

Figure 2.5 provides a typical pit cross-section showing pit design features.

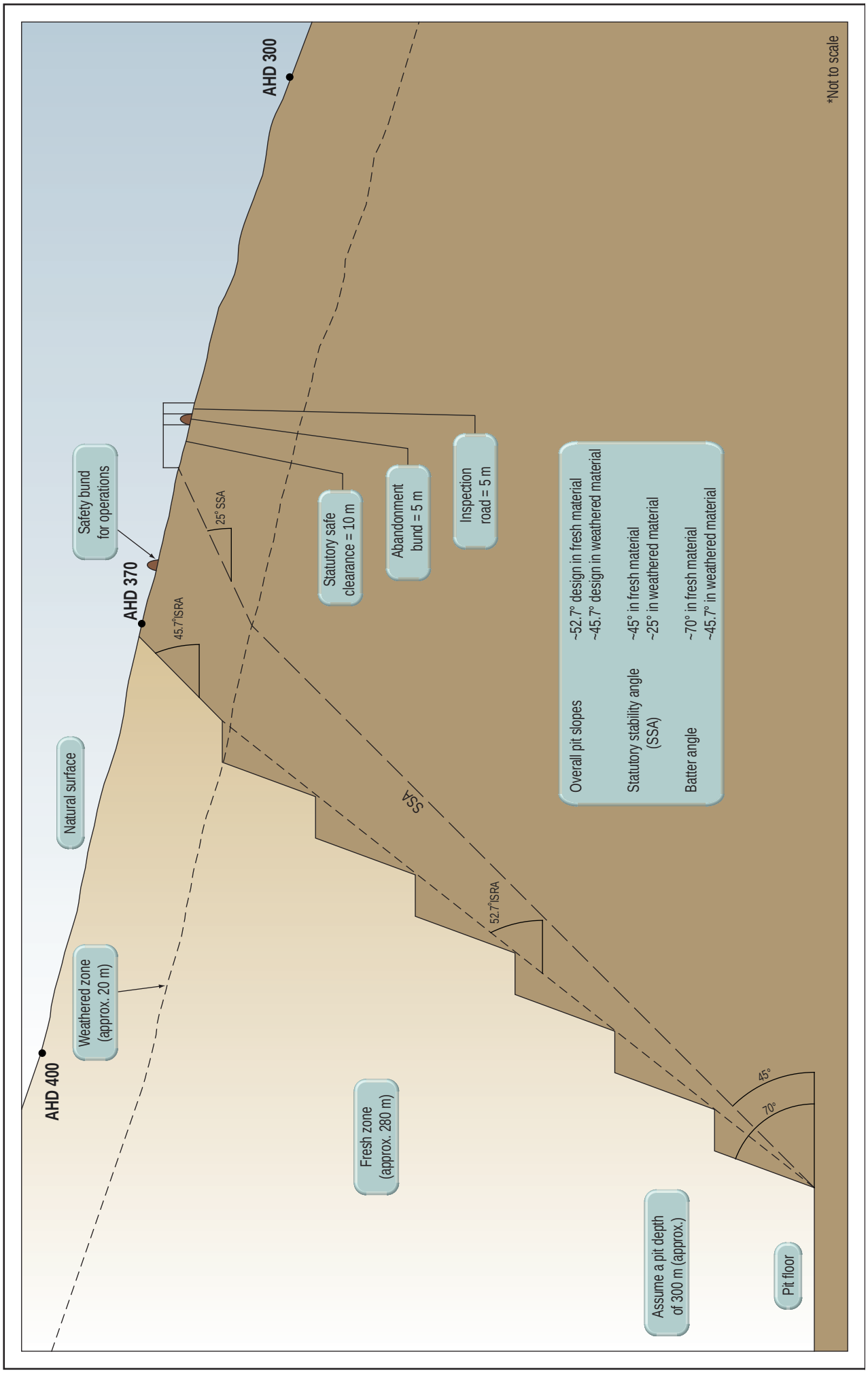
2.3.3 Sequence and Mining Rate

The first year of operation of the Karara Pit will involve the removal of overburden waste rock and mineralised waste rock with minimum ore. Following this, extraction of magnetite ore will occur concurrently from different depths within the pit. The pit will be progressively extended north, with mining at multiple levels in different materials and in different ore grades to optimise pit development and to ensure a relatively consistent ore grade is delivered to the processing plant.

Once operational, mining will be carried out 24 hours per day, 7 days per week.

The mining rates will vary depending on the mine life stage. The overall average mining rate is 15 Mtpa of waste rock and 30 Mtpa of ore (that is, a waste to ore stripping ratio of 0.5:1).

Figure 2.5 Typical pit slope cross section



2.3.4 Mining Method

The pit will be constructed and operated through a conventional process of drilling and blasting, loading and haulage.

Drilling and Blasting

Drilling will be undertaken by hydraulic hammer drills. Explosives will be mixed on site and delivered directly to drill holes by purpose-built trucks.

Blasting will occur typically most days of the week. The explosives used will be ammonium-nitrate based (ammonium nitrate/fuel oil (ANFO) or AN emulsion), supplied and managed by an explosives contractor. Explosive powder factors will be selected to produce material that can be easily excavated, with a maximum particle size of 1,000 mm diameter. Based on an estimated powder factor of 0.26 kg/t and a mining rate of approximately 45 Mtpa, the anticipated explosives use is in the order of 12 ktpa.

Loading

After blasting, hydraulic excavators will load ore and waste into rear dump off-highway haul trucks. Loading will typically occur on 4 m benches.

Haulage

Once the ore or waste is loaded into haul trucks, it will be transported from the pit floor along the pit ramp. The pit ramp will be designed to minimise haulage distances and provide safe transit for all vehicles accessing the pit.

The magnetite ore will be hauled directly to the processing plant, and deposited to the primary crusher for a period. If the amount of ore exceeds the processing capacity of the primary crusher or the crusher is down for maintenance or if blending is required, ore will be stockpiled on the ROM pad, located adjacent to the pit and the processing plant. It is expected that about 85% of the ore will be direct-tipped into the crusher and 15% will go to the ROM pad for later crushing.

Hematite ore will be mined initially from the surface and near-surface horizons of the pit. The blasting and loading techniques for hematite ore are the same as for magnetite ore.

Waste rock will be loaded and hauled from the pit using the same methods as ore haulage. A waste rock dump will be located adjacent to the pit. Waste materials will be separated according to acid-forming potential and potential mineralisation. Some of the NAF materials will be used for site construction works (see Section 2.4).

2.3.5 Pit Dewatering and Depressurisation

Groundwater in and around the minesite is mostly situated in the weathered bedrock and in fractures in the fresh rock, with fractures being more pervasive in, but not restricted to, the mineralized BIF. The natural groundwater table is approximately 50 m below the crest of the existing ridge (refer to Rockwater (hydrogeological consultancy) report, Appendix 6).

It is expected that the Karara Pit will intersect the groundwater table during year 2 or 3 of the operation. In the initial stages of operations, only minor amounts of water will be encountered in the pit. However, for geotechnical and operational reasons, dewatering and depressurisation near the pit walls may be required in advance of the pit intersecting the groundwater table. Groundwater will enter the pit as seepage through fractures and will drain to in-pit sumps. It is anticipated that after Year 3 of mining there will be sufficient groundwater seepage and incident rainfall to meet in-pit dust control requirements.

Water will be pumped from the in-pit sumps via a rising main pipe up the pit wall in the southern extremity of the pit. From the pit crest, water will then be transferred to the process water dam or the retention dam depending on its quality. Water which is collected will undergo regular chemical analysis to determine its suitability for ore processing. If the salinity level is too high it will be used for in-pit dust suppression or sent to the Retention Dam for other purposes less sensitive to quality.

2.3.6 Mining Equipment

Table 2.7 shows the likely mining vehicle fleet. It has been sized to suit the requirements of the proposed rate and the processing plant feed blend. The fleet will be provided by contractors engaged for the project and may differ from that listed.

Table 2.7 Indicative mining fleet

Vehicle	Number
Excavator (229 t, model L994B)	1
Excavator (250 t, model EX2500)	2
Front-End Loader (model 994F)	2
Front-End Loader (model 992)	2
Front-End Loader (model 980H)	1
Haul Truck (190 t, model 789C)	12
Haul Truck (136 t, model 785C)	3
Track dozer (model D10T)	3
Wheel dozer (model 922)	1
Grader (model 16H)	2
Water truck (75 kL, model 777)	2
Blasthole drill (model SKS-15)	7
Prespilt drill (model ECM-720)	3

A fleet of service vehicles and ancillary equipment of various types will be required including light vehicles, buses, service/refuelling trucks, lighting plants, pit sump pumps, and explosives delivery vehicles.

2.3.7 Minesite Haul Roads

Minesite haul roads will link the pit with the ROM pads and contractors yards. The conceptual minesite haul road alignments are shown in Figure 2.1.

Minesite Haul Road Design and Construction

Minesite haul roads will be designed so as to maximise operational safety, haulage efficiency and consideration of surface drainage. It is estimated that the total clearing corridor along haul roads (encompassing running surface, shoulders, drains and visibility zones) will range from 30 to 35 m in width.

Construction and maintenance of haul roads will entail:

- removal of overhanging vegetation within the road corridors;
- construction of road formation;
- alignment of sections of the road to enhance line of sight through corners to increase road safety;
- construction of adequate road drainage structures, which will allow for containment of poor quality water to be used in dust suppression;
- installation of appropriate road signage; and
- grading of the road surface as required.

Minesite Haul Road Operation

Minesite haul roads will be used on a 24-hour basis to transport ore to the processing plant and rock to the waste rock dump.

Off-road dump trucks will constitute the majority of the heavy vehicle traffic on these roads. However, there will also be intermittent traffic from fuel and explosives delivery trucks, and light vehicles accessing the pit.

2.4 Waste Rock Dumps

2.4.1 Conceptual Design and Operation

Approximately 600 Mt of overburden and waste rock will be mined throughout the 40-year life of the project based on the average mining rate of 15 Mtpa of waste. The waste rock dump will be located adjacent to the pit (Figure 2.1) and will cover approximately 135 Ha.

The design of the waste rock dump considers elements of naturally occurring concave slope profiles. This type of profile has two main potential benefits in comparison with more traditional terraced (benched) waste dump slopes (refer Appendix 4):

- it avoids the formation of large gullies typically associated with terraced slopes, which can require maintenance in perpetuity if berms and rock drains are to remain effective; and
- erosion rates are half to one-fifth of those of terraced slopes.

The existing BIF ridges in the minesite area have concave slopes. These slopes are relatively stable and erode slowly over time. The natural slope gradients are closely related to the low-rainfall climate of the area and the erosion-resistant properties of the BIF material, which contributes to the high content of ironstone fragments within the local soil profiles.

Construction of concave slopes can present some difficulties with the size of mining equipment in normal use; hence initially the waste will be dumped in levels 10 m to 20 m high, with berm widths that vary between 10 m wide for upper slopes and 45 m wide for lower slopes. The lower slopes will be shaped by bulldozer to a final angle of approximately 18^{o}. The upper slopes will remain terraced, with an overall slope up to 25^{o}. This facilitates waste rock dump construction and maintains stability on completion. The final angles are similar to the natural landform.

The suitability of the upper slope terracing will be further assessed with DoIR and other stakeholders during detailed design and closure planning.

Figure 2.6 presents a schematic of the preliminary waste rock dump design.

KML will incorporate into its design process the potential for progressive rehabilitation of the waste rock dumps.

The waste rock dump will consist of a mineralised waste stockpile, NAF and PAF waste rock corridors and topsoil stockpiles. In addition, the waste rock dump will include dedicated landfill areas to accommodate general site refuse and other wastes. Landfill areas will be isolated from PAF material, following the principles for the isolation cells detailed in following pages.

The waste rock dump sites will be cleared progressively and topsoil removed and stockpiled in designated areas within the final dump footprint. Mineralised waste, PAF and NAF corridors, and landfill area will be surveyed and marked out within the dump footprint as shown indicatively in Figure 2.6.

Topsoil Stockpile

Topsoil will be stored in stockpiles within the waste rock dump area. The stockpiled topsoil will be used in the progressive rehabilitation of the waste rock dump sites.

NAF Material

NAF material is the largest proportion of waste rock, particularly in the early stages of the mine. Consequently, the NAF parts of the dump will be advanced well in front of the PAF cells. This will result in a 'doughnut' of NAF material effectively encircling the PAF cells.

PAF Material

The guiding principle for PAF waste rock management will be to insulate PAF material from water and to encapsulate all PAF material within NAF material. A conceptual design for the isolation of PAF within cells is shown in Figure 2.7. A PAF material corridor will be contained within the NAF material. The PAF material will be placed in isolation cells, with the primary objective of avoiding water contact with the PAF so preventing acid drainage. As each cell is filled with PAF material, it will be sealed with NAF material and a new cell will be created.In the final landform the PAF material corridor will be capped with NAF material and a drainage layer will be put in place during rehabilitation.

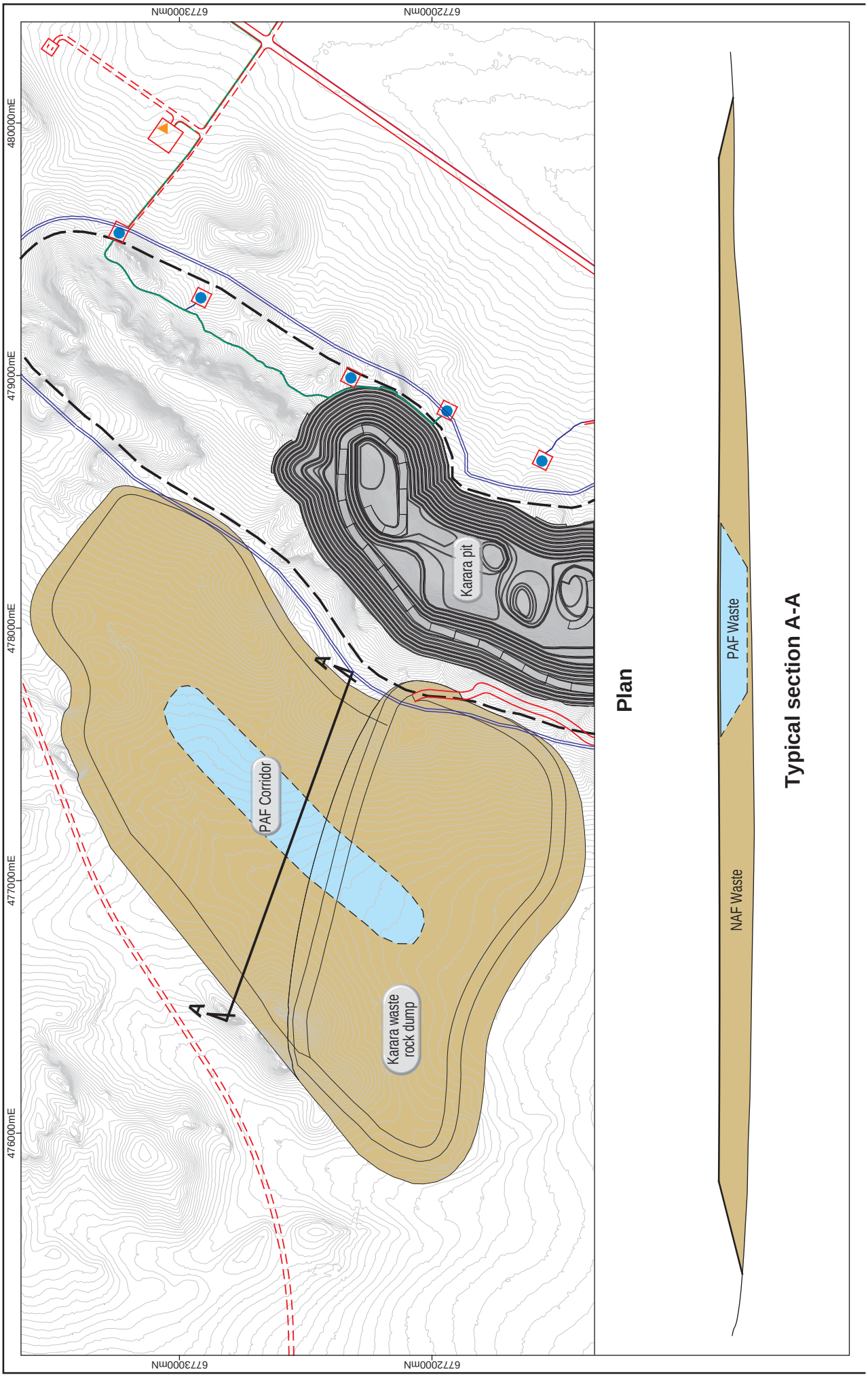
The four main components of the design, as shown in Figure 2.7, are:

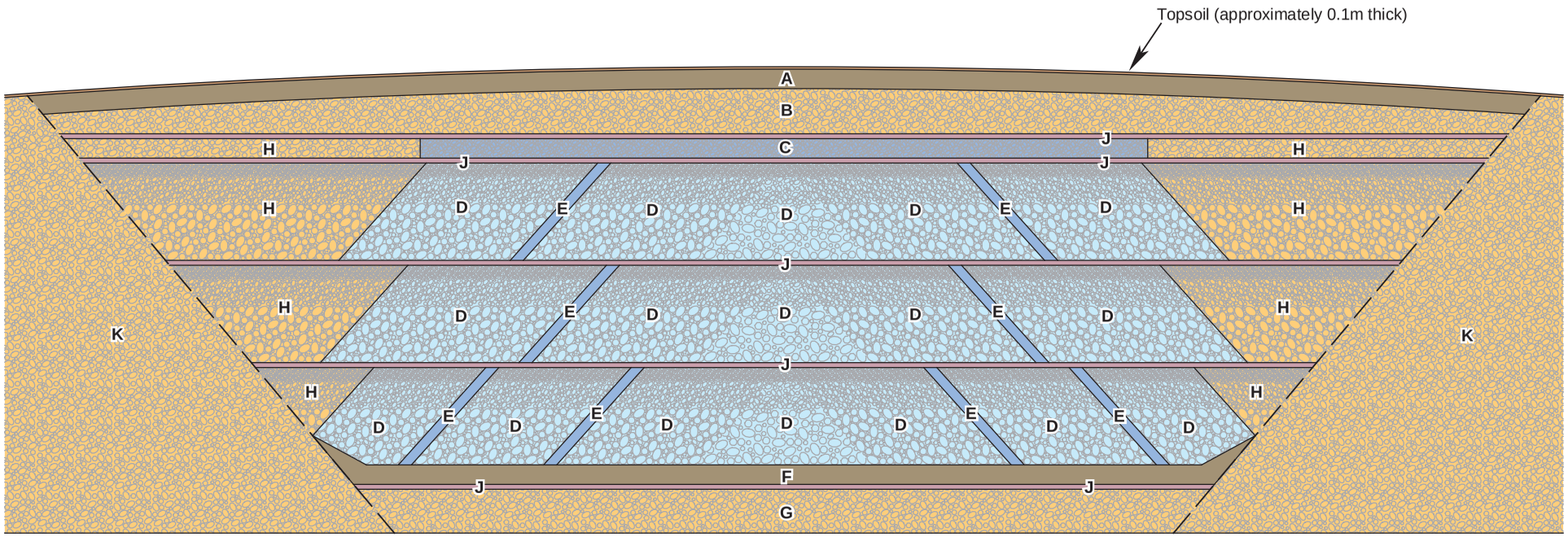
- **Basal Fill Zone**. The basal fill zone (Layer G) has been designed to lift the base of the isolation cell at least 5 m above the natural topography beneath the cell. This layer will most likely be constructed using NAF BIF material which will be blocky in nature and allow water to pass beneath the cell without impacting on the base of the cell. This is important given that the waste dump is in a natural valley and any water not diverted away from the dump may percolate beneath the dump in a significant rainfall event;

- **Water Absorption Layer.** The purpose of the water absorption layer (Layer F) is to retard and absorb seepage of potentially acidic pore fluids from reactive materials during major wet spells that may occur while the Waste Rock Dump is being constructed. NAF waste regolith and bedrock will be used to construct a 1 m to 2 m layer. This layer will act as a sponge and will not drain unless wetted to near saturation. This layer will be developed in, adjacent to and in advance of operating cells to ensure that during construction of the isolation cell, any runoff from the cell area will be contained on top of and within the water absorption layer;

- **Radially dumped reactive material.** The PAF material will be dumped into the cell off a centrally formed causeway then advanced laterally towards the external limits of the cell. Coarse, fresh PAF material (Layer E) will be interspersed with reactive regolith which will suppress the formation of macro-pores through the isolation cell. A 2 m layer of PAF (Layer C)will be compacted on the surface of the cell to create a less-permeable layer. The construction of the cells as layers will result in the compaction of the trafficked surface, also creating a less permeable layer (Layer J) approximately 0.5 m thick. The combination of these elements will discourage water from percolating through the cell; and

Figure 2.6 Conceptual waste rock dump layout showing PAF cells





A Free draining oxide store and release layer (2m thick)
B Skeletal substrate zone (+2m thick)
C Paddock dumped and dozed PAF layer (2m thick)
D End tipped PAF bedrock (8-13m thick)
E End tipped PAF regolith
F Basal oxide blanket (2m thick)
G Basal platform layer (+5m thick)
H End tipped NAF layer
J Traffic compacted layer (0.5m thick)
K Preformed end tipped NAF layer

PAF denotes Potentially Acid Forming waste
NAF denotes Non potentially Acid Forming waste

Figure 2.7 Conceptual isolation cell cross section

- **Vegetated store-release cover system**. The store-release cover is designed to support vegetation and adsorb rainfall so that the underlying reactive waste rock remains isolated from water. Vegetating the cover also helps ensure the Waste Rock Dump is resistant to erosion. The cover will have two zones: a rooting zone and a lower zone. The rooting zone (Layer A) will be topsoil ripped into stony subsoil and will be free draining, skeletal, non-swelling, with a total thickness of up to 1 m. The lower zone (Layer B) will be at least one metre thick and constructed of NAF weathered shale. The cover will absorb and store moisture after rainfall, which will be slowly released through evaporation from the soil and evapo-transpiration from the vegetation. The cover design will be refined once detailed engineering and modelling is completed.

Mineralised Waste

Mineralised waste (low grade ore), which is also NAF, will be stockpiled in isolation from PAF and landfill materials, and where possible, will be kept separate from NAF material. The mineralised waste dump will be developed immediately adjacent to, and concurrently with, the NAF waste rock dump. This low grade material may be processed during the life of the project, therefore access to the material will be maintained. Should KML decide that the mineralised waste material will be processed; the adjoining NAF waste rock dump will be re-contoured to the final landform slope specifications.

Landfill

The waste rock dump will contain a landfill corridor for the disposal of general wastes from the operation. The corridor will be excavated to approximately 3 m, and filled progressively, end to end. As a section of the excavated corridor is filled it will be covered with NAF waste rock. Appropriate management strategies will be applied to prevent waste being distributed outside of the designated general waste disposal area.

2.4.2 Final Landform

Final landforms will be designed to ensure that the following objectives are met:

they are physically safe and stable landforms that are resistant to erosion and soil loss;

- all reactive waste materials (PAF material) will be contained within isolation cells in the dumps to prevent acid mine drainage;
- final landforms blend into the natural surroundings (see concave slope concept outlined above) and maximise visual screening of final mine voids from the western viewpoint; and
- rehabilitation replicates to the extent practicable, pre-mining land systems, soil profiles and vegetation communities.

2.5 Ore Processing

2.5.1 Magnetite Ore Processing Plant Arrangement

Magnetite ore will be treated in the processing plant to produce a magnetite-rich concentrate. This is achieved by:

- primary and secondary crushers to dry crush the ore;
- high pressure grinding rolls (HPGR) to dry grind the ore and liberate waste;
- rougher magnetic separators (RMS) to magnetically concentrate the ore;
- primary ball mills to wet grind the ore and further liberate waste;
- intermediate magnetic separators (IMS) to further magnetically concentrate the ore;
- reverse floatation circuit to separate remnant liberated waste (tails);
- thickening to dewater the concentrate and tailings;
- pressure filtration to further dewater the concentrate and tailings; and
- conveyor to concentrate storage area.

The arrangement of the equipment listed above is presented in Figure 2.8. Figure 2.9 presents the conceptual processing flow diagram.

2.5.2 Ore Processing Method

Magnetite ore, up to 1,000 mm in size, will be transported by dump trucks to the primary crusher hopper located to the southwest of the pit and directly adjacent to the ROM pad. Coarse blending of different ore grades will be achieved by scheduling the arrival of haul trucks at the primary crusher.

The majority of the ore will be tipped directly into the primary crusher hopper. However, a small proportion of the ore will be stockpiled on the ROM pad during periods when the primary crusher hopper is down for maintenance. To suppress dust, water sprays will be activated automatically when a truck or front-end loader is detected in the tipping zone.

The primary crusher will have a maximum capacity of 3,500 dry tonnes per hour (tph) and produce a nominal ore size of 165 mm. Dust generated by crushing will be collected by a negative pressure system. Collected dust will be discharged onto the conveyor to the stockpile. The stockpile will be approximately 35 m high by 95 m in diameter with a live capacity of 25,000 tonnes. Dust generation will be suppressed via a sprinkler system at the point where the ore discharges onto the surge stockpile.

Secondary crushers, each with a nominal capacity of 900 tph, will further crush the ore to a maximum size of 38 mm.

After crushing, the dry ore is passed through HPGRs which are set up in closed circuit with 3 mm screens where the HPGR discharge is mixed with water and wet screened. The screen undersize, i.e. ore which is now less than 3 mm in size, is presented to the first stage of magnetic separation (through the RMS) where a concentrate, the magnetic fraction, is produced. The non magnetic tailings are de-watered to 15% moisture content over dewatering screens. The solids are now ready for placement on the TSF and the water is returned to the circuit to be reused.

Figure 2.8 Indicative processing plant arrangement

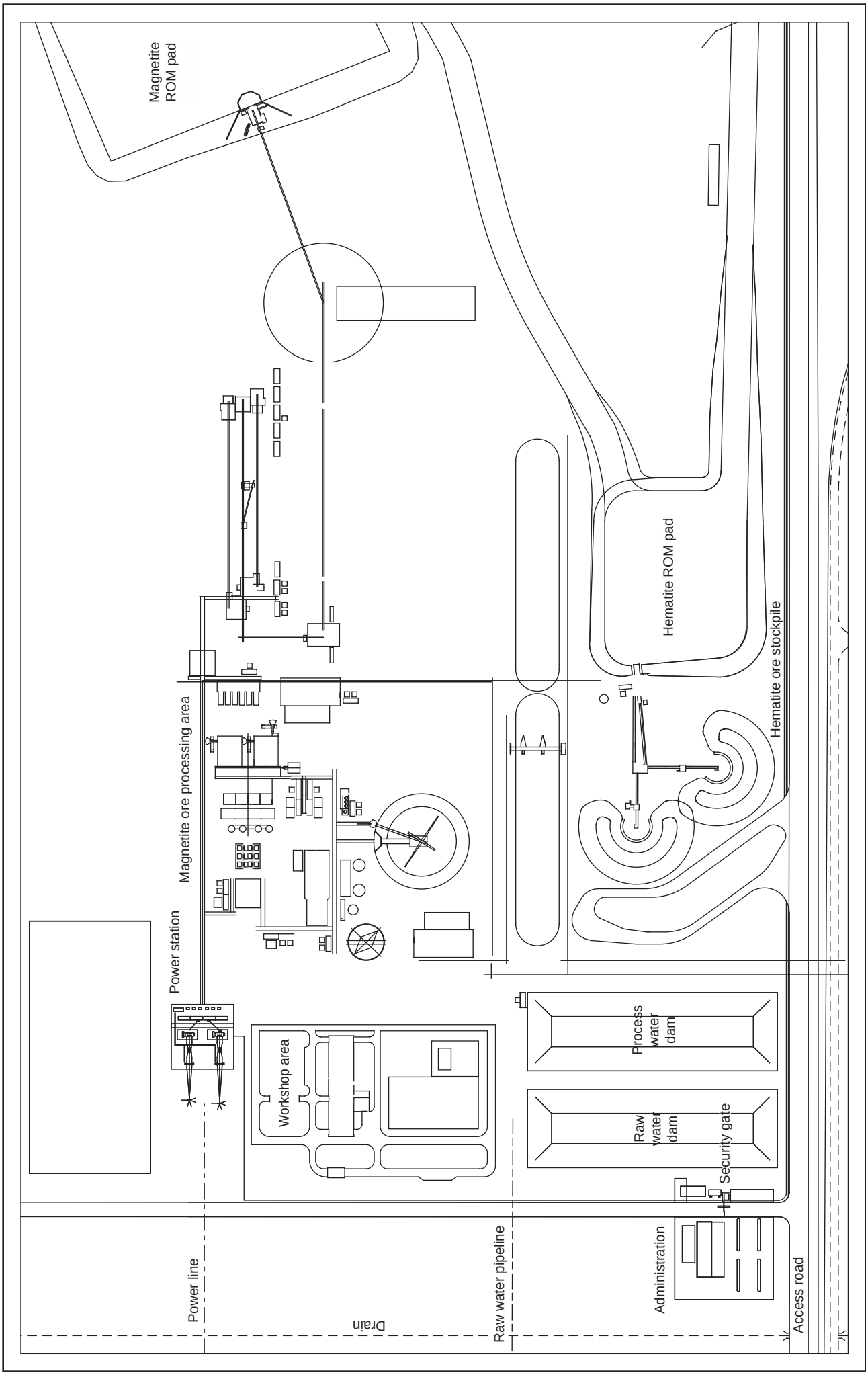
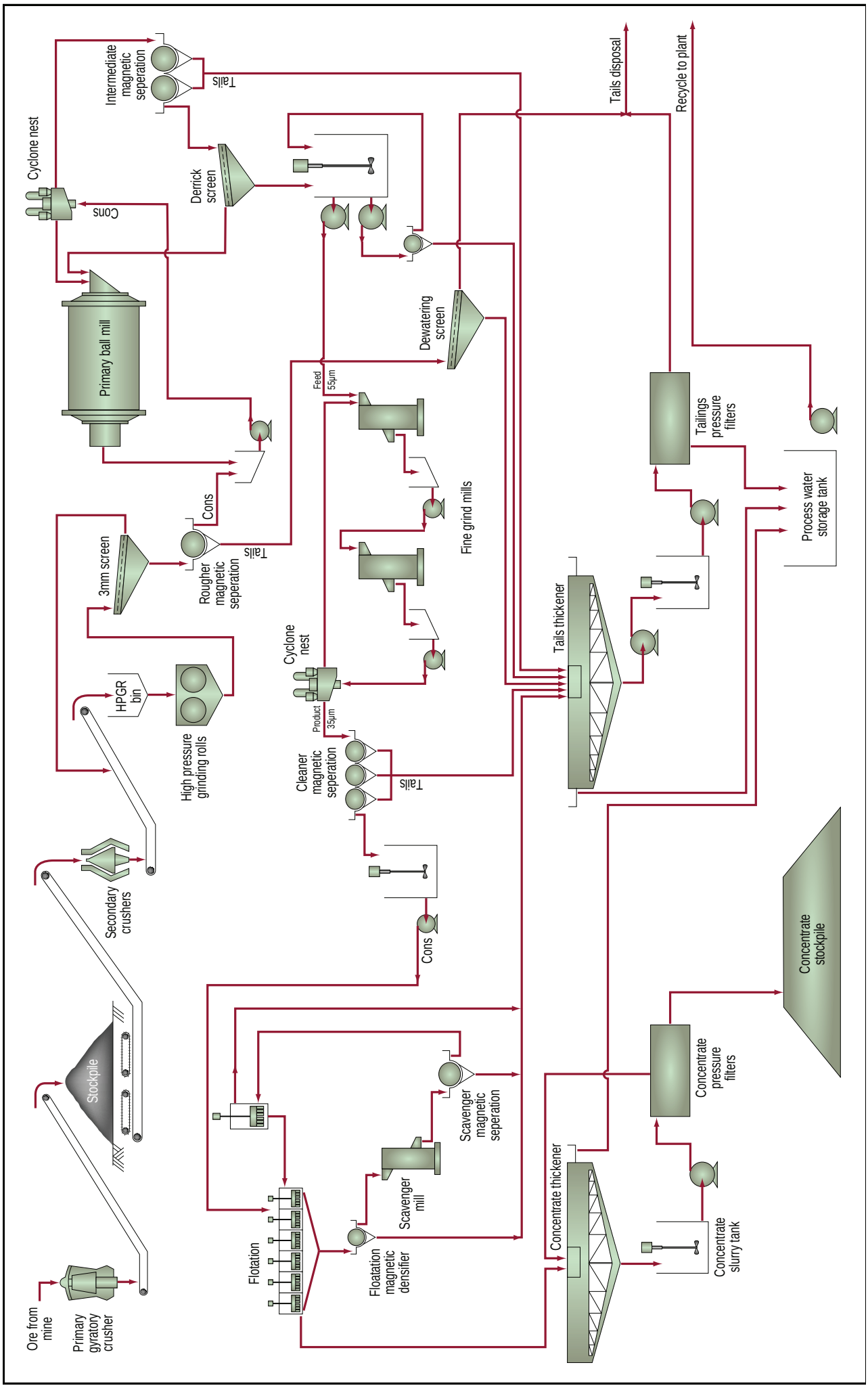


Figure 2.9 Conceptual ore processing flow diagram



The RMS concentrate is fed to the primary ball mills where the size is further reduced so that 80% of the concentrate is less than 55 µm. This size reduction is followed by a second stage of magnetic separation (through the IMS), with the non magnetic tail reporting to the tailings thickener for water recovery.

The IMS concentrate is fed to the fine grinding circuit for further size reduction to 35 µm and another stage of magnetic separation (Cleaner magnetic separators (CMS).This concentrate is further upgraded using a reverse flotation process which uses an amine based reagent known as a collector. The remaining tails are rejected at this stage to produce a final magnetic concentrate which is then dewatered for transportation to Geraldton with an average grade of 68.8% Fe, 4.2%SiO_2, 0.08%Al_2O_3, and 0.01%P.

The CMS non-magnetic tailings and the tailings from the reverse flotation process are combined with the IMS tailings in a common thickener for water recovery prior to pressure filtration. The filtration stage recovers the remainder of the recoverable free water leaving a filter cake containing 15% moisture. This filter cake is combined with the RMS tailings (coarse tailings) for dry stacking on the TSF.

2.6 Tailings Storage Facility

2.6.1 Storage Facility Arrangement

Following consideration of several alternative methods of tailings management (see Section 3.3.5), dry-stacking has been selected as the preferred option. This option was deemed to have the smallest footprint for a 40-year TSF and a lower environmental impact relative to the other options assessed. This option will involve a TSF located south west of the processing plant. The TSF will receive 18 Mtpa of combined tailings from the processing plant.

2.6.2 Dry-stacked Tailings

Dry-stacked tailings disposal is limited in use in Western Australia. The technique has been used in similarly arid climates, most notably the La Coipa silver/gold mine in Atacama, Chile. The process involves dewatering the tailings, with the use of pressure filters, prior to depositing them on the TSF. Tailings are deposited at approximately 15% moisture content. The dry-stacked tailings technique provides several benefits:

- reduces disturbed area footprint, because the greater structural integrity of dry tailings allows steeper slopes and higher landforms;
- allows high water recovery, and thus is very water efficient, compared with wet disposal;
- provides a more stable end landform;
- reduces groundwater seepage; and
- allows progressive rehabilitation.

2.6.3 Tailings Characterisation

Physical Characterisation

The particle size distribution for the combined tailing streams is 80% passing 0.06 mm sieve. The combined tailings will have a moisture content of 15%, with this moisture content likely to decrease due to evaporation during and following deposition. Bulk density of the uncompacted and compacted combined tailings was found to be nominally 2.0 t/m^3. The permeability of the combined tailings is approximately 5x10^{-7} m/sec. This permeability (equivalent to approximately 1.8 mm/hr) is sufficiently high that no runoff will occur during relatively long duration (24 hr to 72 hr), high probability (1 in 20 year or more frequent return interval) rainfall events. Some runoff is likely to occur during short, intense storm events or during low probability storms. A stormwater retention pond has been provided to accommodate water or sediment runoff from the TSF during more intense storm events, as is explained in Section 2.6.4. below.

Geochemical Characterisation

GCA has studied the acid-forming potential, multi-element composition and mineralogy of tailings to be produced during the project (refer Appendix 2). The tailings solids were characterised by:

- sulphur values (as sulphide) of 0.06 to 0.13%;
- acid-neutralising capacity values of 27 to 50 kg H_2SO_4 per tonne;
- net pH of 7.8 to 8.4; and
- net acid-generation value of less than 0.5 kg H_2SO_4 per tonne.

All tailings were identified as NAF. Very slight enrichments of arsenic (As) and antimony (Sb) were found, however in general the tailings were considered to be 'barren' (refer Appendix 2). Pyrrhotite, a potentially reactive iron sulphide, was found in trace amounts, however, the sulphide content (as sulphide) of the samples was less than 0.2% and most were found to have modest near-neutral buffering capacity.

Baseline testing has shown that the pore water contained in the saturated tailings, prior to dewatering, is mildly-alkaline and of brackish quality, with low concentrations of minor elements. The quality of any seepage resulting from infiltration of rainwater into the tailings stack is expected to be similarly benign, as the tailings are non-acid generating and show low reactivity.

2.6.4 Conceptual Design and Operation

TSF Construction

The TSF will be constructed using a combination of end-tipping by dump trucks and a mobile conveyor belt system. The TSF will initially be built up as one small landform on the allocated site, using truck dumping. It is anticipated that truck dumping will be used for the first three to four years of construction to bring the initial TSF landform close to its final landform height. Following this, a mobile conveyor system will be installed running the length of one of the TSF sidewalls. At this point, truck dumping will cease and tailings will be deposited using the mobile conveyor system.

This conveyor system will operate in a sweeping arc, depositing tailings in layers. As one arc is completed, the conveyor system is shifted to the next arc, and tailings deposition continues. This process of sweep filling continues for the remainder of the TSF construction life.

Design Features

Permanent water management structures. Structures will include channels upstream and downstream of the TSF. Surface water runoff from the TSF landform will be directed to the retention pond, situated east of the TSF.

A 'clean water' diversion berm will be constructed upstream of the TSF to direct uncontaminated surface water runoff around the TSF and processing plant sites, and direct it to a downstream watercourse. The berm will be 750 mm high and have slope of 27 degrees. The diversion will be constructed to take into account topography, upstream catchment area and a 1-in-100-year, 72-hour rainfall event.

Retention Pond. The retention pond will be installed east of the TSF to receive waters from the processing plant and TSF. It will be designed to contain a 1-in-100-year, 72-hour rainfall event. It is likely that the only flows the retention pond will receive will come during storm events.

Progressive rehabilitation. Progressive rehabilitation efforts will be undertaken on the TSF. Consultants, GCA, undertook a geochemical assessment of the tailings, and found that all tailings could be considered NAF, and therefore will not impact rehabilitation efforts (refer Appendix 2). It is anticipated that as the TSF footprint expands, topsoil will be removed from the disturbance footprint and used to rehabilitate the TSF landform.

End Landform

The final TSF will be a single stand alone landform. The final landform will be constructed to a maximum height of 90 m (430 m AHD), equivalent to the height of the surrounding BIF ridges.

The following design criteria were used in the feasibility design:

- production rate: 18 Mtpa of magnetite ore tailings;
- particle size: 80% passing 0.06mm sieve;
- 40 year capacity;
- 24 hr per day, 365 days per year operation; and
- tailings mechanically dewatered to 15% moisture.

The slope for the TSF is likely to be approximately 30^{o} during construction and tailings deposition. Following construction to the final landform height of 90 m, the landform will be shaped to a final slope of 18^{o} and rehabilitated. Test work indicates the final stable land form angle to be 18^{o}. This will further assessed during operations and adjusted appropriately to maintain a stable landform.

At closure, the design emphasis for the TSF landform will be on providing a geotechnically stable structure which resists erosion. The chief permeability consideration during both operational and post-mining phases of the TSF relates to erosion control, and not to seepage control. This is because of the chemically unreactive nature of the tailings materials and the low levels of leachable salts and toxicants present in the tailings.

2.7 Ancillary Facilities

2.7.1 Accommodation Village

An accommodation village will be built to house personnel during construction and operation of the project. The village will be located approximately 4 km east of the Karara Pit. During project construction the village will have a capacity of approximately 1,500 people over a 24-month period. Most of the accommodation units for the construction stage will be removed post construction, although some will be retained for temporary increases in numbers on-site such as during major maintenance programs. The operational phase village will accommodate a workforce of approximately 500.

The village for the construction phase will consist of transportable accommodation modules. The operational phase village will likely be a permanent construction and will incorporate sustainable design principles. The village will comprise the following:

- accommodation units;
- village administration buildings;
- ablution and laundry facilities;
- kitchen;
- licensed mess area; and
- recreation facilities, including a grassed playing field and running track.

Sustainable design principles incorporated in the permanent village may include:

- materials of construction to be selected with regard to environmentally beneficial characteristics such as high thermal insulation to reduce energy consumption, good sound insulation, inert and non-toxic, produced from abundant cost effective materials;

- vegetation clearing to be minimised and large trees to be retained to provide shade, increased amenity and enhance the rehabilitation characteristics of the area at mine closure;
- gardens to contain only native species (with the exception of the designated recreation areas e.g. playing field) to reduce the potential for weed invasion and irrigation water requirements. Lawned areas are to be buffered by the surrounding infrastructure reducing the risk of weed invasion to/from these areas;
- water efficiency measures, including night watering regimes to reduce water loss by evaporation; and
- solar water heating to reduce power consumption.

2.7.2 Administration Complex and Laboratory

An administration complex will be built adjacent to the processing plant with an intended capacity of approximately 125 people. The complex will incorporate similar sustainable design principles to the village. The following amenities will be incorporated within the administration complex and laboratory:

- office buildings;
- gatehouse;
- training rooms;
- crib rooms;
- first aid and emergency response facilities;
- ablution facilities;
- laboratory and sample preparation area.

2.7.3 Communications

A 60 m high communication tower will be installed to the southwest of the village at a topographical high point. The tower will allow telephone, internet and radio services to the village. The tower will have direct communication with the local power and communications infrastructure at Morawa.

2.7.4 Explosives Compound and Explosives Magazine

An explosives compound and an explosives magazine will be located northeast of the Karara Pit. The compound will contain facilities for the unloading and storage of bulk materials to produce ANFO and emulsion bulk explosives. Ammonium nitrate and emulsion will be trucked to site in bulk and stored in tanks until required for use. Explosives will be either auguered (in the case of ANFO) or pumped (in the case of emulsion) into the loading vehicle. Final mixing of the products will occur in purpose-built trucks for delivery of explosives down the blast-holes within the pit. The magazine will be separated from the compound to avoid propagation of any incident at either facility. Light vehicle access roads will link the two facilities with the mine pit and the ancillary facilities.

Primary products stored will include:

- ammonium nitrate (in bulk form - considered an “oxidising agent”);
- emulsion (in liquid form in typically 90 kL tanks - considered an “oxidising agent”); and
- diesel (typically 20 kL).

Additionally, there will be a small workshop and store within these facilities. This will incorporate concrete pads with oil separators and a drainage pond to contain any spills or leaks.

Overall responsibility for the management of explosives resides with the Registered Manager; however, the explosives supplier is directly responsible for the safe transport, mixing and loading of explosives products under direction from the Registered Manager or their delegate.

The compound and magazine will require licensing under Part V of the *Environmental Protection Act 1986* as it falls under Category 73 (Bulk storage of chemicals) of the schedule of prescribed premises. Design, construction and management of the facilities will be in accordance with regulatory Dangerous Goods Licence requirements.

2.7.5 Hydrocarbon Storage and Refuelling Facilities

Hydrocarbons will be stored in multiple locations across the project site. The primary hydrocarbon storage facility designed for the storage and refuelling of mining equipment will be located in a bunded area adjoining the main workshop in the mine contractors yard. The haulage contractors yard will also have a storage and refuelling area, as will the village infrastructure area. In all of these facilities strict drainage control will be employed to separate and capture hydrocarbons to prevent them being released into the environment. This will be managed by using appropriate bunding, oil/water separation and containment of potentially contaminated water.

Within the concentrator area, there will be storage of lubricant oils and greases within bunded areas in the stores yard. The primary products will be in 200 L drums, however lesser volumes of other hydrocarbons will be present in various smaller containers.

Table 2.8 provides an indication of the likely quantity of hydrocarbons to be stored. Actual quantities may vary from that indicated.

Table 2.8 Fuel storage requirements

Fuel Type	Mining Contractor Yard	Haulage Contractor Yard	Concentrator Area	Explosives Compound	Accom. Village Service Area
Diesel	6 x 100 kL tanks	3 x 100 kL tanks	-	1 x 20 kL tank	5 x 100 kL tanks
Oils (including waste oil)	6 x 5 kL tanks	2 x 5 kL tanks	10 x 1 kL tanks 20 x 200 L drums	4 x 200 L drums	2 x 5 kL tanks
Unleaded Petrol	-	-	4 x 200 L	-	1 x 5 kL tank
Grease (and other hydrocarbons)	30 x 200 L drums	20 x 200 L drums	40 x 200 L drums	10 x 200 L drums	6 x 200 L drums

Refuelling of heavy vehicles will be via high-speed pumps, while refuelling of light vehicles will be via conventional bowsers. In-pit machinery will be refuelled via 10 kL diesel tankers. Refuelling areas will have a collection sump to recover hydrocarbons. Collection sumps will be designed and permanently bunded to prevent surface inflow to enable full capture of incident rainfall, and product leakage and spillage.

2.7.6 Laydown Areas

Within the minesite area, there will be four laydown areas (also known as hardstands), as outlined below.

- A mine contractors yard located within the processing plant will be required for:
  - light and heavy vehicle servicing, refuelling and fuel storage;
  - hydrocarbon and chemical storage (e.g. lubricants, diesel, oil, grease, cleaning agents). Storage facilities will have specific design features to contain product spillage;
  - vehicle washdown; and
  - materials storage (e.g. tyres).

- A haulage contractors yard located east of the Karara Pit will be required for:
  - light and heavy vehicle servicing, refuelling and fuel storage. Fuel storage facilities will have specific design features to contain product spillage;
  - light and heavy vehicle parking; and
  - general maintenance.
- A general laydown area located within the processing plant precinct. This area will be required for:
  - construction materials;
  - chemical storage;
  - materials and equipment storage. Storage facilities will have specific design features to contain product spillage; and
  - waste transfer and recyclable materials storage (e.g. scrap metal). Only inert materials will be stockpiled. All other material that has the potential to result in contamination will be stored in appropriately bunded areas in accordance with regulatory requirements.
- An infrastructure area located adjacent to the sewage farm. This area will be required for:
  - power generation;
  - light and heavy vehicle refuelling and fuel storage. Fuel storage facilities will have specific design features to contain product spillage;
  - water treatment; and
  - sewage treatment.

2.7.7 Minesite Gravel Pits

To supply gravel and building materials during the construction phase of the project, gravel pits will be created using bulldozers. Where appropriate these borrow pits will be subsequently rehabilitated when borrow requirements have ceased. To date, potential gravel resources have been identified within the footprints of the TSF and waste rock dump, and adjacent to the proposed airstrip location. Gravel pits outside the disposal area footprints will be no greater than 3 m deep. The size of the pits is yet to be determined and will reflect the extent of the insitu resources and the demand.

Gravel extraction will occur in the following stages:

- topsoil stripping and stockpiling;
- extraction of gravel;
- recontouring and deep ripping of excavated areas; and
- progressive rehabilitation of disturbed areas where appropriate and as seasonably practicable.

2.7.8 Non-process Waste Facilities

Non-process waste is defined as all project-related waste other than waste rock or process tailings and includes general office and accommodation village waste (e.g. cardboard, paper, plastics, etc.), food scraps and potentially contaminated material meeting waste acceptance criteria and special wastes (e.g. Type 1 and 2 wastes).

KML is committed to managing waste in an environmentally responsible manner during all phases of the project. At each of the project sites, a 'reduce, reuse and recycle' approach to waste management will be applied. Table 2.9 provides information on non-process waste types relevant to the project and the intended disposal method.

Table 2.9 Non-process wastes types

Waste Type	Disposal
Waste hydrocarbons and hydrocarbon-contaminated material (i.e. rags, filters)	Stored in sealed containers on designated and appropriately-sized bunded pallets. Returned to supplier or removed regularly by a suitable waste management contractor for off-site licensed disposal or recycling.
Solid hydrocarbons and hydrocarbon contaminated material	Solid wastes such as oily rags, filters and used batteries will be contained and stored on a pallet within a bunded covered area. It will be collected periodically by a suitable waste management contractor for licensed off-site disposal or recycling.
Store/office cardboard	Collected in dedicated bins and recycled where possible or disposed of in on-site landfill.
Scrap steel / Metal cabling / other metals	Collected in a dedicated area within the lay-down yard and collected by a scrap merchant as required.
Tyres	Stored at an on-site landfill facility, and recycled or disposed of by a licensed waste contractor. Some tyres will be used in traffic management on major haul roads, intersections and pit ramps.
Plastic (recyclable)	Collected in dedicated bins and transported to an appropriate waste management facility as required.
Plastic (non-recyclable)	Mixed with general domestic waste for disposal at the on-site landfill.
Pallets	Returned to supplier where possible and unbroken. Buried within the on-site landfill where an alternative recycling opportunity is unavailable.
General domestic waste (e.g., food scraps, non-recyclable crib room and office rubbish)	Buried within the on-site landfill.
Recyclable domestic waste (e.g., office paper)	Collected in dedicated bins and transported to an appropriate waste management facility as required.
Construction waste	Inert material disposed of in on-site landfill; hazardous and controlled waste disposed of in an appropriate waste management facility.

2.7.9 Power Facilities

On-site power generation and supply-related facilities will be located in the infrastructure area adjacent to the sewage farm.

During project construction, at least seven 1.5 MW diesel generators will supply the peak power demand of 10 MW. No gas pipelines are available near site, making the use of diesel generators the most economically viable option to supply power to the minesite. Additional generators will be installed for plant start-up if there is a delay in connecting to the Southwest Interconnected System (SWIS).

Operational phase power will be supplied to the minesite from the SWIS via a 330/132 KV spur line from the Golden Grove high voltage transmission line. Western Power will seek approval for this power delivery project as a separate process. The SWIS high voltage power supply will connect to the project via a substation at the processing plant, at which point it will be reduced to 33 KV. Power will be reticulated via a network of transmission lines that will extend to the village, airstrip and water bores.

Several of the diesel generators will be retained at site as contingency against Western Power failure to deliver power requirements and as an emergency supply to maintain critical services and operations.

2.7.10 Water and Wastewater Treatment Plants

Potable quality water will be provided from reverse osmosis (RO) plants situated at the accommodation village and the processing plant. Initially, low salinity water will be pumped from an existing bore at Mungada Ridge to the RO plants. This will later be changed to a supply from a borefield near Mingenew, which is a more sustainable water source. A combined total of 0.3 GL of water will be treated through the RO plants annually, producing 0.2 GL of potable water and 0.1 GL of brine, which will be discharged to the retention pond. The pond is to be used to supply dust suppression makeup water.

For domestic wastewater, two stand-alone modularised wastewater treatment plants (WWTPs) will be installed. One will be at the village and one at the plant.

Enviroflow Water Technologies has prepared a preliminary design for each WWTP. This includes separate plants for grey water and black water. All water discharged will meet the discharge criteria of the WA Department of Health (DoH) and DEC. The proposed technology has been approved by DoH.

Under normal operations, the treated grey water will be used to water gardens at the village via subsoil drippers. Treated black water will discharge to a nearby absorption area via subsoil drippers. This area will be fenced to avoid accidental contact.

Sludge will be produced as part of the treatment process. This will be removed by a vacuum truck as required and treated to a standard that allows it to be disposed of in the domestic landfill facility serving the site.

2.7.11 Workshop and Warehouse Complex

The following workshops and related facilities will be included within the workshop and warehouse complex:

- a vehicle maintenance workshop adjacent to the Karara Pit for repair and general maintenance of the heavy machinery fleet and light vehicles;
- a wash-down facility adjoining the vehicle maintenance workshop. This facility will have a sloped drainage system designed to direct all runoff from the workshop into an oil/water separation system;
- a workshop to service the maintenance requirements of the processing plant;
- hydrocarbon storage facilities. Any products with specific storage requirements will be designed to ensure containment of any spillages/ leakages;
- offices; and
- ablution facilities.

2.7.12 Airstrip

An airstrip will be constructed 2 km southeast of the accommodation village to accommodate the fly-in/fly-out workforce, in an area of relatively low conservation significance (see Figure 2.1). This is the preferred location as it obviates the need for light traffic movements across haul roads.

The airstrip will be certified by the Civil Aviation Safety Authority (CASA) and will comply with Aerodrome Reference Code 3C. It will be able to accommodate aircraft of up to 70 seat capacity. A terminal building will be located adjacent to the airstrip.

The total area of impact for the airstrip will be approximately 25 ha. The airstrip layout and impact area is illustrated in Figure 2.1. It is anticipated that the total length of the airstrip will be 2,400 m. The total width of 90 m consists of a 30 m sealed runway with 30 m of compacted gravel either side. Vegetation will be cleared to a distance of 90 m from either end of the runway and approximately 20 m from the side in keeping with CASA Aerodrome Reference Code 3C.

Construction will require approximately 35,000 m^3 of materials, which will be sourced in situ and from a gravel pit located to the east of the airstrip.

During construction and operations at the minesite, the airstrip will normally be used during daylight hours only. Emergency lighting will be provided, and may be subsequently lit to a standard allowing night-time operation.

2.7.13 Light Vehicle Roads

At present, a series of exploration and access tracks run across the Karara project area. Additional light vehicle roads will be required to connect elements of the minesite infrastructure. The conceptual light vehicle road alignments are shown in Figure 2.1.

These roads will be restricted to light vehicles and watering trucks only, and where possible will be kept separate from haul roads to minimise interaction between light and heavy vehicles. The maximum width of these onsite access roads will be 15 m.

Water carts will be used on all unsealed access roads to control the generation of dust. Carts will be suitably equipped and operators will be trained to apply water in a way which minimises overspray into the adjacent native vegetation. Roads and tracks subsequently not required for operations activities will be progressively rehabilitated as seasonably practicable.

2.8 Transportation

2.8.1 Minesite Access Road

An access road will be constructed to connect the Karara Minesite to the road and rail network at Morawa. The access road will be approximately 89 km in length and developed by upgrading a number of existing roads in line with Shire and Main Roads Western Australia standards and the Austroads (2003) Rural Roads Design publication.

It is anticipated that the total cleared width required along the length of the access road will range from 15 to 25 m. This width includes running surfaces, shoulders, drains and visibility zones.

The existing roads that will be upgraded to become the Mine access road are not currently heavily trafficked and in general are only used by local pastoralists, exploration or mining personnel, and a small number of tourists. The improved road will be constructed to a load-bearing capacity for quadruple road trains. Although the proposal is to transport magnetite product by rail from the minesite, there is the potential that there may be a delay in construction of the standard gauge line from the site to the export facility. If this occurs, the access road may be used to transport product until such time as standard gauge rail capacity is completed, after which it will be maintained as the main road access to the minesite.

The majority of the access road upgrade will occur within existing road reserves. The proposed alignment is shown in Figure 2.10. The proposed road construction and maintenance procedures will be consistent with those used for minesite haul roads (refer Section 2.3.7).

An estimated 200,000 m^3 of road base will be required to upgrade the existing roads. Suitable material has been identified within five borrow pits, situated within 1.5 km of the access road (refer Figure 2.10). The operation and rehabilitation of borrow pits is discussed further in Sections 7.5.1 and 8.7.3.

Approximately 0.07 GL of water will be required for surface compaction and dust suppression during access road construction. To minimise haulage distances, water will be trucked from either the borefields at Karara or sources in the Morawa or Koolanooka areas.

If there is a delay in extending the standard gauge rail line to the minesite, up to 12 quadruple road trains, each with a 106-tonne capacity, will be used to transport product from the minesite to a rail siding at Morawa. Each of the road trains will complete seven round trips per day on a three-hour cycle time. Up to 9,000 tonnes of ore will be delivered to the rail siding daily.

2.9 Water Supply

Water is a critical issue for the KIOP. Onsite, there are quantities of groundwater and rainwater which will be managed to ensure operability of the mine. Generally, the quality of that water will be unsuitable for ore processing or dust suppression outside the pit. Water sources of adequate quantity and quality are remote from the site, and will be secured and developed for the project to proceed.

This section presents the following information:

- construction phase requirements and supplies;
- conceptual water balance for the proposed 12 Mtpa magnetite production rate;
- on-site water quality and quantity, and site water management;
- raw water supply from the Twin Hills borefield, north east of Mingenew;
- water delivery infrastructure; and
- contingency planning.

2.9.1 Water for Construction Phase

Requirements

During the construction phase, including the initial removal of overburden and waste rock, the project will require approximately 2.3 GL of water. The demands are listed in Table 2.10. Water is required for construction of roads, dust suppression during clearing activities, and in-pit dust suppression, all of which can use saline water. Other activities requiring the use of relatively fresh water include:

- concrete batching (to ensure integrity of concrete);
- access road upgrade (to ensure integrity of road surface); and
- potable water (water of higher natural total dissolved solids (TDS) will be treated through a reverse osmosis unit at the minesite).

Figure 2.10 Access road alignment and borrow pits

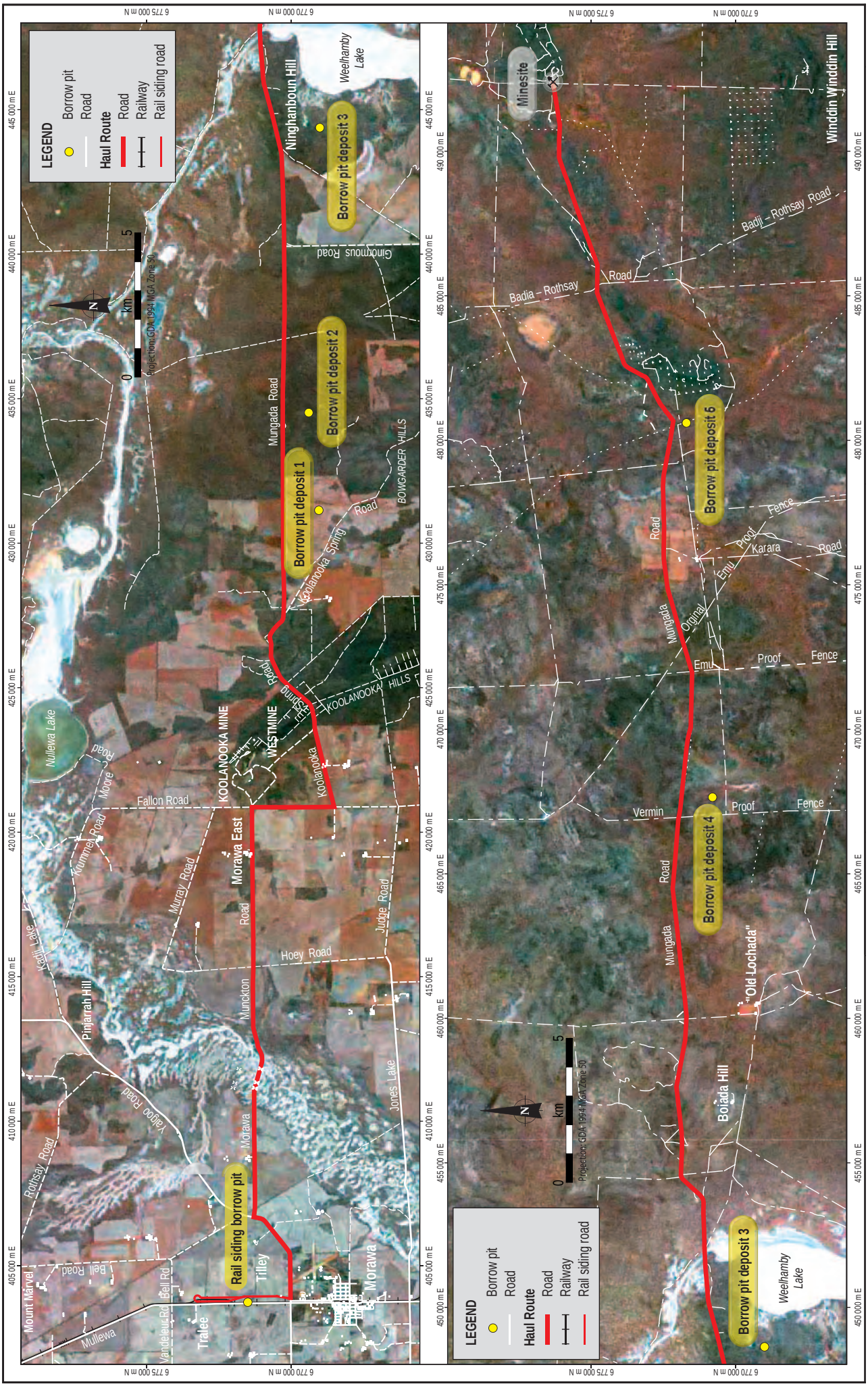


Table 2.10 Construction water balance

Requirement (Total for 18 months)		Source	
Description	**GL**	**Description**	**GL**
Construction Village	0.3	Karara Bores	1.6
Concentrator Plant	0.7	Silverstone Pit	0.6
In-pit Dust Suppression	1.0	Mingenew area (to be determined)	0.1
Haul Roads and Airstrip	0.2		
Raw Water Pipeline	0.1		
Total required:	**2.3**	**Available:**	**2.3**

Water Sources during Construction

Water for construction will be sourced from bores located at the minesite and from a pit at the Silverstone Mine. KML has identified a number of viable water supply bores at the minesite (refer Section 2.9.4) and is continuing to examine further potential bores as part of its ongoing exploration drilling programs. These bores will be the preferred source of water for construction of the minesite and access road.

KML maintains a water licence to abstract up to 0.25 GLpa of water from three disused mining pits in the Silverstone area and has a land access agreement with the current tenement owner, Minjar Gold (Figure 2.11). KML will apply to the DoW to increase the allocation limit of the licence during the construction phase if required. These pits will supplement water from the minesite bores during the construction period. The open pits at Silverstone intersect a local fractured rock aquifer. Water quality from these pits is saline with an average salinity of 20,000 mg/L TDS.

Water will be abstracted from the Silverstone South open pit initially. The pits are currently under care and maintenance and not being dewatered. Abstraction will be undertaken via a floating pontoon and semi-submersible pump system, or from production bores located adjacent to the pits. This water will be pumped to the minesite via an aboveground pipeline laid within the disturbed area of existing roads and tracks. The pipeline will deliver directly into the minesite pipe network.

To reduce haul distances for water to construct the access road between Karara and Morawa, potential water sources closer to the western portion of the access road are being investigated. Should sources be located, the appropriate licences will be obtained from the DoW.

2.9.2 Operation Water Balance

A conceptual water balance for the operation of the KIOP is shown in Figure 2.12 and is set out in Table 2.11. This water balance is based on estimates from the feasibility study, and is to be refined during detailed design of the project. The balance covers two main aspects, namely groundwater inflow and rainfall into the pit, and raw water supply to the ore processing circuit. The relatively small quantity of raw water to be treated for potable water was covered in Section 2.7.10 and Section 2.9.6.

To improve the stability of walls of the pit, some groundwater will be pumped from adjacent bores. However, complete dewatering is not possible due to the nature of the fracturing of the formation, and some seepage flow into the pit will accumulate at low points. The combined groundwater flow from these sources has been estimated at approximately 1.1 GLpa. Groundwater will be used for dust suppression on in-pit haul roads and at the waste rock dump as its quality is insufficient for ore processing use. Any groundwater or runoff that cannot be used in the short-term for dust suppression will be pumped to the water retention dam for later use.

Runoff due to major rainfall events may be of a quality adequate for ore processing, in which case the draw on the raw water supply will be temporarily reduced. Conversely, prolonged dry periods may result in a need to augment the supply for in-pit dust suppression with raw water. The use of binding agents for dust suppression at road surfaces will be investigated as an additional means of improving water use efficiency.

Table 2.11 Mining water balance

Requirement (Outgoing)		Source (Incoming)	
Description	**GLpa**	**Description**	**GLpa**
Moisture in Ore	0.6	Moisture in Ore	0.6
Moisture in Waste Rock	0.6	Moisture in Waste Rock	0.6
In-pit dust suppression	0.6	Pit dewatering and Karara Bores	1.1
Evaporation	0.9	Rainfall	0.4
Total required:	**2.7**	**Available:**	**2.7**

A key water quality parameter for magnetite ore processing is low salinity. The average demand for good quality raw water for these uses (including 0.3 MLpa of potable water supply) is 6.6 GLpa. The majority of this consumption is in the moisture content of the magnetite concentrate leaving the site and of the tailings deposited in the TSF. As presented in Sections 2.5 and 2.6, a tailings dewatering process which is of limited use in Western Australia will be used in magnetite production to minimise project raw water demand.

For the Karara Pit, there is expected to be minimal pit dewatering in the first three years of mine development, and water for dust suppression will be obtained from the local Karara bores. The water table is expected to be intersected in year 2-3 of mining, at which stage dewatering would commence and the water would be used for in-pit dust suppression as required.

2.9.3 Contingency Planning

As a water saving mechanism, filtered tailings has been incorporated as the base case for the project and a water saving will be achieved relative to disposal as wet tailings. The water recovery efficiency of filtering will be established during the commissioning phase. The processing water balance provided in Table 2.12 assumes conservative water efficiency gains expected to be achieved in this processing method, so a total bore field allocation of 6.6 GLpa needs to be secured to allow for this. Table 2.12 assumes that pressure filtering of tailings would achieve a moisture content of 20%. If 15% moisture content can be achieved, as is the design intent, demand would be reduced by about 1.2 GLpa. If all the efficiency measures currently planned succeed, a potential saving of over 2 GLpa could be achieved, which would reduce the total raw water requirements from the borefield at Mingenew to approximately 4.5 GLpa.

Table 2.12 Processing water balance

Requirement		Source	
Description	**GLpa**	**Description**	**GLpa**
Tailings water loss	4.9	Borefield near Mingenew	6.3
Export (moisture in concentrate)	1.2	Moisture in ore	0.6
Evaporation	0.8		
Total required:	**6.9**	**Available:**	**6.9**

Figure 2.11 Construction water infrastructure

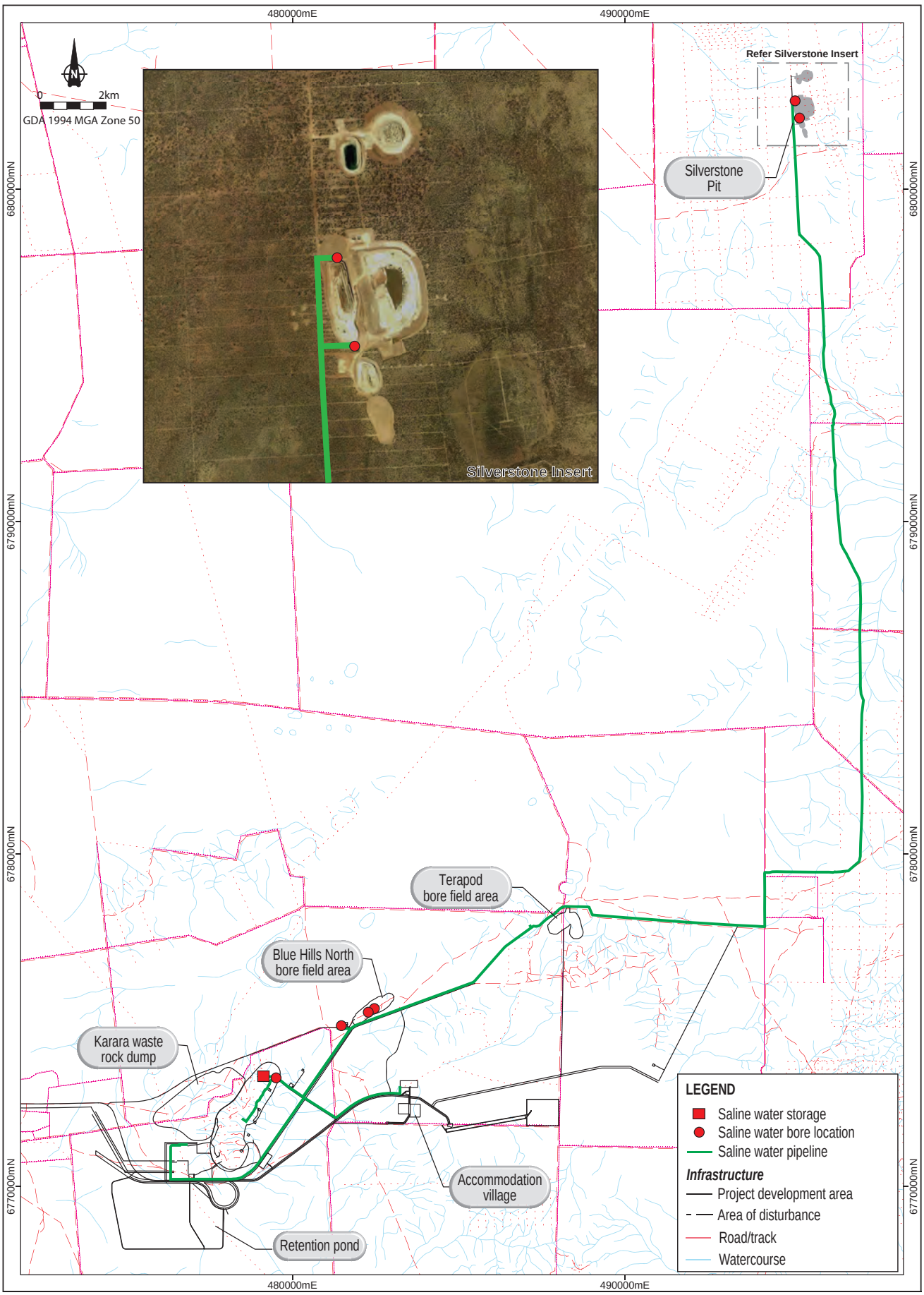
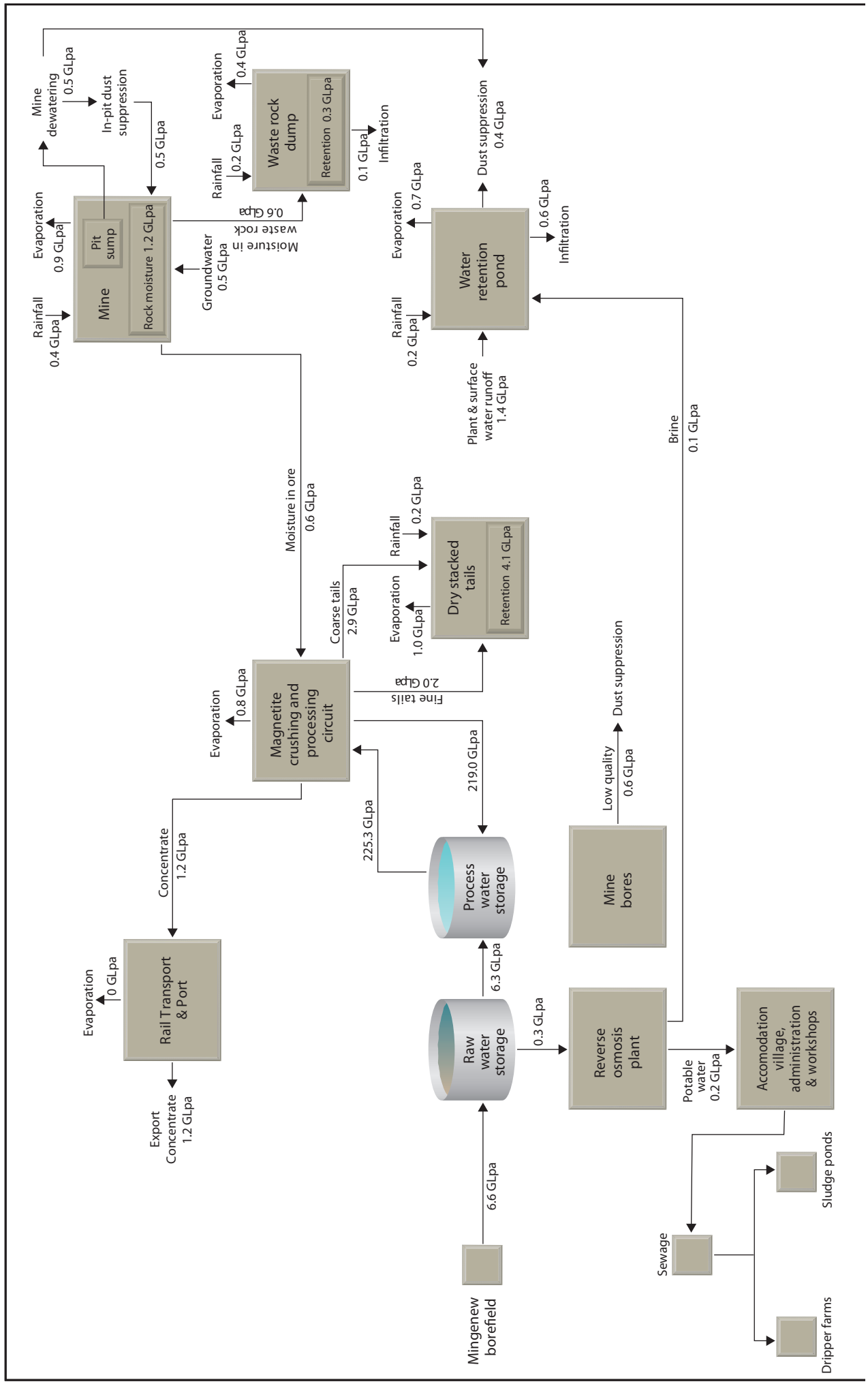


Figure 2.12 Operations water balance



2.9.4 Water Sources

Minesite Bores

Lower quality water will be sourced from bores at the minesite. KML has identified viable water supply bores at the minesite and is continuing to examine further potential bores in its ongoing exploration drilling programs (refer Table 2.13 and Figure 2.1). These bores will target fractured rock aquifers, including locally permeable contact zones between BIF and the adjoining metasediments, and aquifers located near the base of weathering in basaltic and ultramafic rocks. The final selection of bores to equip with pumps and their operating regime will depend on the proven safe yield, water quality requirements and spare capacity provision.

Water quality is highly variable at the minesite, ranging from 580 mg/L TDS to 81,000 mg/L TDS (see Table 2.13). The high TDS from some bores is principally due to sodium chloride ions.

Table 2.13 Minesite water supply bores

Bore	Water Level (m bgl)	Expected Yield (GLpa)	Salinity (mg/L TDS)
MGW082	24.2	0.05	580
MGW441	~36	0.03	1,400
MGW442	~54	0.15	900
MKW039	50.5	0.04	31,000
MKW310	46.6	0.18	9,800
MKW311	12.6	0.26	81,000
MKW312	30.0	0.07	1,100
MKW318	39.4	0.11	40,000
MKW319	12.7	0.22	64,000
MKW321	32.5	0.08	23,000
MKW366	43.0	0.04	600
MKW375	47.0	0.02	950
MKW376	55.0	0.05	900
Blue Hills North	To be determined	0.07	1,000
Terapod	To be determined	0.04	1,000
Total		**1.41**	

Twin Hills Borefield

Higher quality raw water will be sourced primarily from a borefield abstracting from the Yarragadee aquifer, within the Twin Hills sub area of the Arrowsmith Ground Water Area, north east of the town of Mingenew. This water will be used for purposes that cannot use lower quality water, e.g., for the processing plant and for potable water supply. Working with DoW, KML initially identified and investigated two potential options for a borefield near Mingenew: the Twin Hills Groundwater Sub Area (GWSA) or the Mingenew GWSA and has now sought an allocation from the Twin Hills GWSA (Figure 2.13).

Figure 2.13 Location of Twin Hills borefield

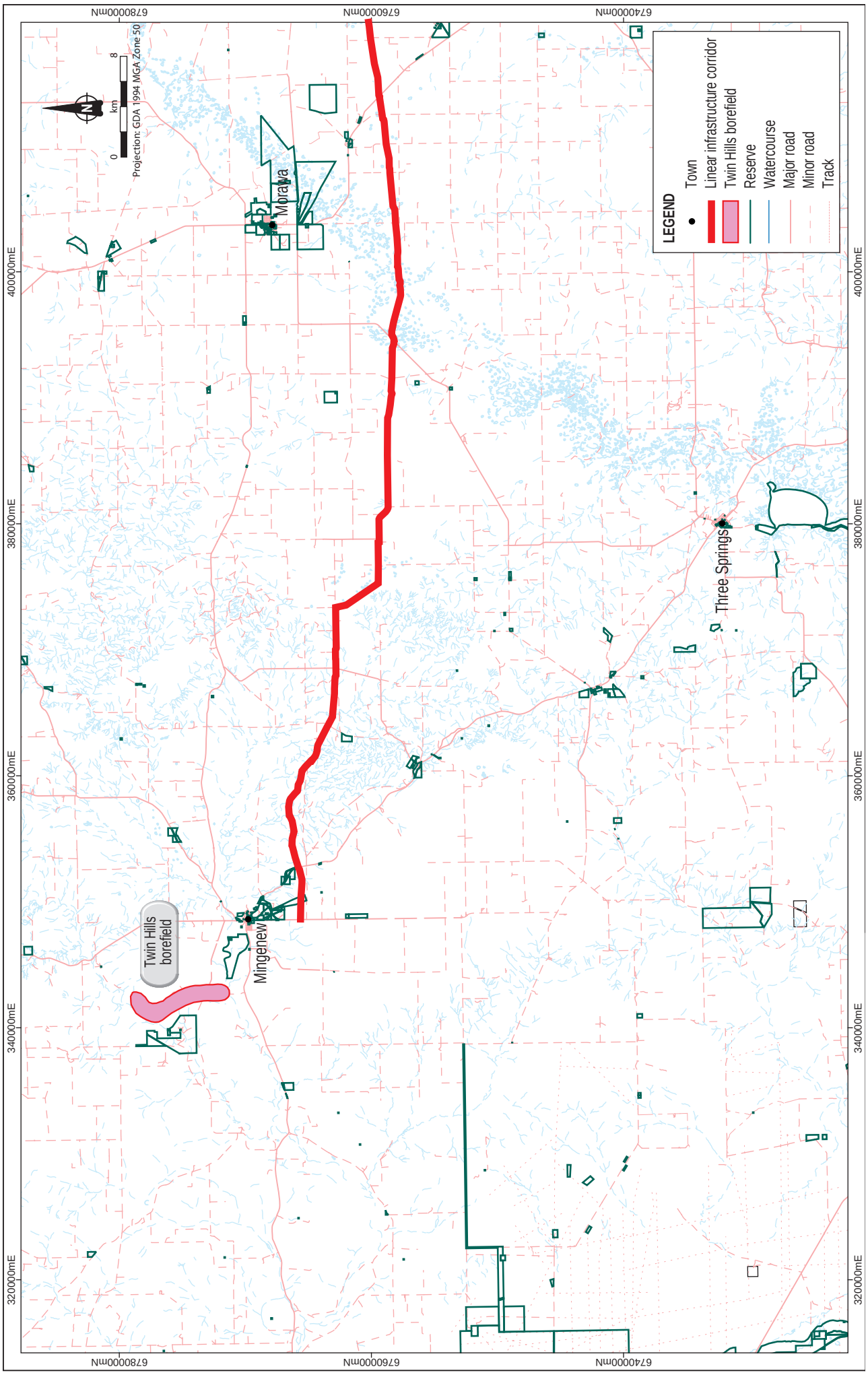


Table 2.14 provides information on the quantity and quality of borefield water. Water is of potable water quality with sodium chloride type salts.

Table 2.14 Borefield characteristics

Groundwater Sub Area and Aquifer		Twin Hills GWSA (Yarragadee aquifer)
Available for allocation	(GL/a)	48
Allocation being sought	(GL/a)	6.6
pH	-	6.6
TDS	mg/l	780 (grav)
Silica	mg/l	23
Sulphate	mg/l	110
Iron	mg/l	0.58
Manganese	mg/l	0.08
Nitrate	mg/l	<0.02

At the time of finalising this PER, negotiations with the DoW were continuing to determine water allocation, bore locations and design. The environmental effects of abstraction are required to be fully addressed in the DoW process; as such they are not considered further in this document.

2.9.5 Raw Water Pipeline

Water from the borefield at Mingenew will be pumped to the minesite via the raw water pipeline, a distance of approximately 140 km, to be constructed in the Linear Infrastructure Corridor. A midline pump station will be required at approximately KP100. Power infrastructure for the borefield will consist of a step-down transformer and 33kV transmission lines to bring power to the in-bore pumps. The steel pipeline will have a nominal diameter of 550 mm and wall thickness 6.4 to 9.5 mm. It will discharge to the raw water dam at the minesite.

The pipeline alignment (Figures 2.14a and b) has taken into consideration:

- topographical and terrain features, including rocky outcrops and escarpments;
- areas of remnant native vegetation, environmentally sensitive areas and known locations of listed flora and fauna;
- land use and stakeholder considerations, including bores, wells, stockyards and homesteads;
- water course, road and railway crossings;
- known sites of aboriginal and cultural significance;
- cost of pipeline construction (length and terrain related); and
- cost of pumping during operations (length and terrain related).

The Pipeline construction process is shown in Figure 2.15.

Figure 2.14a Route constraints along the linear infrastructure corridor

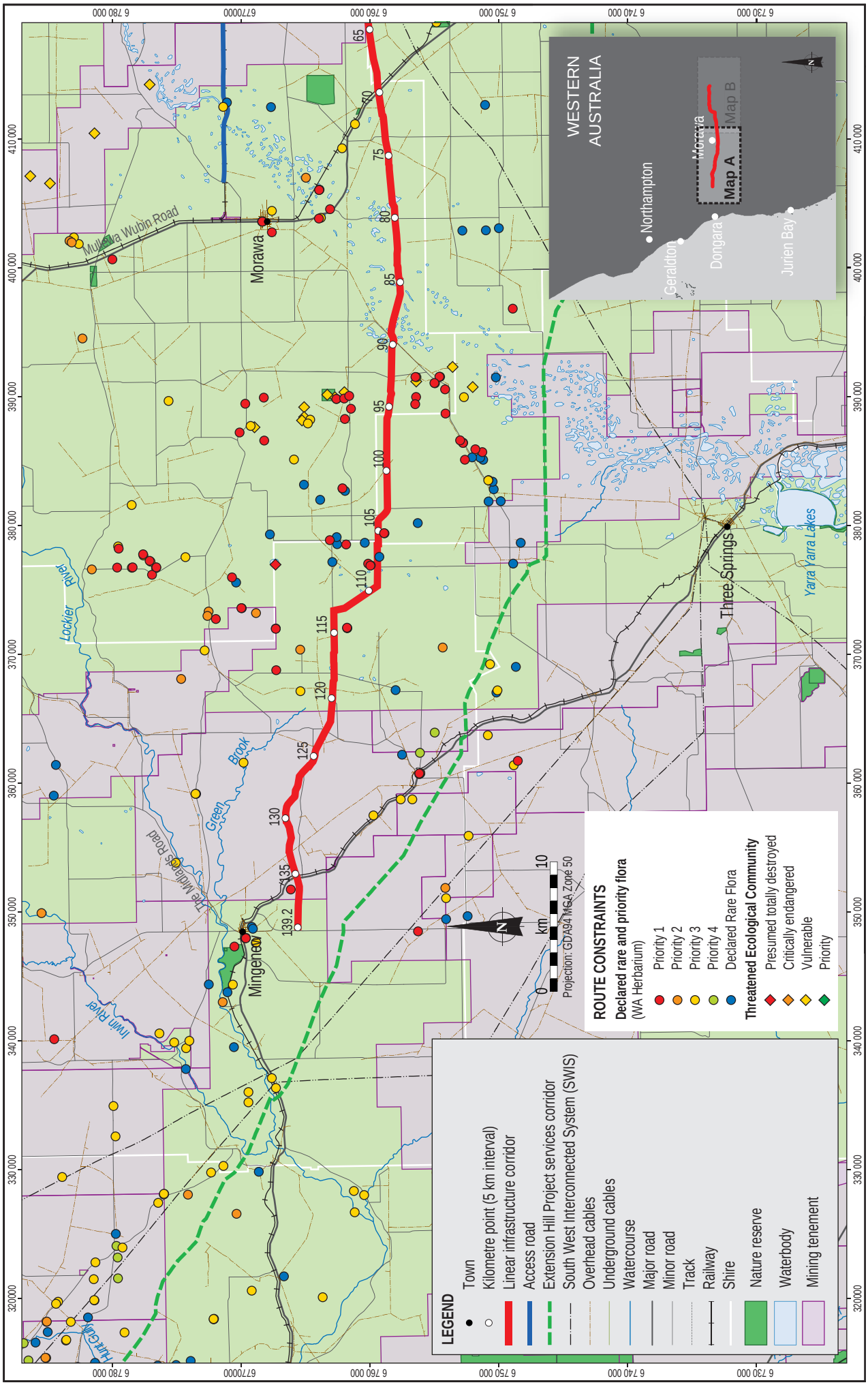
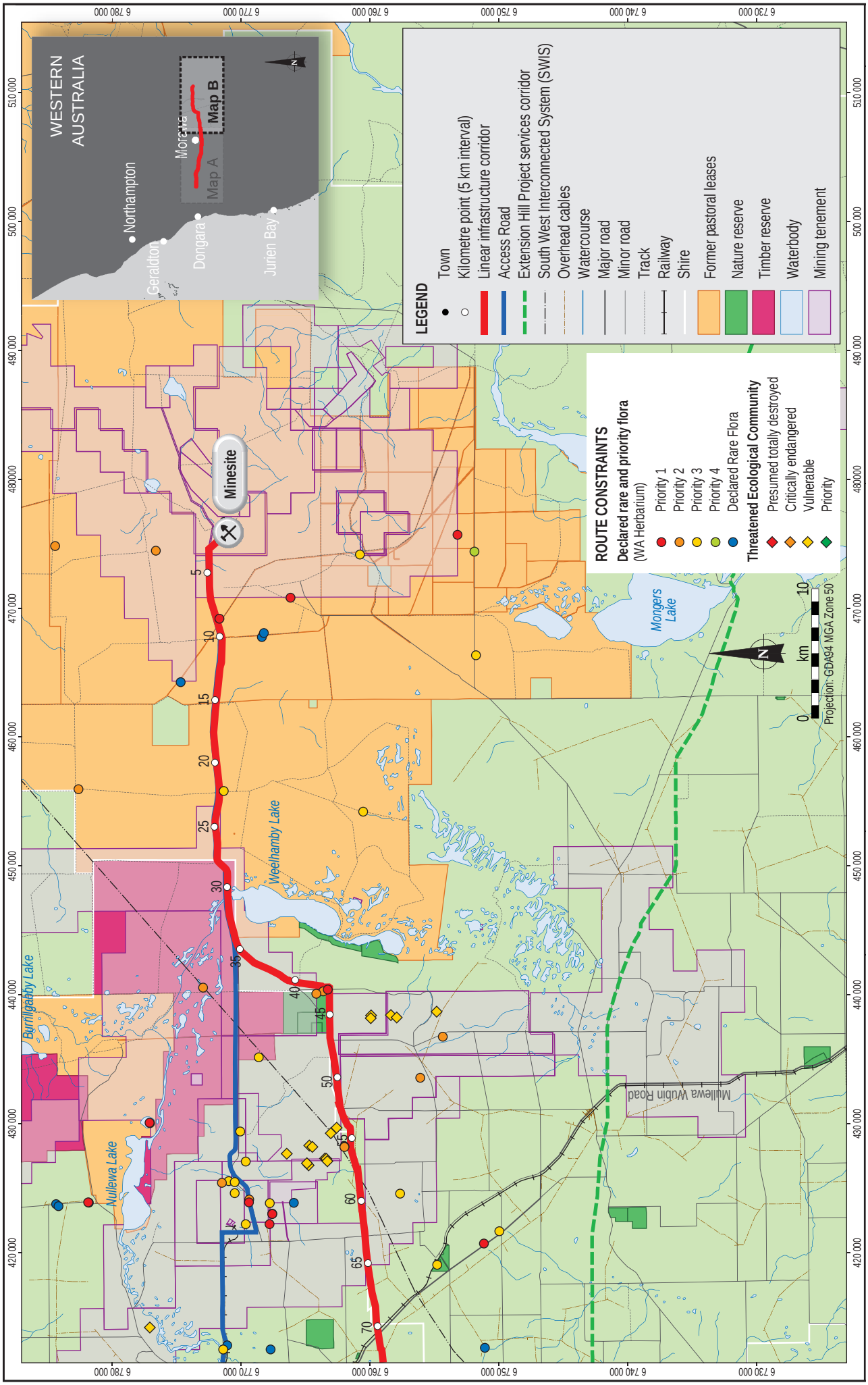


Figure 2.14b Route constraints along the linear infrastructure corridor



2.9.6 Water infrastructure at Minesite

Water from the raw water pipeline will be delivered to a raw water dam, located at the processing plant. The dam will have a polyethylene liner.

Ore processing will draw water from a process water dam, located adjacent to the raw water dam. Water recovered from ore processing will be returned to the process water dam for reuse. When required, the process water dam will be topped up from the raw water dam, or from the retention pond (if quality suitable). This dam will also be lined. Detailed design will seek to minimise evaporative losses from both the raw water and process water dams.

Bores around the minesite that produce low quality water (i.e. water that is not suitable for use in ore processing) will be directed to separate lined storage dams (turkey's nests) and standpipes, and water will be collected from these locations by a water truck and used for dust suppression or other suitable uses.

Potentially contaminated water collected from the processing plant area will be directed into a retention pond (see Figure 2.1). The retention pond has been designed to contain a 1-in-100-year, 72-hour storm event. A smaller section of the pond, sized for normal dry weather flows, will be lined to prevent infiltration of poor quality water. (Refer Section 7.2.2 for further detail). Alternatively the water will be treated to maximise the water available for reuse. Water in the retention pond will be regularly tested for water quality (including hydrocarbons) and, if of suitable quality, will be pumped back to the process water dam for re-use. If water is too saline for ore processing, it will be used for dust suppression.

2.9.7 Potable Water

Approximately 0.3 GL of water per annum will be processed through two reverse osmosis water treatment plants (located at the processing plant and near the accommodation village) to produce potable water for the administration building, laboratory, workshops and village.

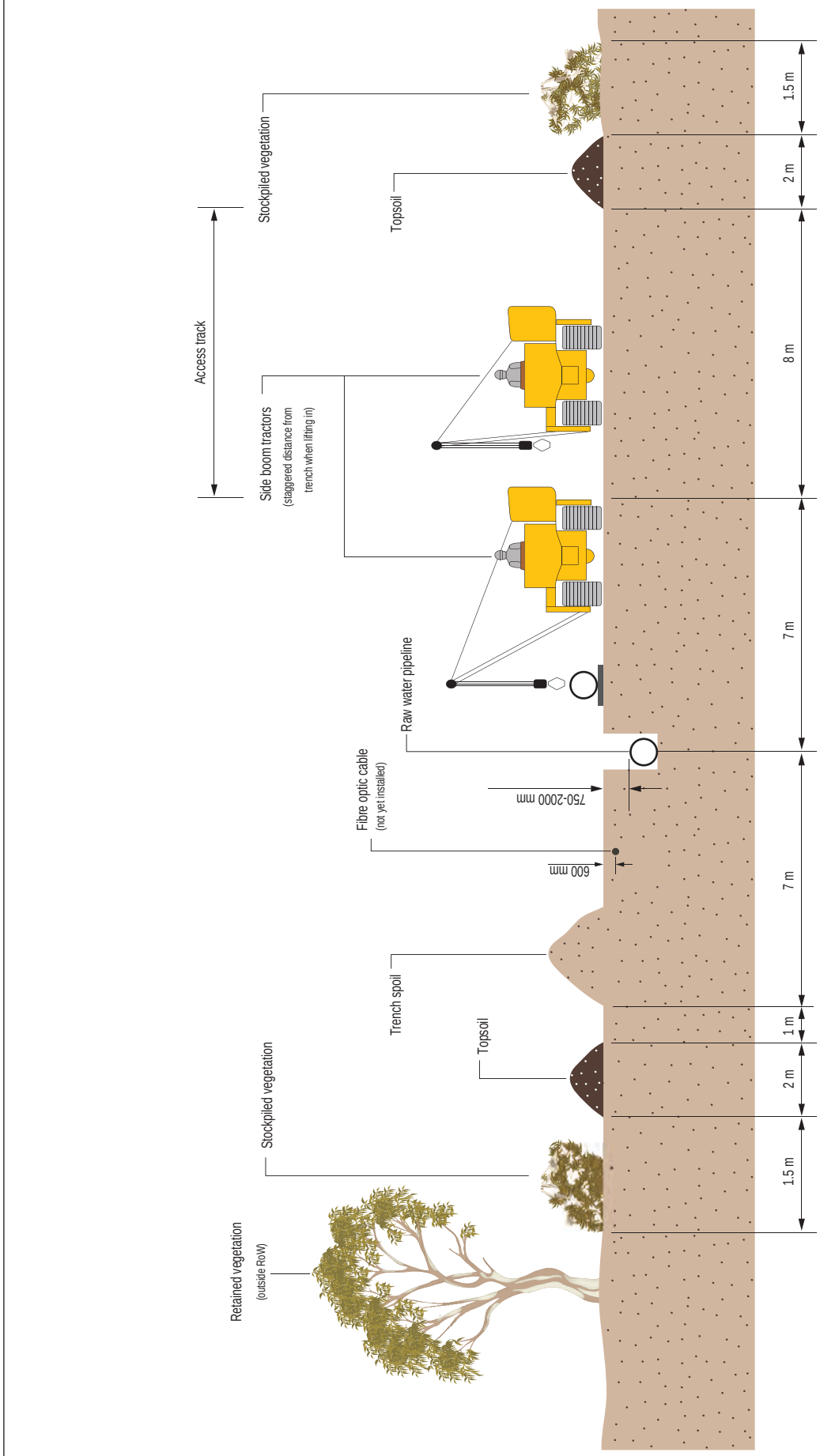
Saline waste water from the reverse osmosis plants can be used to supplement other saline water for dust suppression purposes, as it is expected to have salinity levels too high for re-use in the processing plant.

The main potable water tank for the site will be located in the vicinity of the village. There will also be a potable water tank in the processing plant area.

(Footnotes)

[1] It is planned that product will be railed from the minesite to the regional rail network at Morawa via a spur line. If the spur line is not available when product is available to be exported, product will be hauled by road to a siding at Morawa.

Figure 2.15 Raw water pipeline construction schematic



3

PUBLIC**ENVIRONMENTAL**REVIEW

project rationale and alternatives

3 Project Rationale and Alternatives

3.1 Rationale

Karara Mining Limited's (KML's) Karara Iron Ore Project (KIOP) proposes to supply 12 Mtpa of magnetite concentrate as feedstock to Anshan Iron and Steel Group Corporation's (AnSteel's) steel-making facilities in China which will incorporate a jointly owned pellet plant. AnSteel is developing a new, fully integrated steelworks at Bayuquan near the Port of Yingkou, located on the northeast coast of China. AnSteel is also significantly enhancing the operational performance of its current steelworks at Anshan City, 100 km inland from Yingkou.

The main factors driving the KIOP are summarised below, all of which reflect those mentioned in the Government of Western Australia's "*Strategic Review of the Conservation and Resources Values of the Banded Iron Formation of the Yilgarn Craton"* (Government of Western Australia 2007):

- the Karara iron ore deposit is substantial and of high quality - thus maximising long-term production and economic benefits relative to the investment and environmental impacts incurred;
- the demand for iron ore is rapidly expanding in the Chinese steel industry. This demand arises from sustained, strong economic growth within China as well as a robust export market for steel. In 2007 alone, a large proportion of the Western Australian iron ore industry was predominantly driven by the strong demand from China's rapidly growing steel industry. Western Australia produced over 250 Mt of iron ore, accounting for 98% of Australia's production (DoIR 2007). It is predicted that demand will continue to increase and will drive the Western Australian iron ore industry to continue to expand capacity (The Economist 2008);
- AnSteel's desire to diversify the supply of iron ore to its steel-making facilities; and
- AnSteel's desire to develop a long-term, reliable customer/supplier relationship with a well-positioned, strategic partner. Although Australia is currently the third largest producer of iron ore, behind China and Brazil, it still maintains a major advantage over its main competitors through its large, high quality, accessible deposits, a stable legal and political environment and proximity to major markets in Northeast Asia (Commonwealth of Australia 2006; DITR 2006).

3.2 Benefits of the Proposal

The KIOP will involve a number of impacts (both positive and negative) to the biological, physical and socio-economic environment of the project area, the region and the nation. The project has been designed to minimise or avoid potential adverse impacts, and to optimise benefits, as discussed in this PER.

The predicted benefits of the project are summarised below.

Increase in employment

The construction phase will require a workforce of approximately 1,500 people. The operation phase employment is estimated to be approximately 500 people plus up to an additional 80 people during periods of maintenance shutdown. These will result in a flow-on effect and boost employment in the businesses that provide goods and services to the different phases of the project in the Mid-West Region.

Increase in Gross State and Regional Product

Economic modelling predicts an increase in Gross Regional Product (GRP) for the Mid-West Region. In the 2008-09 financial year, GRP is estimated at $113 million rising to $636 million by 2019-20. At the State level for the same intervals, the forecast rise in Gross State Product (GSP) for Western Australia is $181 million rising to $736 million by 2019-20.

Economic Diversity

At the local level, the development will broaden the economic base of the Shires of Perenjori and Morawa, which currently rely predominantly on agriculture. The proposed development will also broaden business and employment opportunities within the Mid-West Region, and will diversify the State's industrial and economic base away from the Perth Metropolitan, Goldfields, South West and Pilbara regions.

Government Revenue

Revenue to local shires will increase through direct and indirect effects, such as an increase in local population leading to increases in rate revenue, over and above the direct payment of rates associated with the project infrastructure. The key revenue benefits are at the state level, with the Western Australian Government likely to receive in the order of $43 million per annum in royalties and approximately $4 million per annum in payroll tax, as well as other state taxes and charges. The Commonwealth Government will also receive a boost to revenue primarily in the form of company taxes, income taxes and goods and services tax (GST).

3.3 Project Alternatives

A number of alternatives were initially investigated to identify the most sustainable minesite design. The minesite design and alternative operational establishment options considered are presented below.

3.3.1 Minesite Location

The minesite is located within a tenement area that KML has secured. The mine pit is located at the economic concentration of iron ore on the Karara Ridge. This and other regional ridges exist due to the fact that they are a hard Banded Iron Formation (BIF) surrounded by softer shale rock. The BIF units contain varying amounts of iron ore, some being of sufficiently high concentrations of contained iron to be economically viable to mine.

3.3.2 Open Cut Mining or Deep Mining

Open-cut mining is the preferred method of extracting the Karara iron ore deposit, as the iron ore occurs relatively close to surface. Underground Mining is not an economically viable alternative at this time.

3.3.3 Water Supply Options

The KIOP requires a reliable supply of fresh water, which cannot be sourced in the immediate project area. Consideration was given to the possibility of an alliance with an adjacent iron ore developer in the region, Asia Iron, to obtain water from a borefield in the Tathra sub-area of the Arrowsmith Groundwater Area. However, there was insufficient water to be allocated to both projects. Following advice from the Department of Water (DoW), KML investigated locations in the Twin Hills and Mingenew sub-areas of the Arrowsmith Groundwater Area. Rockwater (a hydrogeological consultancy) planned and supervised the drilling and pump testing of one bore in each sub-area and modelled the results. Subsequently, DoW has advised that in line with potential changes to its water allocation policies, the department will only consider allocation of water from the Twin Hills sub-area to support KIOP's full water requirements. Consequently, KML is now focussing efforts on securing water from the Twin Hills sub-area and is progressing licenses to conduct more drilling.

3.3.4 Product Transportation by Road or Slurry Pipeline or Rail

While capital outlay for rail and slurry are similar and the operating cost of slurry transportation is significantly less than rail and road transport, rail transport has been selected for transport of product to the export Port for several reasons, including the:

- potential for rail to carry a variety of mineral products, whereas a slurry pipeline can only transport highly processed, finely ground product;

- ability of rail to provide incremental expansion in transportation capacity, where a slurry line is at or near its operational capacity upon construction; and
- potential for rail to provide regional benefits and possible use by others, where a slurry pipeline is an exclusive use option only.

Transportation of iron ore by road is the most expensive form of transport and creates a significant impact for other road users (from dust, noise, accident risk and visual amenity) if used on a long term basis, and is therefore not considered as a viable long term option in this instance.

3.3.5 Dry-stacked Tailings or Wet Tailings Disposal

In an endeavour to advance water consumption efficiency beyond prior industry achievements, KML intends to implement the best practice technique of dry-stacked tailings in lieu of conventional wet tailings disposal. Dry-stacked tailings involve the dewatering of tailings via filtering equipment; followed by mechanical transportation of tailings in solid form by conveyor or truck to a tailings storage facility (TSF). The material within the facility is in a dewatered state, and has the integrity to be stacked in similar fashion to a conventional rock waste dump albeit with a smaller average particle size.

Traditional wet tailings disposal involves the transportation of a tailings-water slurry by pipeline to a tailings dam, where tailings settle out and some of the transporting water is clarified and returned to the processing plant for reuse.

The advantages of the dry-stacked tailings (technique) over wet disposal are:

- recognition that dry-stacked tailings is considerably more water efficient;
- dry-stacked tailings requires significantly less land area per tonne of tailings solids;
- dry-stacked tailings minimises or removes the infiltration issues of wet tailings; and
- dry-stacked tailings provide a stable land-form upon deposition.

Dry-stacked tailings disposal for iron ore tailings is new technology now in some use in the Americas. The practice is yet to be undertaken on a commercial basis in Australia and yet to fully demonstrate water efficiencies and overall economic benefits when applied in the local geographical and climatic conditions. KML is confident in the ability of this technology to effectively apply to the KIOP conditions. However, KML maintains that the option of wet tailings disposal is the fall back position for tailings disposal for the project should dry-stacked tailings fail to be effective.

At the time of this PER preparation, KML is investigating the applicability of a mechanised system for transporting and stacking dewatered tailings in lieu of conventional truck transportation. The system entails the use of a combination of fixed, moveable and mobile conveyors. The ultimate mobile conveyor unit has a self-unloading device called a 'tripper' which travels up and down the conveyor removing material from the belt and stacking it uniformly to the TSF. The advantages of mechanised transportation and deposition are a significant reduction in diesel fuel use, total energy consumption, tyre consumption and greenhouse gas emissions through replacement of trucks with electrically-driven energy efficient conveyors.

Mechanised materials transport and stacking systems are yet to be employed on a commercial basis in Australia. Mechanised stacking is a preferable option, however KML maintains that conventional truck transport is the fall back position for tailings transport, should the investigation of mechanised transport and stacking prove inappropriate.

3.3.6 Accommodation Village and Airstrip Location within DEC Station

Due to the relative isolation and scale of the KIOP, an accommodation village and airstrip are planned to be established in close proximity to the mine and processing plant. Consideration has been given to locating these facilities further from the mine, outside the area of former pastoral leases purchased by DEC. Such siting was considered inferior from a worker safety and logistical perspective. After mining and processing ceases the accommodation village and airstrip will be removed and rehabilitated unless an alternative arrangement for their retention is reached with the State Government and or local Shire.

3.3.7 Power Supply Options

KML has considered the use of gas fired generators in the pre-selection process. It was found that the price of gas was prohibitively expensive and that long term supply arrangements were not able to be secured, potentially compromising the future of operations. Additionally, the associated infrastructure needed for a gas fired generation solution would require significant connection pipeline/transmission to connect to the Dampier/Bunbury Natural Gas Pipeline where the closest connection point is located approximately 180 km from the project.

3.3.8 In-pit Crushing vs Haul Out of Pit

At the time of this PER preparation, KML is investigating the applicability of moveable primary crushers for the KIOP. In-pit crushing has the potential to improve both the economic and environmental performance of the operation, as it has the potential to be more energy-efficient than trucking. This method is being considered as an alternative to 'haul to surface' truck haulage required for fixed installations.

Moveable crushers employ the same technology for crushing as fixed installations, however, the structure of the crusher is free standing and relocatable. This ability allows the crusher to be relocated periodically so as to maintain proximity to the active mining face as it moves. Through this, a significant reduction in the number of trucks required is achievable, compared to the number that would otherwise be needed as the pit deepens and mining faces become more distant from a conventional fixed crusher location. Crushed material is still delivered to the crusher by truck, but then transported from the crusher to surface and onto the processing facility via conveyor belt instead of being trucked all the way to the surface.

The advantages of moveable crushers are a significant reduction in diesel fuel use, total energy consumption, tyre consumption and greenhouse gas emissions through the replacement of trucks with electrically-driven energy efficient conveyors.

The base case for the project involves truck haulage to a fixed crusher adjacent to the processing plant. KML will investigate the applicability of this technology as more detailed engineering design is undertaken.

4

PUBLIC ENVIRONMENTAL REVIEW

sustainability, environmental protection and management

4 Sustainability, Environmental Protection and Management

4.1 Introduction

This chapter highlights the influences that have shaped the project and the company's management of environmental and social impacts. Details of Karara Mining Limited's (KML's) management of these impacts are included in later chapters of this Public Environmental Review (PER). The Government of Western Australia has provided direction for sustainable development in Western Australia through the State Sustainability Strategy (Government of Western Australia 2003). In response to this strategy, the Environmental Protection Authority (EPA) has developed a number of position statements providing direction to proponents and policy makers on incorporating sustainability. The two key position statements for this project are:

- Position Statement No. 6: Towards Sustainability; and
- Position Statement No. 7: Principles of Environmental Protection.

Nationally, the Commonwealth Government has provided guidance on sustainable development through the National Strategy for Ecologically Sustainable Development (ESDEC 1992). Chapter 5 of the strategy document discusses sustainability issues particular to the mining industry.

Within the mining industry, the International Council on Mining and Metals (ICMM) Sustainable Development Framework Principles and the Minerals Council of Australia (MCA) Enduring Value articulate the mining industry's commitment to sustainable development and provides standards and implementation guidelines on sustainability within the mining industry.

The objective of this chapter is to:

- discuss the context for sustainable development, having regard to these State and National statements on sustainable development in the mining industry;
- assess the proposed project design and management measures against the principles of environmental protection; and
- outline the Environmental Management Systems that Karara KML will put in place to ensure the long-term protection and management of the environment.

4.2 Sustainability Context

No matter where a new mine is sited, it will impact environmental and social values to a lesser or greater extent (that is, it will have an ecological footprint, consume energy, deplete non-renewable ore resources, and be visible). New mines also have an opportunity to enhance environmental and social values, to a lesser or greater extent, as well as playing a valuable role in enhancing the community in which they operate through employment, prosperity and economic development. Position Statement No. 6 and the National Strategy for Ecologically Sustainable Development provide guidance on the sustainable production and use of minerals.

Key considerations for sustainable mining are summarised below.

- New mines must be planned on a whole of lifecycle basis, with closure planning and provisions for land rehabilitation considered in the design of the project. Minesites should be rehabilitated to sound environmental and safety standards. Planning for final land use should be undertaken early in the project life, in consultation with relevant stakeholders;
- Mining should aim to provide appropriate returns to the local community, considering the objectives of social equity, with regular community consultation. Economic and social benefits that may be derived, both directly and indirectly, from mining should continue beyond the life of the mineral deposit. In practical terms, this means that mine closure planning must consider the communities and social institutions which have grown up around mining activities; and
- Environmental management, rehabilitation and closure should be considered as an integral component of the planning and operation of mines.

The ICMM Sustainable Development Framework Principle is provided in Box 4.1 and provides a global standard for sustainable development in the mining industry.

Box 4.1 ICMM Sustainable Development Framework Principles

Principle 1:	**Implement and maintain ethical business practices and sound systems of corporate governance;**
Principle 2:	**Integrate sustainable development considerations within the corporate decision-making process;**
Principle 3:	**Uphold fundamental human rights and respect cultures, customs and values in dealings with employees and others who are affected by our activities;**
Principle 4:	**Implement risk management strategies based on valid data and sound science;**
Principle 5:	**Seek continual improvement of our health and safety performance;**
Principle 6:	**Seek continual improvement of our environmental performance;**
Principle 7:	**Contribute to conservation of biodiversity and integrated approaches to land use planning;**
Principle 8:	**Facilitate and encourage responsible product design, use, re-use, recycling and disposal of our products;**
Principle 9:	**Contribute to the social, economic and institutional development of the communities in which we operate; and**
Principle 10:	**Implement effective and transparent engagement, communication and independently verified reporting arrangements with our stakeholders.**

KML is committed to developing the Karara Iron Ore Project (KIOP) in a manner that recognises the potential to deliver benefits to the communities within which it operates, and will construct and operate its mine within this sustainability framework with a focus on sharing such benefits with these communities.

4.3 Implementing Sustainability in Project Design and Management

4.3.1 Principles of Environmental Protection

The objective of the *Environmental Protection Act 1986* (EP Act), as stated in Section 4A, is to protect the environment of Western Australia, having regard to the following principles:

a. The Precautionary Principle;
b. The Principle of Intergenerational Equity;
c. The Principle of the Conservation of Biological Diversity and Ecological Integrity;
d. Principles relating to improved valuation, pricing and incentive mechanisms; and
e. The Principle of Waste Minimisation.

These principles underpin the environmental component of sustainability (EPA 2004a) and the EPA Position Statement No. 7: Principles of Environmental Protection (EPA 2004b) provides direction in applying these principals in government policy and guidance on their application within the EPA decision-making process. With regard to Position Statement No. 7, this PER has considered the principles of environmental protection as follows:

a. *The Precautionary Principle:* where serious or irreversible (environmental) damage is likely to occur, measures to prevent the environmental degradation should not be postponed due to lack of scientific certainty. If there is an uncertainty, proposed management and mitigation measures should be conservative in favour of preventing the realisation of the risk. To ensure optimum environmental outcomes from KML's expenditure on management and mitigation measures, KML will implement these management and mitigation measures, for each aspect of its activities, using a risk based approach to assessment;

b. *Intergenerational Equity:* the project should not compromise the health, diversity and productivity of the environment for future generations. The project should consider opportunities to act in a stewardship role to maintain natural capital. In all instances, the hierarchy of mitigation (that is, avoid, minimise, rectify, reduce) will be applied in respect to all activities;

c. *Conservation of Biological Diversity and Ecological Integrity:* the conservation of biological diversity and ecological integrity should be a fundamental consideration for the project. Biological diversity includes genetic diversity, species diversity and ecosystem diversity. Where KML cannot achieve this, the hierarchy of mitigation (that is, avoid, minimise, rectify, reduce) will be applied, with offsets considered where other options are not practicable;

d. *Principles related to improved valuation, pricing and incentive mechanisms:* environmental factors should be included in the pricing of assets and services, including the costs of minesite closure and rehabilitation. KML recognises its obligations in respect to mitigation and containment under the "polluter pays" principle. Environmental goals should be pursued in the most cost effective way. Market mechanisms, such as financial incentives, should be considered to enable the people best placed to maximise benefits and minimise costs to develop solutions and responses to environmental problems; and

e. *Waste Minimisation:* the project should minimise waste generation and its discharge to the environment. KML will implement the principle of the 'prevent, minimise, re-use, recycle' hierarchy for waste generation and disposal.

4.3.2 Project Implementation

KML has and will continue to implement measures to improve the overall sustainability of the project. These include:

- innovative mine planning to maximise ore recovery and minimise pit footprint;
- extensive consultation with the local communities has been undertaken in order to seek their views and expectations, and to provide information on the project (see Chapter 5);
- extensive research into best practice design and construction of the accommodation village, use of sustainable construction materials, passive solar design etc; and
- project design engineers have been responsible for reviewing drafts of this PER to ensure that design engineers understand the commitments made in this document and that those commitments are technically and practically achievable.

A specific assessment of the project against the five principles of environmental protection is provided in Table 4.1.

4.4 Environmental Management System

This section provides and overview of the Environmental Management System (EMS) that will be applied to the project. It describes the framework and elements of the system that will be used to achieve the environmental and social objectives, targets and commitments of the project and the application of mitigation measures described in the PER.

KML is committed to developing and implementing an EMS consistent with ISO14001:2004 to promote excellence in environmental management and continual improvement. The EMS is a structured, documented approach to managing risks and potential environmental or social impacts arising from the project. The principal steps in the process are:

- an assessment of environmental or social risks (based on specialist studies and corporate knowledge and experience);
- identification of relevant government policy, law and guidelines;
- incorporation of conditions of approval, commitments and performance criteria;
- development and implementation of environmental controls and procedures;
- monitoring of environmental impacts and performance;
- corrective action to address issues as they are identified; and
- review of procedures and plans to ensure continual improvement.

In particular, the EMS will have a strong emphasis on ensuring that conditions of operation and commitments made by KML are translated into defined actions or work practices with allocated responsibilities for work on the ground. In-built quality assurance practices will help to ensure that the work is carried out as intended and that there is continuous improvement in standards and outcomes. The main elements of the corporate EMS include:

- policy;
- planning;
- implementation and operation;
- checking and corrective action; and
- management review.

Table 4.1 Principles of environmental protection and their relationship to the KIOP

Principle	Consideration in the Project	Has principle been met?	Section(s) in PER
a. The Precautionary Principle	• KML has sought to reduce the uncertainty surrounding the extent and magnitude of environmental and social impacts. To do this, KML has commissioned technical specialists to collect baseline information on the current environmental health and diversity of the project area to enable the assessment of the potential for environmental change from project activities. • In addition, government regulators, special interest groups and technical specialists have been consulted during all stages of planning and environmental approval to evaluate the potential impacts to the environment and to assess the consequences of various project options. • KML is also committed to the development and implementation of environmental management measures based on construction and operations risks, to identify and implement appropriate mitigation measures to minimise the potential impacts from those risks. • KML recognises that the project has the potential for significant impact on a number of flora species of conservation significance and the same floristic community types which, to date, appear to be restricted in distribution. In these instances, where the species and communities occur over the mineral deposits and cannot be avoided by impact minimisation measures, KML has proposed a number of offsets to compensate for this impact (see Chapter 9).	Yes	Chapter 5 Chapter 6 Chapter 7 Chapter 8 Chapter 9
b. The Principle of Intergenerational Equity	• KML recognises the responsibility and obligation it has to ensure that all land within their sphere of influence is preserved for future generations. This includes appropriate custodianship of undisturbed land within their tenements and prompt and effective rehabilitation and closure of disturbed land; • KML is committed to the principles of minimum resource use and emissions minimisation. Performance and efficiency targets are established and regularly monitored and reviewed as part of KML's commitment to continual improvement (e.g. for water, energy and fuel waste production such as greenhouse gas, dust, noise, and wastewater); and • KML recognises that the KIOP has the potential for significant impact on some species and vegetation of conservation significance and has proposed a number of offsets to compensate for this loss (see Chapter 9).	Yes	Chapter 7 Chapter 8 Chapter 9

Table 4.1 Principles of environmental protection and their relationship to the KIOP (cont'd)

Principle	Consideration in the Project	Has principle been met?	Section(s) in PER
c. The Principle of the Conservation of Biological Diversity and Ecological Integrity	• KML has sought to reduce its disturbance footprint to avoid disturbance as far as practicable. Project design engineers have developed the project layout with the objective of avoiding as many FCTs of moderate to high or high conservation significance as practicable. In addition, KML has, where practical, clustered areas of disturbance in order to maximise continuity of undisturbed vegetation and preserve its ecological integrity; • KML recognises the project has the potential for significant impacts on a number of flora species of conservation significance and therefore has proposed a number of offset activities and programs to address these impacts (see Chapter 9) and is committed to continuing research into the genetic diversity, life history and propagation of these species to ensure that biodiversity impact is minimised; • KML is committed to further development and implementation of both Flora and Fauna EMPs in order to minimise the impacts that the project will have on flora and fauna. KML is committed to an open and transparent process throughout its operations and will continue to report the results of flora and fauna management activities as a component of its annual environmental report. The EMPs have been provided with this PER; and • KML will implement an adaptive approach to environmental management to ensure a continual improvement to environmental management and performance.	Yes	Chapter 7 Chapter 8 Chapter 9 Volume 2
d. Principles relating to improved valuation, pricing and incentive mechanisms	• When considering the options for all elements of the project in the feasibility phase (including equipment selection and site layout) environmental factors were considered and, where necessary, changes to the project were made (see Table 7.1 in Chapter 7); • The costs and requirements for closure have been considered in the design of the project, particularly for major items such as the waste rock dump and tailings storage facility; • A Conceptual Mine Closure (and Rehabilitation) EMP has been included with this PER. KML recognises its obligation under the *Mining Act 1978* to continually update this closure plan and is committed to providing a fully costed closure plan within three years of the commencement of operations, with periodic review as and when required; and • KML recognises itself as best placed to maximise the benefits of good environmental management and to minimise the costs of environmental harm. KML will implement training for all personnel on their responsibilities and obligations to care for the environment. This will be enforced through the implementation of environmental and social key performance indicators (KPI) for key personnel.	Yes	Chapter 2 Chapter 7 Chapter 8 Volume 2
e. The Principle of Waste Minimisation	• KML will implement a 'reduce, re-use and recycle' approach to waste management across all components and phases of the project. The strategies for waste minimisation will be outlined within the project EMS.	Yes	Chapter 2 Chapter 7 Chapter 8

Significantly, the EMS will be implemented universally across the greater Karara Iron Ore Project. Further detail on each element is discussed below.

4.4.1 Policy

The activities of the KML joint venture will be aligned to the corporate charter and policies of its Australian 50% shareholder, Gindalbie Metals Ltd. Gindalbie is committed to managing its activities, and those of the joint venture projects in which it participates, in an environmentally responsible manner, as reflected in its corporate environmental policy (Box 4.2). This policy defines the direction of the company in relation to the environment and provides the guiding philosophy for its implementation through the EMS.

4.4.2 Planning

Planning ensures that clearly stated environmental objectives, consistent with the environmental policy, are considered in the company's economic and mine planning processes. Good planning also ensures that KML is aware of, and addresses, its ongoing legal obligations and that intended environmental outcomes are achieved in the most efficient manner.

4.4.3 Implementation and Operation

Practical procedures within the EMS will help ensure compliance with obligations and environmental performance criteria for all works with the potential for significant environmental impact. These procedures will clearly document and define roles and responsibilities for environmental management and will be integrated with other standard operating procedures at each site. The implementation process will begin at induction and continue through ongoing training. The environmental objectives, and each employee's obligations for environmental management, will be clearly communicated to all staff and contractors. Figure 4.1 outlines a corporate structure and responsibilities for the effective management and deployment of environmental management activities within KML.

4.4.4 Checking and Corrective Action

Regular inspection and periodic auditing is a necessary step to assess compliance with environmental management objectives and commitments. It will also provide a system of dealing with non-compliance, incidents and complaints, data recording and reporting. Regular inspections and audits will be conducted internally and periodic, third party audits will be carried out as part of KML's audit process. The DEC may also undertake compliance audits at any time pursuant to the provisions of s48(1) and Part VI of the EP Act.

4.4.5 Management Review

Internal review of the EMS will help ensure continual improvement in levels of compliance and consistency across the organisation. Objectives and targets identified during the environmental approval process will provide benchmarks upon which performance will be measured.

The project objectives, targets, procedures and practices will be reviewed and modified on a regular basis to reflect issues that arise as the project develops.

4.4.6 Environmental Management Plans

Environmental and other management plans are primary tools for the implementation of the EMS. Management plans will be developed to control the most significant environmental aspects of exploration and mining activities. KML has developed full Environmental Management Plans (EMPs) for the following factors. These EMPs have been developed as they represent the more significant aspects of the project, and to comply with an EPA request that they be developed in advance of project approval:

- Flora;
- Fauna;
- Water (including Water Efficiency Management Plan);
- Dust; and
- Rehabilitation and Conceptual Mine Closure.

A summary of these Environmental Management Plans is presented in Chapter 8 of this PER and the full plans are included in Volume 2. KML has also prepared the framework for the management of other factors, not considered key to the project but essential tools for sound environmental management. These are:

- Audit and Compliance Management Plan
- Vegetation Clearance and Soils Management Plan
- Weed and Plant Pathogen Management Plan
- Feral Animal Management Plan
- Noise and Vibration Management Plan
- Greenhouse Gas Management Plan
- Waste Management Plan
- Traffic Management Plan
- Cultural Heritage Management Plan
- Stakeholder Consultation Management Plan

The frameworks for these plans are included in Chapter 8. KML will develop additional management plans as required for issues identified through the ongoing operation and management of the project. During operations operational procedures will be developed, consistent with these plans.

Box 4.2 Gindalbie Metals' Environmental Policy

GINDALBIE METALS LTD

Environmental Policy

Successful environmental management in the resources sector is dependant on recognising, and avoiding or minimising, environmental impacts.

Gindalbie Metals is aware that protection of the environment requires careful planning and commitment from all levels within the Company. Best practise environmental management in mining and exploration demands a continuing, integrated process through all phases of a project.

Environmental management is a core business requirement for Gindalbie Metals, essential to long term success. Gindalbie Metals will comply with all relevant legislative requirements and commitments applicable to our operations, and where practicable, exceed these requirements.

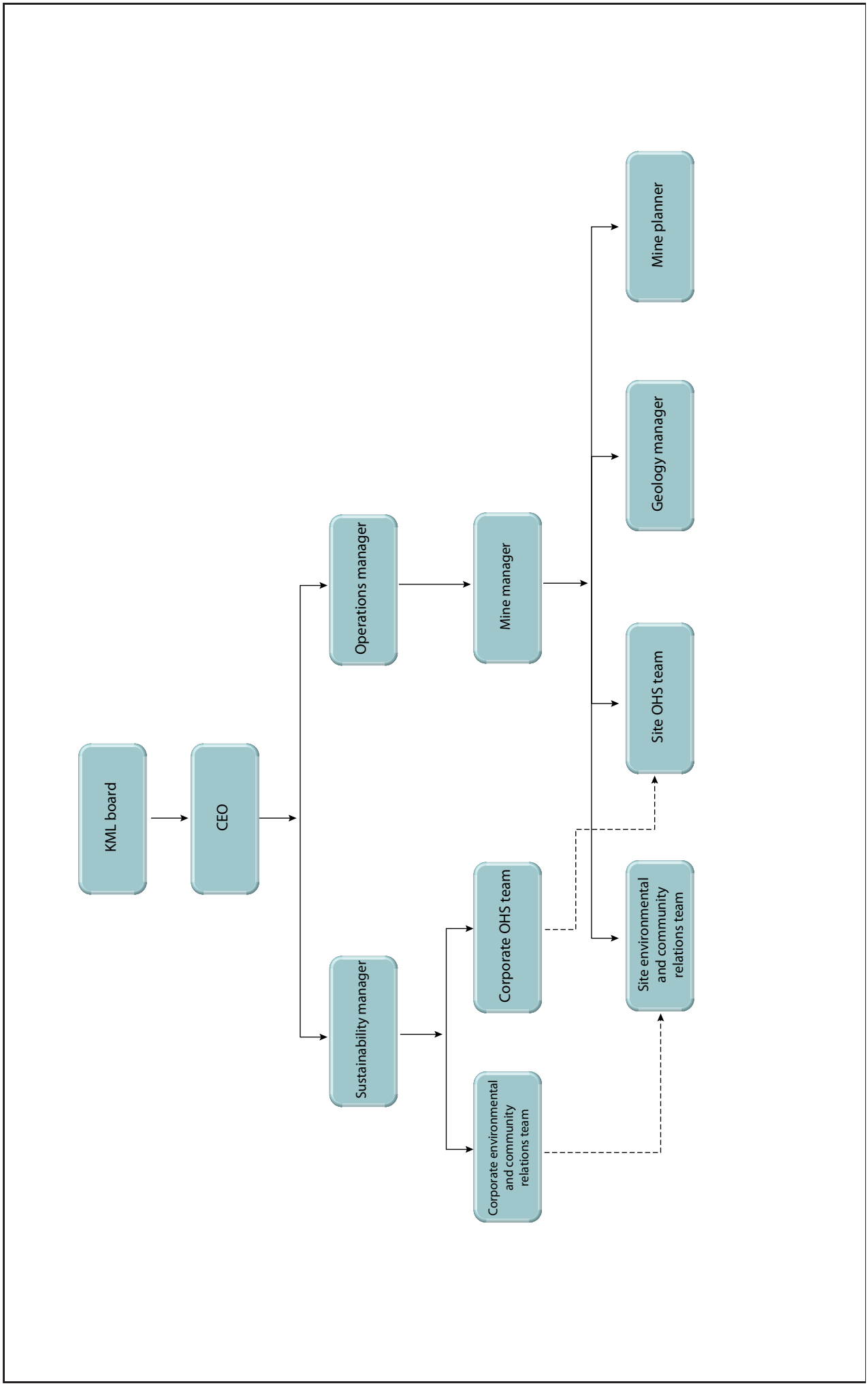
In addition Gindalbie Metals is committed to achieving environmental management excellence through continuous improvement of our environmental performance.

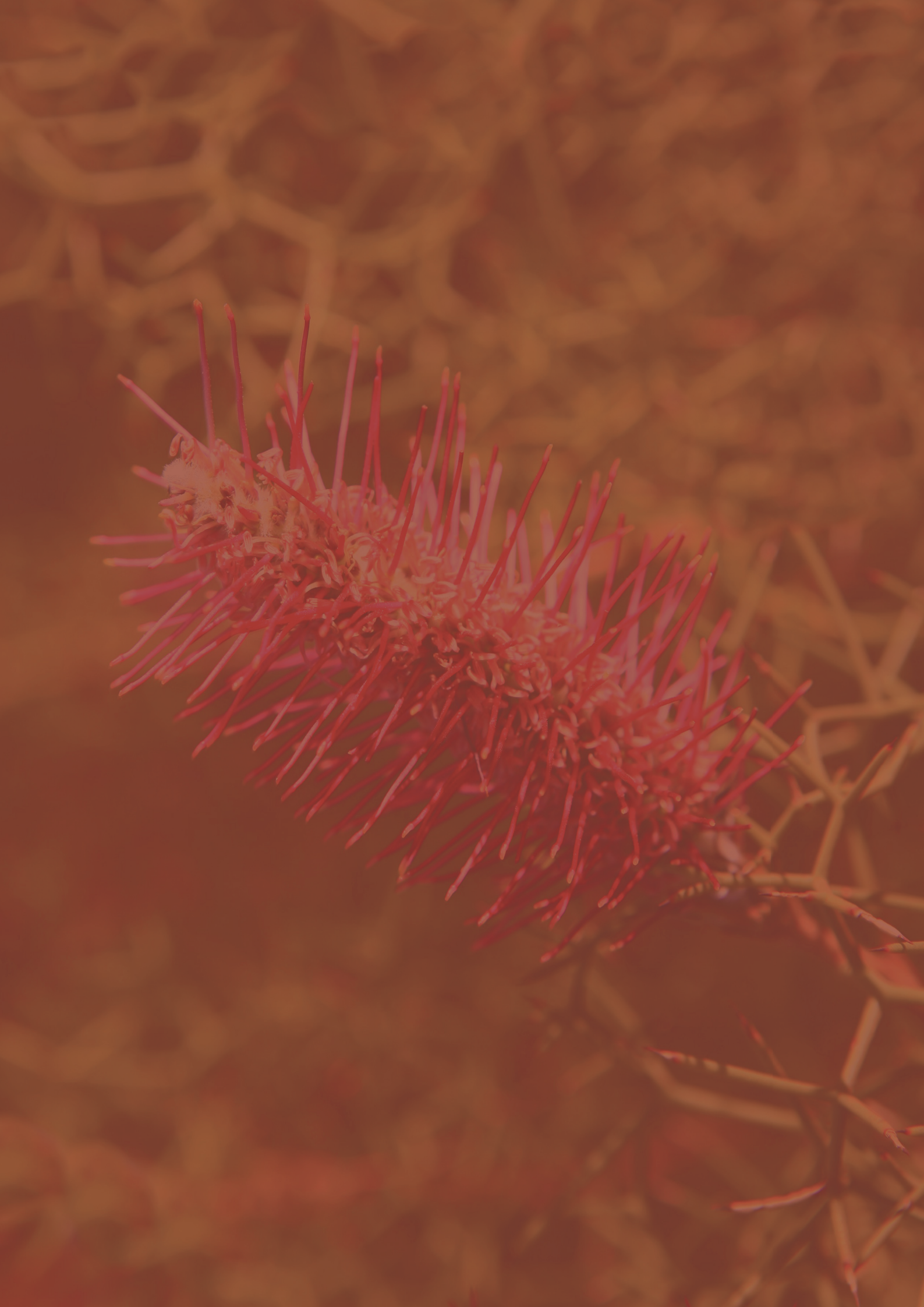
The Company has also committed to membership of various local and regional environmental groups and associations, that allow for up to date information and industry best practises to be readily adopted in all phases of our operations.

Garret Dixon
Chief Executive Officer
June 2007

GINDALBIE METALS LTD Tel: +61 8 9480 8700 | Fax: +61 8 9480 8799 | Level 9, London House, 216 St Georges Terrace, Perth, WA 6000 | www.gindalbie.com.au

Figure 4.1 Corporate structure and responsibilities





5

PUBLIC**ENVIRONMENTAL****REVIEW**

stakeholder consultation

5 Stakeholder Consultation

5.1 Consultation Program

Karara Mining Limited (KML) is committed to a transparent approval process. KML has consulted with regulators and key stakeholders to ensure that any potential concerns are raised and addressed.

The principal objectives of the stakeholder consultation program to date have been to:

- identify and consult with interested and affected individuals and groups to understand the nature of their stakeholder interests in the project;
- provide accurate information about the project to stakeholders in a timely fashion thereby increasing stakeholder knowledge and involvement in the environmental assessment and approval process;
- ensure that local communities and government are properly informed about the project and its progress; and, that these stakeholders have adequate and timely opportunities to provide input into the environmental assessment and approval process, and to express any relevant problems, difficulties or concerns they may have;
- minimise the risk of delays to the project by ensuring that issues or concerns are dealt with in advance of and during the environmental assessment and approval process rather than after submission of the required documentation;
- ensure that the relevant regulatory requirements are being anticipated and met with regard to appropriate stakeholder input into the process; and
- provide the basis for ongoing consultation through construction, operation and mine closure.

To achieve these objectives, KML has utilised a number of communication mechanisms to facilitate consultation. These have included:

- project briefings: held with key stakeholders at key project milestones (e.g., environmental assessment scoping, study findings and mitigation planning);
- one-on-one technical discussions: organising and attending one-on-one meetings with stakeholders for information dissemination, obtaining stakeholder input to project planning, and discussing technical issues;
- land and easement meetings: held with landholders and land managers, native title claimants and Aboriginal communities in relation to access and where applicable, compensation negotiations; and
- information releases: dissemination of information to the wider community, including media releases, public notices and public forums inviting comment on project information and permit and planning applications.

5.2 Relevant Stakeholders

Stakeholders are individuals, parties or communities that can potentially influence or are potentially influenced by the project. Since February 2005, KML has consulted with a range of organisations and individuals regarding the Karara Iron Ore Project (KIOP). On many occasions, consultations with stakeholders have covered aspects of both the KIOP and the Mungada Iron Ore Project (MIOP) which together constitute the greater Karara Iron Ore Project. For this reason, stakeholders and consultation activities for both projects are presented here.

Table 5.1 lists the key stakeholders in broad categories reflecting their interests.

Table 5.1 Key stakeholders consulted

Stakeholder Group	Details
Community Forums on KIOP and MIOP in Geraldton, Perenjori and Morawa	
Private holders of neighbouring pastoral stations and tenements, and freehold landowners	
	Meetings with individuals and Landholders (approx. 80) in the vicinity of the minesite and along proposed infrastructure corridor and borefield area
Corporate holders of neighbouring pastoral stations and tenements	
Indigenous groups	
	Widi Mob
	Widi Binyardi
	Yamatji Land and Sea Council (Geraldton)
	Amangu
	Mullewa Wadjari
Employee and industry groups	
	Permanent and contracted employees
	Geraldton Iron Ore Alliance
	Mid West CCI
	CCI Perth
Interested groups and organisations	
	Conservation Council of Western Australia
	Wildflower Society of Western Australia
	Western Australian Museum
	Landcare - Morawa
Utility and infrastructure groups	
	Geraldton Port Authority
	Public Transport Authority
	Landcorp
	WestNet Rail
	Western Power
	Water Corporation
Local and regional services and businesses	
	Mid-West Development Commission
Local government authorities	
	Shire of Morawa
	Shire of Perenjori
	Shire of Mingenew
	Shire of Greenough
	Shire of Irwin
State government agencies	
	Environmental Protection Authority
	Department of Environment and Conservation (incl DoE & CALM) – Perth & Geraldton
	Office of Development Approvals Coordination
	Department of Indigenous Affairs – Perth & Geraldton
	Department of Industry and Resources – Perth
	Department for Planning and Infrastructure – Perth
	Department of Housing and Works
	Department of Water – Perth & Geraldton
	Department of Health

Table 5.1 Key stakeholders consulted (cont'd)

Stakeholder Group	Details
Commonwealth government agencies	
	Australian Customs Service
	Commonwealth Treasury
	Department of the Environment, Water, Heritage and the Arts
	Department of Industry, Tourism and Resources
	Department of Infrastructure, Transport, Regional Development and Local Government
	Department of Immigration and Citizenship
	Federal Government Mining/Indigenous Workshop
Western Australian Political representatives	
	Minister for the Environment; Climate Change; Peel
	Minister for Resource Development and Energy
	Minister for MidWest
	Minister for Water Resources
	Western Australian Government Treasurer
	Secretary for the Minister of Indigenous Affairs
	City Commissioners – City of Geraldton-Greenough
	Member for Geraldton
Federal Political representatives	
	Senator Chris Evans
	Member for O'Connor; Wilson Tuckey

5.3 Matters Discussed and Issues Raised

A consultation record is maintained which tabulates the dates of consultation, and as a minimum the topic and issue discussed. Where deemed necessary, minutes are maintained for reference and accuracy. A summary of the issues relevant to this PER which were raised by key stakeholders is provided in Table 5.2, which also lists the relevant section of the PER which the issue raised pertains to.

5.4 Ongoing Consultation and Records

Consultation with key stakeholders will continue to be undertaken for the life of the project to ensure due consideration of all project-related opportunities and concerns. The consultation mechanisms used as discussed in Section 5.1 will continue to be used into the future.

During the approval consultation process, a stakeholder consultation register was developed. This register will be maintained during both the construction and operations phase of the project. The detail of stakeholder consultation undertaken and relevant outcomes, such as commitments, will be documented within this register.

Table 5.2 Stakeholder Discussions

Stakeholder	Matters Discussed and/or Issues Raised	Reference Relevant KIOP PER Section or Other
Private neighbours		
Meetings with individuals	Site location of the Mingenew test bore, permission to access property.	Section 2.9.4
	Discussion on proposed rail siding options, design and development schedule.	Mungada (MIOP) PER
	Discussions regarding potential noise, visual amenity and dust issues at Tilley Siding.	Mungada (MIOP) PER
	Discussed noise issues relating to Tilley Siding.	Mungada (MIOP) PER
Landholders (approx. 80) along proposed linear infrastructure corridor and borefield area	Pipeline issues and access. Water supplies in the Mingenew area.	Chapter 1 and Section 2.9
	Survey access, water access, and pump station placement.	Chapter 1 and Section 2.9
	Test bore pumping and bore monitoring in the Mingenew area.	Chapter 1 and Section 2.9
Corporate neighbours		
Midwest Corporation Ltd	Discussion regarding the potential for an infrastructure corridor; baseline data sharing; cumulative impact assessment; fauna survey data.	Cumulative Impact Assessment addendum document, Volume 2
Asia Iron Ltd	Discussion regarding potential joint access for linear infrastructure within Geraldton Southern Transport Corridor (GSTC).	Section 6.10.1
	Discussion regarding potential sharing of major Power Infrastructure.	
Indigenous groups		
Widi Mob	Discussion of the significance of the southwest tip of Mt Karara.	Section 7.2.9 and 8.15
	Site visit to Karara. Archaeological and ethnographic surveys in relation to proposed exploration drilling programs.	Section 7.2.9 and 8.15
Widi Binyardi	Discussion of the southwest tip of Mt Karara.	Section 7.2.9 and 8.15
Interested groups and organisations		
Conservation Council of WA & Wildflower Society of WA	1. Dust impacts and management. 2. Surface water and drainage management. 3. Landform characterisation. 4. Fauna response plan, if appropriate. 5. Presence of significant flora. 6. Impacts to visual amenity of landforms. 7. Banded Iron Formation Review and PER.	1. Section 7.2.5 & 8.11 2. Section 8.6 3. Section 6.1.3 4. Section 8.4 5. Section 6.2.2, 6.3.1 & 6.4.1 6. Section 7.2.3 7. Section 1.4.5
Western Australian Museum	Discussion and recommendations regarding survey methodology for short-range endemics and stygofauna assessment.	Section 8.4 & Volume 2
Landcare - Morawa	Potential establishment of a horticultural nursery, as a new business, in the shire to assist KML with mine rehabilitation requirements.	Volume 2

Table 5.2 Stakeholder Discussions (cont'd)

Stakeholder	Matters Discussed and/or Issues Raised	Reference Relevant KIOP PER Section or Other
Utility and infrastructure groups		
Geraldton Port Authority	Introduction to the project and discussion of the options for shipping facilities at the Port of Geraldton and the requirements of Geraldton Port Authority re project approvals, licensing and Works Approval requirements.	Section 1.1
Landcorp	Proposals for land request at Narngulu.	Section 6.12.1
	Proposals for Oakajee Port.	N/A
Public Transport Authority	Discussion of the proposed rail siding developments for KML and Midwest Corporation Ltd.	Mungada (MIOP) PER
	Discussion regarding access to Tilley – Koolanooka Rail Corridor.	
Verve Energy	Discussion regarding 15-year Power Supply Agreement.	
Western Power	Connection to existing South West Interconnected System (SWIS) corridor alignment. Power upgrade requirements. Approvals process. Ownership and maintenance.	Section 2.1.2
WestNet Rail	Discussion of the proposed Tilley rail siding development.	Mungada (MIOP) PER
	Discussion of rail infrastructure capabilities.	Chapter 1
Water Corporation	Potential user of return water. Recycling and reuse opportunities.	Sections 2.1.2, 2.9 & 8.6
Local government authorities		
Shire of Morawa	Discussion regarding potential power line easement.	Chapter 1
Shire of Perenjori	Discussion regarding potential power line easement.	Chapter 1
Shire of Mingenew	Test bore pumping information.	Section 2.9
	Discussion regarding potential power line easement.	Chapter 1
Shire of Greenough	Discussion regarding potential power line easement.	Chapter 1
Shire of Irwin	Discussion regarding potential power line easement.	Chapter 1
State government agencies		
Department of Environment and Conservation	Introduction to the project and discussion of potential impacts as a result of the project. Main issues raised: • Flora issues related to the development within the minesite area; • Regional implications; and • Potential impacts on the conservation parks proposal.	Sections 7.3.3, 7.4.3 & 7.5.2
	• Road safety and public access routes.	Sections 7.2.7 & 8.14
	• Rare and protected flora at the minesite.	Section 6.2.2
	• Flora survey methodology with DEC specialist.	Section 8.3.4 & Volume 2
	• The requirement for spring flora surveys and methodology.	Section 8.3.4
	• The importance of species definitions in the PER.	Section 8.3.4
	Fauna survey methods and findings to date, particularly in regard to Malleefowl, Skinks, short-range endemics, and subterranean fauna.	Section 7.3.3 & Volume 2

Table 5.2 Stakeholder Discussions (cont'd)

Stakeholder	Matters Discussed and/or Issues Raised	Reference Relevant KIOP PER Section or Other
DEC cont'd	KIOP's total water requirements and operational philosophy.	Section 2.9
	Ideas for environmental offsets proposals.	Chapter 9
	Flora surveys and plant species of interest.	Section 6.2.2
	Flora baseline and impact assessment reports for the Mungada Ridge Hematite Project minesite.	Mungada (MIOP) PER
	Discussion of cumulative impact assessment process for flora and fauna.	Cumulative Impact Assessment document, Volume 2
	Part V licensing (i.e. water sources and wastewater issues, discharge etc.).	Section 1.4
Department of Industry and Resources	Discussion of the proposed Midwest Corporation Ltd and KML rail siding developments.	Mungada (MIOP) PER
	Waste rock dump design and resistance to erosion.	Section 2.4
	Acid mine drainage potential of waste rock.	Sections 2.2 and 2.4
Department of Planning and Infrastructure – Perth	Discussion of the proposed KML and Midwest Corporation rail siding developments.	Mungada (MIOP) PER
	Discussion regarding Rail Transport Strategy.	Chapter 1
	Discussion regarding Port options.	Chapter 1
Department of Water – Perth	Water Extraction Licence application and clarification on the Karara Iron Ore Project's total water requirements and operational philosophy.	Section 2.9
	Water allocation policy and constraints.	Section 2.9 & Volume 2
Department of Water – Geraldton	KML intention to lodge a Water Extraction Licence application for the Dandaregan Sub Area Yarragadee Aquifer. DoW suggested that KML would be more successful with applications made for water extractions from the Mingenew and Twin Hills aquifers.	Section 2.9
Department of Housing and Works	Access above the Geraldton Southern Transport Corridor.	Section 6.10.1
Department of Health	Introduction to the project and identification/clarification of Department of Health approvals requirements.	Section 1.4
Environmental Protection Authority	Vegetation and flora impacts.	Sections 7.3.2, 7.4.2, 7.5.1 & Volume 2
	Seasonal timing of vegetation and flora surveys.	Section 8.3.4
	Fauna impacts.	Sections 7.3.3, 7.4.3, 7.5.2 & Volume 2
	Cumulative Impact Assessment expectations.	
	Weed quarantine.	Section 8.8
	Rehabilitation.	Section 8.5 & Volume 2

Table 5.2 Stakeholder Discussions (cont'd)

Stakeholder	Matters Discussed and/or Issues Raised	Reference Relevant KIOP PER Section or Other
Environmental Protection Authority cont'd	Discussion of PER approval process and timelines.	Section 1.4.4
	Fauna survey methods and report for minesite. Fauna species of interest and whether additional surveying would be required. Additional surveying for Woolley's pseudoantechinus and the Shield-backed Trapdoor Spider is warranted.	Section 6.2.3 & 7.3.3
	Magnetite Environmental Scoping Document approved subject to minor revisions, including need for spring surveys and cumulative impact assessment.	Cumulative Impact Assessment addendum document
	BIF review and impact on proposal	Section 1.4.5
Office of Development Approvals Coordination	• Current uncertainty over power supply source requires clarification within the Environmental Scoping Document and PER.	Section 2.7.9
	• Potential concerns to remnant vegetation impacts caused by slurry pipeline construction.	N/A
	• Discussion pursuant to impact minimisation on identified BIF ranges. Impact of BIF review on KIOP.	Section 1.4.5
	• Request to discuss resource locations and prospectivity of leases in the PER.	Section 1.4.5
	• Survey requirements for short-range endemics.	Section 6.2.3 and 7.3.3
	• Need for technical input from DEC specialist (N Gibson) on regional BIF flora survey data.	Section 8.3.4
	Project Definition Document. Discussion of water supply source, allocation, return water quality and possibility of reuse by other parties.	Section 2.9
	Meeting to discuss Works Approvals required for the KIOP. DoIR and DEC regional representatives present.	Section 1.4.4
	Discussion of slurry pipeline easement crossing numerous road reserves and other areas of Crown land; ODAC to assist with these approvals. Discussed water supply allocations.	N/A
Commonwealth government agencies		
Department of the Environment, Water, Heritage and the Arts.	Discussion regarding the proposal's potential to trigger any aspect of the *Environment Protection and Biodiversity Conservation Act 1999*.	Section 1.4.2
Federal Government Mining/Indigenous Workshop	Workshop and Steering Committee Meetings in regard to industry/government initiative to pursue indigenous employment and business development initiatives in the Mid-West Region.	Section 8.15
Department of Industry Tourism and Resources	Workshop and Steering Committee Meetings in regard to industry/government initiative to pursue indigenous employment and business development initiatives in the Mid-West Region.	Section 8.15

6

PUBLIC**ENVIRONMENTAL****REVIEW**

description of existing environment

6 Description of Existing Environment

6.1 Existing Environment - Project wide

6.1.1 Project Setting

The Karara Iron Ore Project (KIOP) minesite lies within the Shire of Perenjori, on the former Karara Pastoral Lease. This pastoral lease was purchased by the Department of Conservation and Land Management (CALM) in 2002 and is currently managed by the Department of Environment and Conservation (DEC) for conservation purposes under section 33 (2) of the *Conservation and Land Management Act 1984* (CALM 2003). The lease is subject to mining tenements held by KML and its related corporate entities. The minesite area is relatively isolated with the nearest residence being the currently unoccupied Old Karara Homestead, approximately 7 km from the site. The closest towns to the site are Perenjori, Morawa, and Mingenew (approximately 65 km southwest, 75 km west, and 130 km west respectively).

The linear infrastructure corridor (LIC) runs across the Shires of Perenjori, Morawa and Mingenew, with the closest town to the LIC being Mingenew. The mine access road runs through the Shires of Perenjori and Morawa.

The KIOP minesite is located within the Yalgoo Bioregion of the Interim Biogeographic Regionalisation for Australia (IBRA) classification system. This region is described as an interzone between the South-Western and Murchison bioregions, characterised by low woodlands to open woodlands of *Eucalyptus*, *Acacia* and *Callitris* on red sandy plains of the western Yilgarn Craton and southern Carnarvon Basin. The Yalgoo Bioregion falls within Bioregion Group 2 as listed within the EPA Guidance Statement No. 56 (EPA 2004d).

6.1.2 Climate

The climate at the project site is described as being extra-dry Mediterranean, characterised by seven to eight months of dry weather with cold, wet winters and hot, dry summers (Payne et al. 1998). The temperature data is based on averages from Bureau of Meteorology (BoM) automatic weather stations (AWS) (Morawa, Mount Magnet, Paynes Find, Carnamah) located in the region surrounding the project area. The Karara BoM AWS, which is approximately 9 km southwest of the minesite, was not incorporated because it only obtains rainfall data (Appendix 5 and Appendix 7). Average daily minimum and maximum temperatures during the warmer months (November to April) are 13°C and 38°C respectively, while in cooler months (May to October) average daily minimum and maximum temperatures are 5°C and 29°C respectively (Figure 6.1) (refer Appendix 7).

The prevailing winds of the project area are based on the Morawa BoM AWS (Figure 6.2) and The Air Pollution Model (TAPM) generated seasonal wind roses for the minesite (Figure 6.3) (refer Appendix 7). The interpretation of these windroses are summarised below.

The prevailing winds at Morawa are:

- in summer, the dominant wind direction is from the south;
- in autumn, the dominant wind direction is from the east;
- in winter, the dominant wind direction is from the west; and
- in spring, the dominant wind direction is from the south.

The prevailing winds at the minesite are:

- in summer, the dominant wind direction is from the south-southeast through to the south-southwest;
- in autumn, the dominant wind direction is from the east;
- in winter, the dominant wind direction is from the southeast and east-southeast; and
- in spring, the dominant wind direction is from the southern quadrant.

The average yearly rainfall for the minesite is 300-400 mm, the wettest month being June. The average monthly rainfall is presented in Figure 6.1. A one-in-100-year, 72-hour rainfall event can generate 170 mm of rain (Appendix 5). As for Morawa, the average annual rainfall is 333 mm, ranging from an average monthly rainfall during December of 8 mm to 60 mm during June (Figure 6.1). Extreme rainfall events (i.e. a 1-in100-year, 72-hour rainfall event) can be expected to generate 160 mm of rain (BoM 2008).

6.1.3 Soil Quality, Stability and Land Systems

Landloch Pty Ltd (Landloch) undertook a soil survey of the KIOP minesite area. Figure 6.4 shows the extent of the area surveyed. The objectives of the study were to characterise the soils, identify soils requiring specific management measures (e.g. sodic or dispersive soils) and provide guidance in relation to soil management for rehabilitation. This section summarises the findings of the assessment. Landloch's detailed survey report is included as Appendix 4.

Site inspections were conducted over the minesite areas to identify the major soils of the area and to determine their relationship with the landscape. Sampling locations were selected on the basis of planned areas of disturbance, aerial photo interpretation, distribution of vegetation, and location in the landscape. Greater sampling density was applied in areas to be stripped during project development and operation (that is, proposed pits, waste dumps and infrastructure areas), as these areas will be the main source of materials used for rehabilitation.

A land systems approach was adopted for the study because of the large area to be assessed. While not identifying accurate soil boundaries, the land systems approach provides information on the relationship between the landscape and the soils present. Land in the minesite areas was subsequently divided into three land systems based on differing landform, abundance of rock, and soil characteristics. Figure 6.4 shows the distribution of the three land systems.

Land Systems

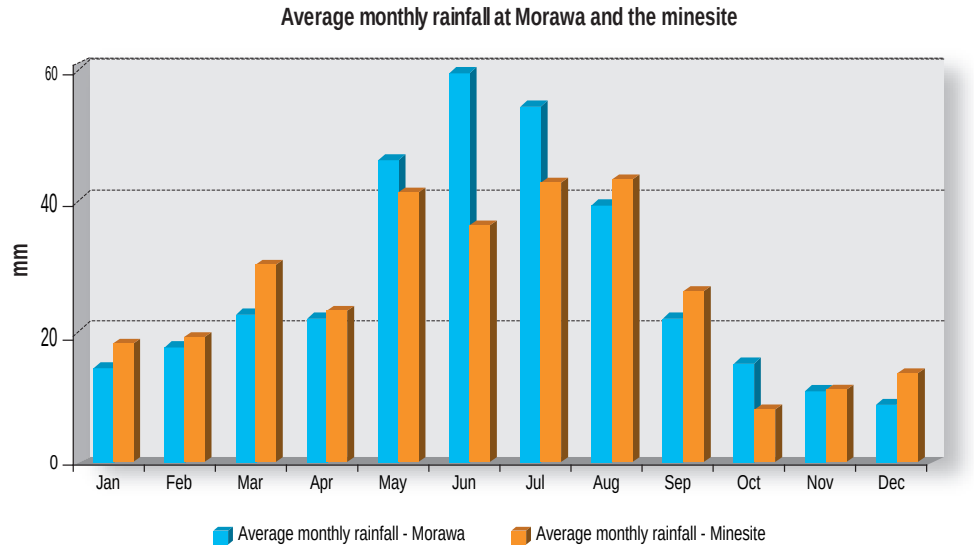
The land in the minesite area consists of steep hills to steep low hills surrounded by rolling low hills and undulating rises and plains. The upper slopes of the hills are steep with some scree slopes and cliff faces. The mid slopes are moderately inclined, and the lower slopes merge into the plains.

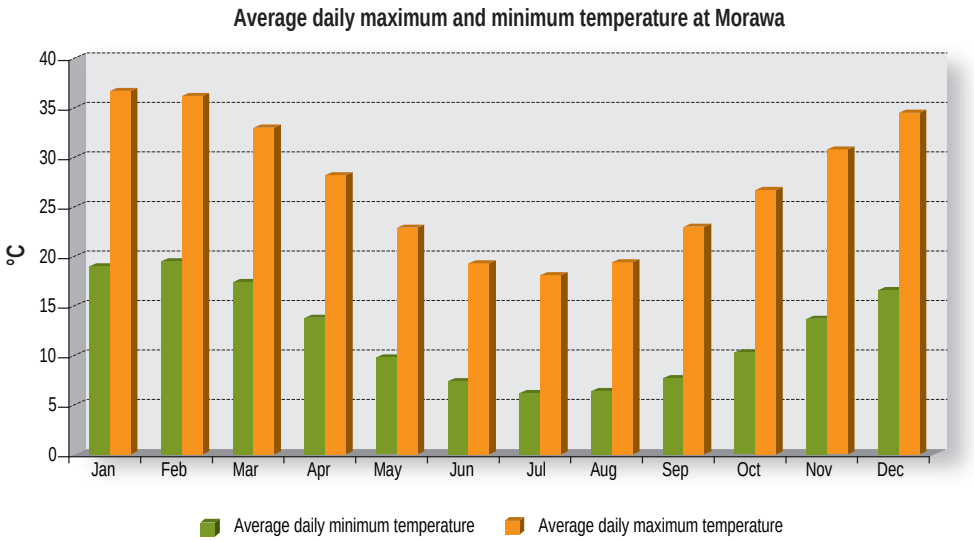
The three land systems identified by Landloch are:

- Land System 1 – crests, upper and mid slopes of the rolling low to steep hills. These areas are generally found on top of the main ridges in the minesite area. Gradients range from 1% to 5% for the crests and 10% to 40% for the upper and mid slopes.
- Land System 2 – lower slopes of the rolling low to steep hills and the undulating low hills and rises. This land system encompasses both the lower slopes of the main ridges and the low hills in their entirety. Gradients range from 3% to 10%.
- Land System 3 – level to gently undulating plains. This system includes all level areas surrounding the rolling low to steep hills and the undulating low hills and rises. It includes the playa lakes (claypans) in the northwest and the northern part of the study area. Gradients range from 1% to 3%.

Detailed descriptions of the characteristics of the three land systems can be found in Appendix 4.

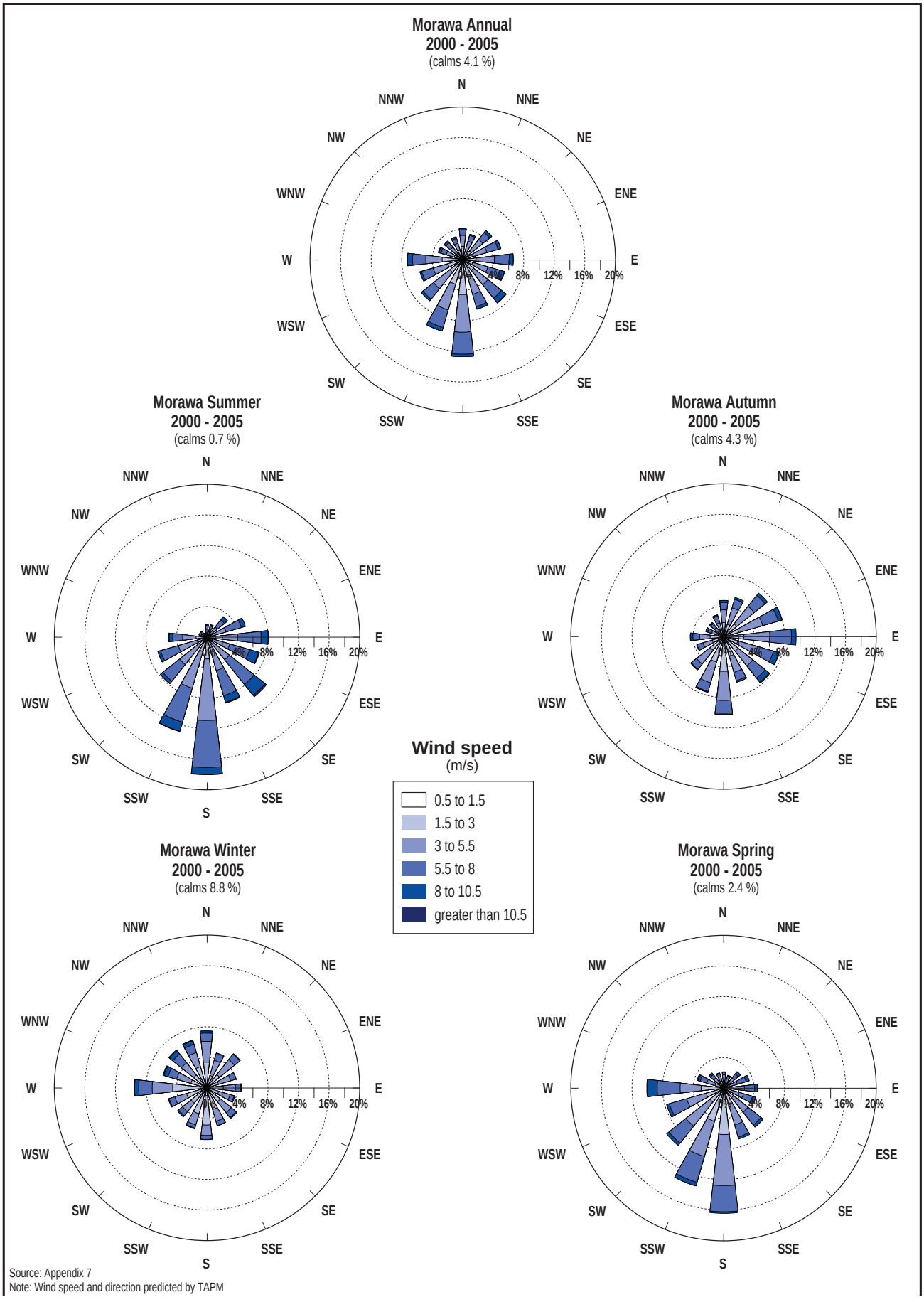
Figure 6.1 Average monthly rainfall (Morawa and minesite) and temperature (Morawa)





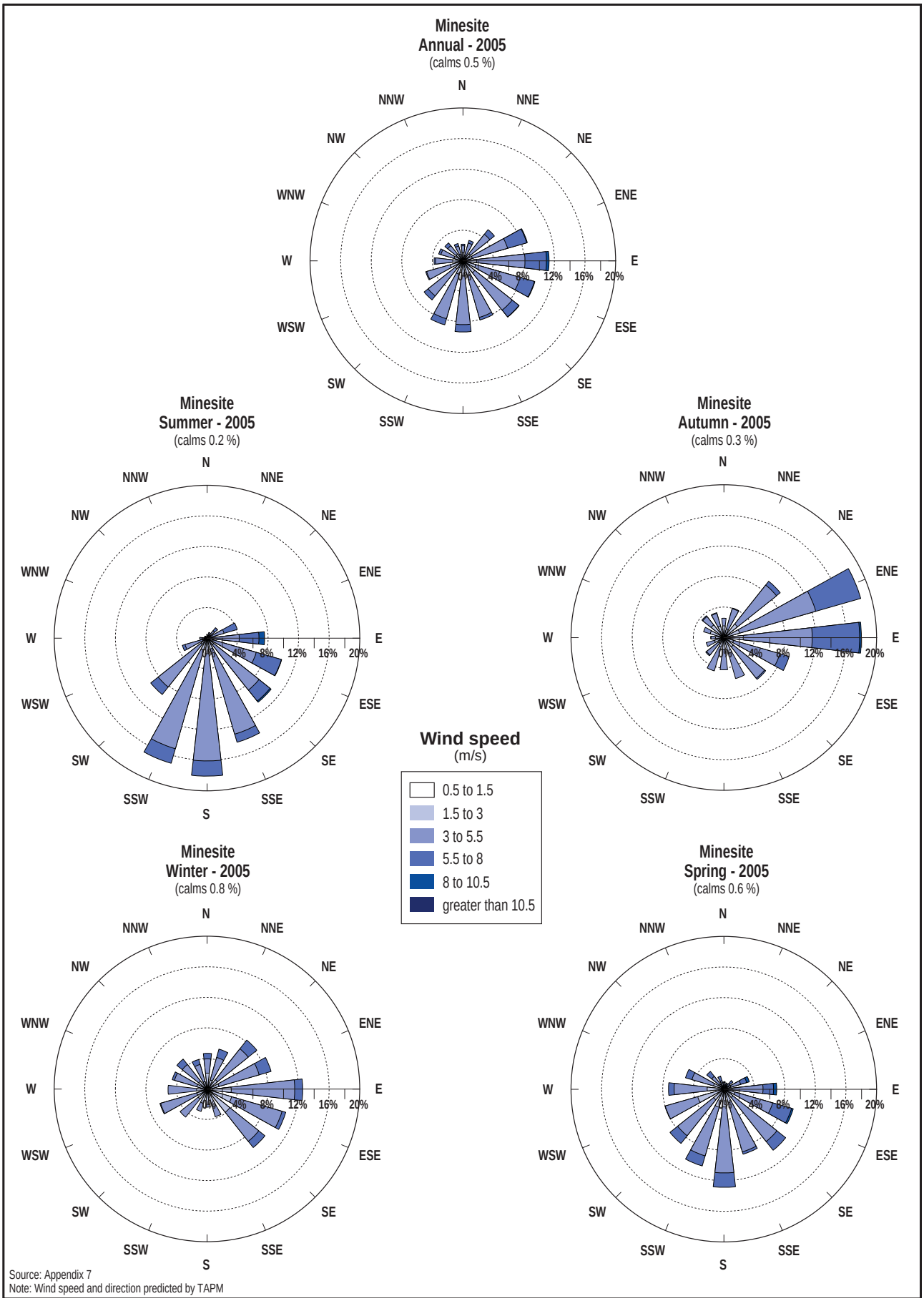
Source: BOM 2007. Data record 1925 - 2005

Figure 6.2 Morawa wind roses



Source: Appendix 7
Note: Wind speed and direction predicted by TAPM

Figure 6.3 Minesite wind roses



Source: Appendix 7
Note: Wind speed and direction predicted by TAPM

Minesite Soil Properties

Soil profiles were observed and described in detail at 36 sites, and observations were made at a further five sites where the soils were similar to those already described (for a total of 41 sites).

Analyses of selected soil samples show that the minesite soils generally have low fertility. Based on site observations of vegetation biomass, it appears that the local vegetation is well adapted to the existing surface soil pH and nutrient levels. The vegetation showed no visible symptoms of trace element deficiency.

Data from the assessment indicates that soils in the minesite area are broadly distributed as three soil groups, which are described below.

- Soils developed on crests and ridge tops in Land Systems 1 and 2 (Plate 6.1 and Plate 6.2) are generally shallow to very shallow and consist of very gravely red loamy to clay-loamy massive soils. The surface of these soils is hardsetting and is dominated by ironstone fragments (20 mm to 600 mm in diameter) or outcropping. These coarse fragments occur throughout the soil profile, resulting in well-drained soils with moderate permeability. Soils are generally acidic (topsoil pH of 5.5 to 7.0 and subsoil pH of 5.0 to 6.5) with low salinity levels.

- Soils developed on the crests and upper slopes of Land System 2 (Plate 6.2) are shallow and consist of very gravely, red, clay-loamy soil while soils developed on the mid to lower slopes of Land System 2 are deeper and consist of very gravely, red, loamy to clay-loamy soils. The soil surface of Land System 2 is hard setting and dominated by ironstone fragments up to 60 mm in diameter. Some quartz or rock outcropping may be present in steeper areas. Soils of Land System 2 contain coarse rock (usually ironstone) fragments throughout the soil profile, resulting in well-drained soils with moderate permeability. In addition, these soils exhibit a water-repellent character. Topsoils are generally acidic (pH 5.1 to 7.3) while subsoils have a highly variable pH. Salinity levels are satisfactory to depths of 500 mm to 900 mm.

- Soils developed on Land System 3 (Plate 6.3) occur as a mosaic of seven different soil types and two different soil phases. Soils 1 to 4 represent the majority of Land System 3 but are not able to be mapped discretely using the current information. Soils 5 to 7 are mapped in Figure 6.4. A brief description of each soil type is provided below.

    - *Soil 1.* Deep, red, gravely clay-loamy to clay soils on pediments and plains. Surface is hardsetting, may develop a surface crust and is prone to sheet erosion.

    - *Soil 2.* Very alkaline, shallow sandy-clay-loamy to clay-loamy soil over hardpan. Occurs on lower plains, and vegetation is usually sparser than on deeper soils. Surface is hard setting and prone to sheet erosion, and soil is poorly drained.

    - *Soil 3.* Shallow, very gravely, red clay-loamy soil on slightly elevated plains and low crests. Surface is firm or hard set and not prone to erosion.

    - *Soil 4.* Deep, alkaline, red, structured and massive clay-loam to light soils in broad, open depressions. Often more saline than other soils. Eucalypts dominate the vegetation. Surface is firm or hard set and not prone to erosion.

    - *Soil 5.* Moderately deep to deep, red, sandy-loam soils with ironstone on gently undulating plains. Surface is hardsetting and not prone to erosion.

    - *Soil 6.* Shallow to moderately deep, alkaline sand to sandy-loam soils on plains. Surface is soft and rapidly drained.

    - *Soil 6a.* A phase of Soil 6. Shallow, alkaline sand to sandy-loam soils on slightly elevated plains with many to abundant surface pebbles and cobbles.

Figure 6.4 Minesite land systems and soils

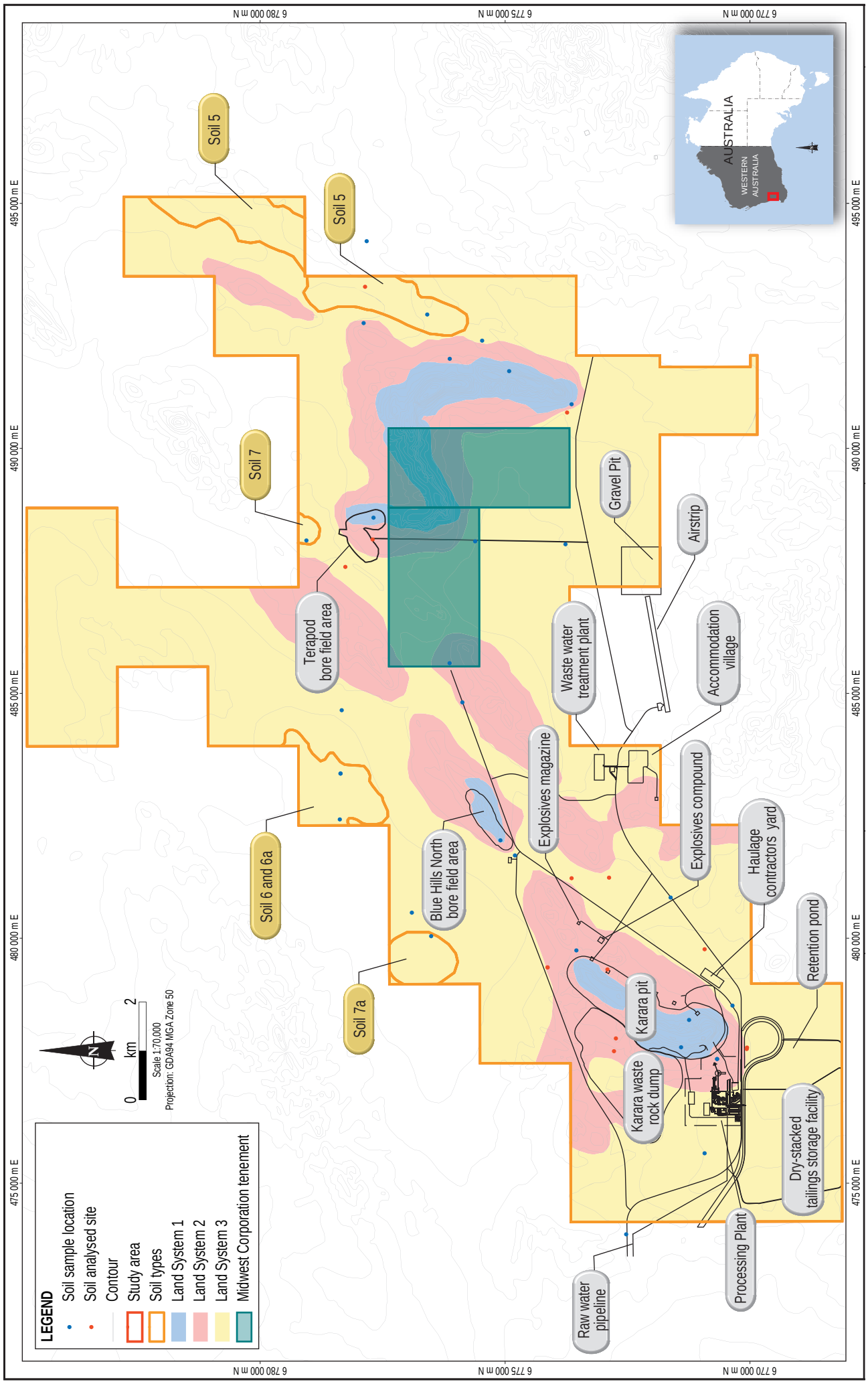


Plate 6.1 Minesite typical soil profile: Land System 1

Plate 6.2 Minesite typical soil profile: Land System 2

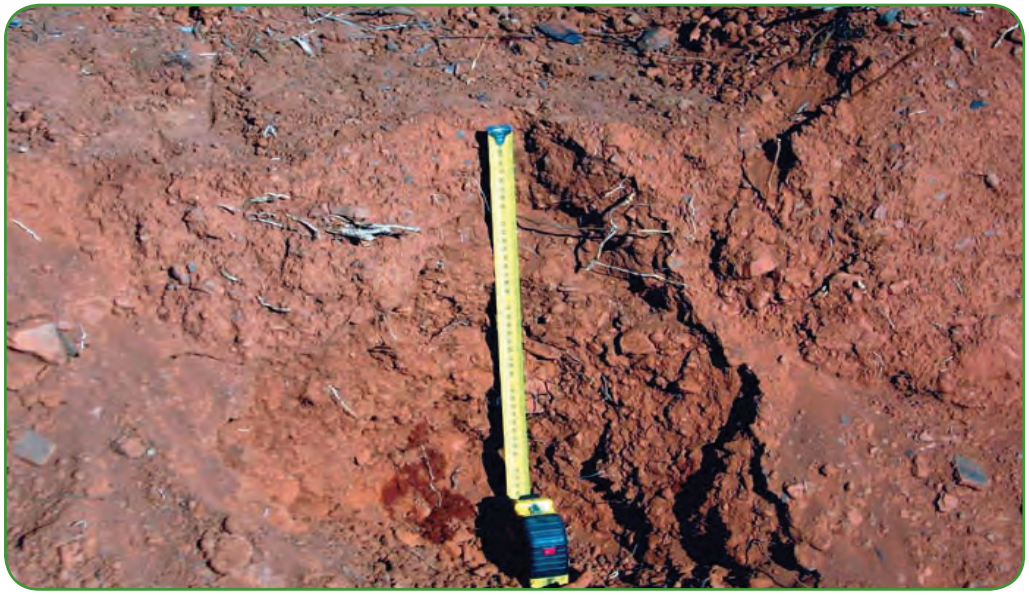
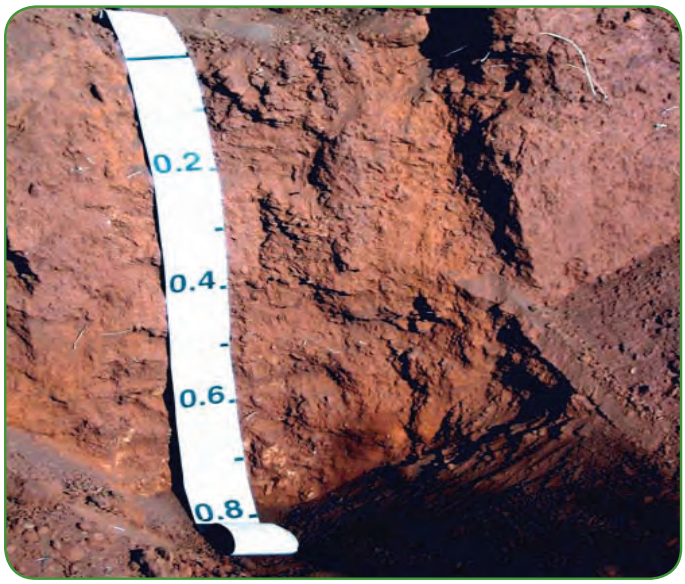


Plate 6.3 Minesite typical soil profile: Land System 3



- *Soil 7.* Shallow, non-saline clay soil over pan on playa (claypan) with no vegetation. Surface is hard setting and very poorly drained.

- *Soil 7a.* A phase of Soil 7. Moderately deep, saline clay soil over pan on playa (claypan) with salt-tolerant shrubs.

In general, the soils of Land System 3 tend to be more saline (below depths of 300 mm), dispersive, and erodible but also have greater potential productivity due to higher plant-available water capacity and possibly fertility.

The geology underlying the LIC is shown in Figure 6.5. The corridor has been divided into geomorphological units that correspond to the underlying geological units.

Soil and land systems (as mapped by the Department of Agriculture in Western Australia) traversed by the LIC are shown in Figure 6.6a and Figure 6.6b. The characteristics of each zone are presented in Table 6.1.

Soil-landscape systems traversed by the access road (as mapped by the Department of Agriculture in Western Australia) are characterised in Table 6.2.

Soils from six borrow pits located along the access road route were tested by Graeme Campbell and Associates for salinity and potential acidification (Appendix 1). All samples tested were geochemically benign and devoid of sulphide minerals. One sample tested (from the rail siding area) was saline, possibly due to accumulation of salts from historic road watering for dust suppression.

6.1.4 Surface Water

A report on surface water for the KIOP has been prepared by MWH (Appendix 5).

Mt Karara is a semi-arcuate ridge that is part of the Blue Hills Range formed by Banded Iron Formation (BIF). It extends from an elevation of about 340 m AHD at its base to a peak of about 440 m AHD. The ridge is part of a catchment divide with most drainage to the west and south along poorly-defined, ephemeral drainage lines that lead towards Mongers Lake; and with minor drainage to the north to tributaries of the same drainage system.

The KIOP is within the Yarra Yarra Catchment Basin as shown in Figure 6.7. This Basin has an area of 41,880 km^2, with catchments draining southwards via a series of inter-connected salt lakes to Yarra Yarra Lakes near Carnamah.

The catchments surrounding the minesite are shown in Figure 6.8 and their areas are listed in Table 6.3. For all these catchments, runoff flows to claypan areas that are lower than the surrounding land. In general, these claypans are sparsely vegetated, except for the gilgai formation, east of Karara, that is host to a stand of Melaleucas (see Section 6.2.2 for more information). Water will overflow to other catchments if the storage capacity of the claypan is exceeded. The table shows the lowest point of each claypan and the level at which water would overflow to another catchment (the spill point). Also shown is the storage volume available below the spill point.

Table 6.1 LIC land system characteristics

Km from mine	Land System	Landform	Geology	Soil
1–42	NA	NA	NA	Red deep sand, red loamy earth, red shallow sand, Yellow deep sand, red loamy earth, red shallow loam, salt lake soil.
43–78	Pindar System	Gently undulating sandplain with long, gentle slopes.	Eluvial and colluvial sands and gravels weathered from laterite.	Yellow sandy earths, yellow deep sands and red shallow sands.
	Koolanooka System	Range of rolling to very steep low hills with gently inclined footslope.	Colluvium, sedimentary and volcanic rocks.	Bare rock, stony soil, red loamy earths, red-brown hardpan shallow loams.
	Bowgarder System	Undulating rises and gently inclined slopes.	Colluvium, basalt and ultramafic volcanic rocks.	Red loamy earths, red sandy earths, red-brown hardpan shallow loams and bare rock.
	Noolagabbi System	Extensive level flats to very gently inclined slopes in broad valleys with often saline associated drainage networks.	Alluvium and colluvium.	Red-brown hardpan shallow loams and red loamy earths.
	Morawa System	Gently undulating low rises and ridges and gentle upper slopes.	Colluvium, granite and gneiss.	Red and yellow loamy earths, red shallow sands.
79–89	Saline Drainage System	Narrow drainage lines to broad, level salt plains in broad mature valleys.	Alluvium.	Salt lake and saline wet soils, red-brown hardpan shallow loams and red loamy duplexes.
90–93	Noolagabbi System	Extensive level flats to very gently inclined slopes in broad valleys with often saline associated drainage networks.	Alluvium and colluvium.	Red-brown hardpan shallow loams and red loamy earths.
94–95	Mount Nunn System	Rolling to steep low hills with rocky crests and long, gently inclined sandy footslopes.	Basalt and footslope sand deposits.	Yellow and red deep sands, stony soils, yellow sandy earths.
96–113	Dalgooka System	Gently undulating terrain with numerous low rocky rises and low, narrow limestone ridges intersecting gentle slopes and flat areas	Colluvium, calcrete, laterite, chert, dolomite, siltstone, shale, quartz arenite, pebble.	Yellow deep sands, yellow sandy earths and loamy duplexes and gravels.
114–131	Mount Scratch System	Line of rolling, low hills and gently inclined footslopes.	Colluvium, siltstone, tillite, shales and conglomerate.	Red shallow loamy duplexes and earths, calcareous loamy earth with some yellow deep sand.
	Mullingarra System	Undulating to steep low hills with numerous rocky ridges and hillcrests.	Colluvium, gneiss.	Red deep and shallow sandy duplexes, with loamy duplexes and shallows loams.
	Yandanooka System	Level to very gently inclined alluvial plain with meandering drainage network, some footslopes.	Alluvium and colluvium, minor sandstone.	Alkaline red shallow loamy duplexes, hard cracking clays, red sandy and loamy earths.
132–140	Mount Horner System	Level to very gently inclined alluvial flats and terraces.	Alluvium, granite and sandstone.	Red sandy earths, sandy duplexes with self-mulching cracking clays and red loamy earths.

Figure 6.5 Geological composition along the linear infrastructure corridor

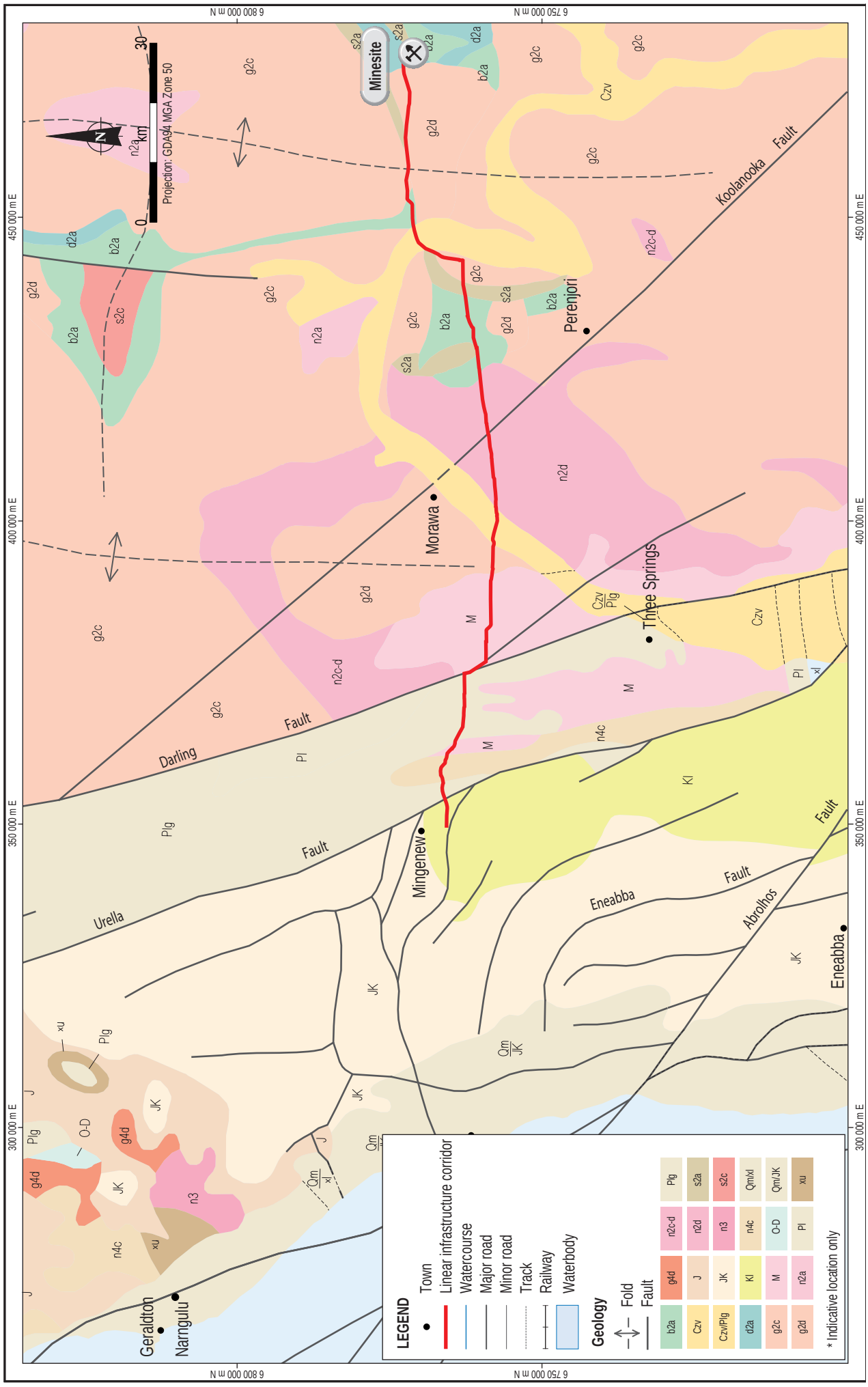
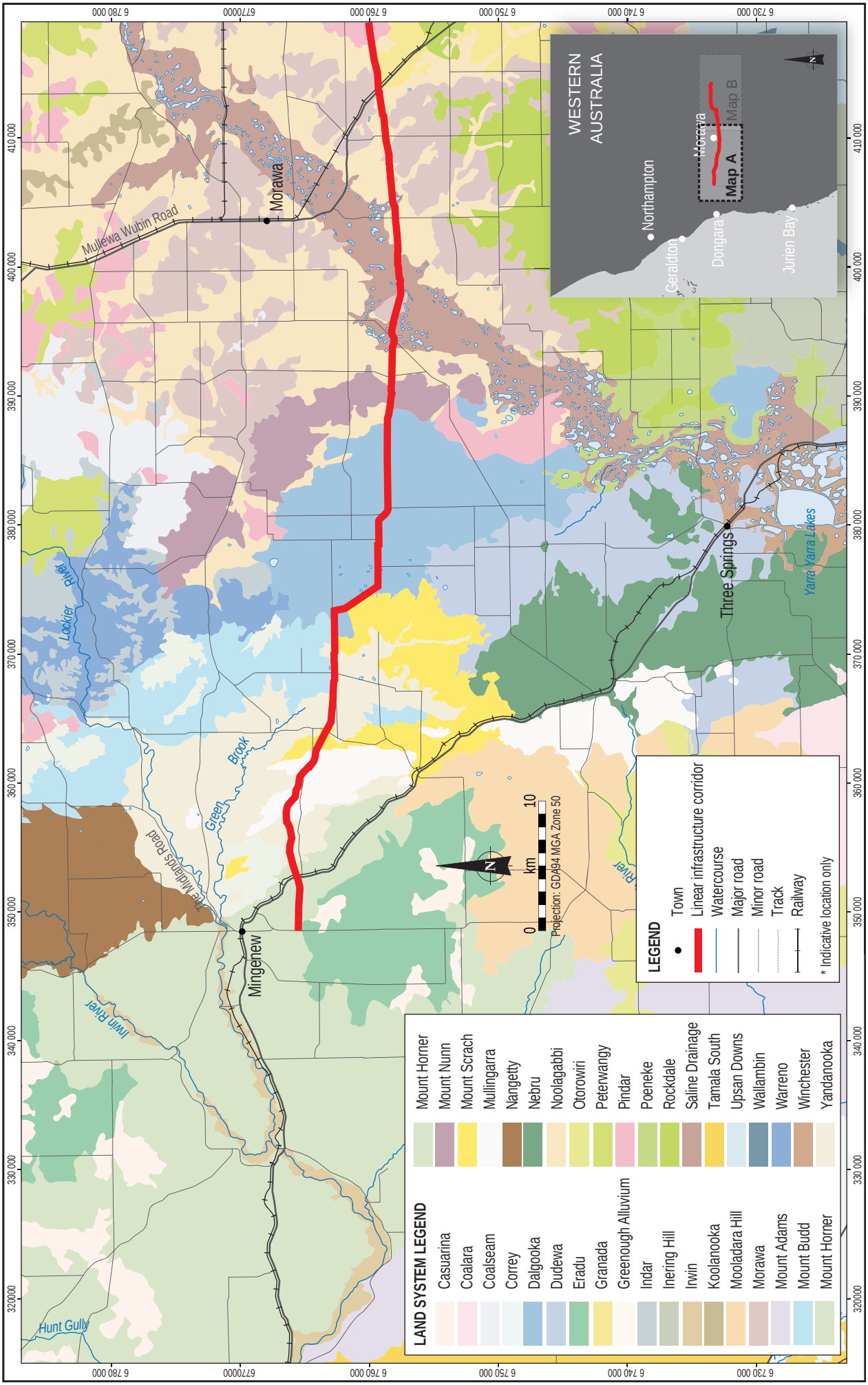


Figure 6.6a Soil landscape zone along the linear infrastructure corridor



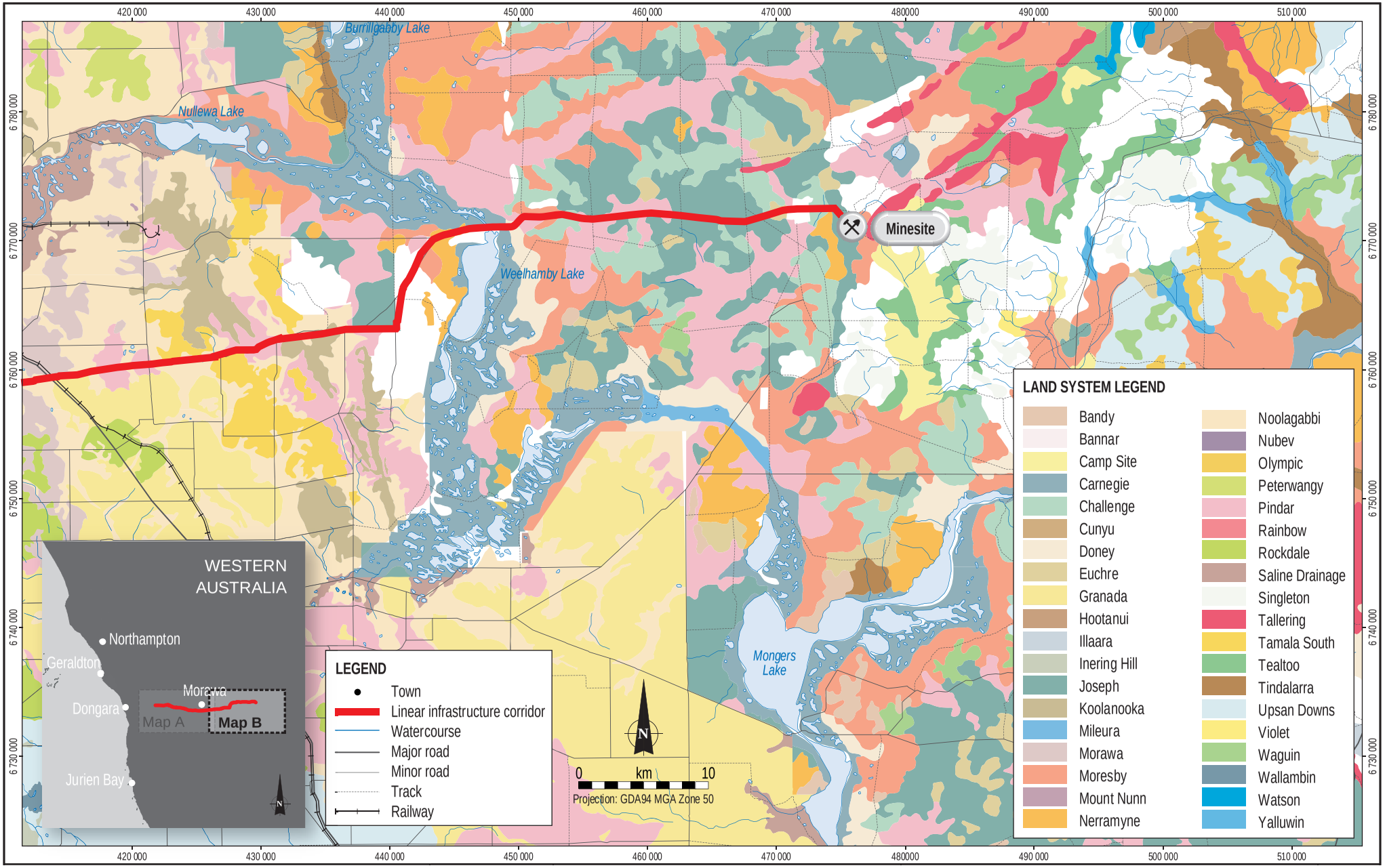


Figure 6.6b Soil-landscape zones along the linear infrastructure corridor

Table 6.2 Soils and land systems along the access road

System	Landform
Tallering	Prominent ridges and hills of banded ironstone, dolerite and sedimentary rocks.
Yowie	Extensive plains with sandy surfaces (similar to Desdemona but with denser tall shrubs and less wanderrie grass).
Tealtoo	Level to gently undulating plains with gravely mantles.
Pindar	Gently undulating sandplain with long gentle slopes.
Joseph	Undulating yellow sandplain with very dense mixed shrublands.
Challenge	Gently undulating plains with occasional hills, tors and breakaways on granite.
Euchre	Low breakaways with short saline footslopes.
Doney	Level to very gently inclined plains (mainly eucalypt woodlands).
Carnegie	Salt lakes with fringing alluvial plains and dunes of kopi or sand.
Nerramyne	Plains and low rises on weathered granite above sandy drainage plains.
Noolagabbi	Extensive level flats to very gently inclined slopes in broad valleys with often saline associated drainage networks.
Bowgarder	Undulating rises and gently inclined slopes.
Koolanooka	Range of rolling to very steep low hills with gently inclined footslope.
Saline Drainage	Narrow drainage lines to broad, level salt plains in broad mature valleys.
Morawa	Gently undulating low rises and ridges and gentle upper slopes.

Table 6.3 Catchment area data

No.	Area (km^2)	Lowest Point RL (m)	Spill Point RL (m)	Storage Volume (m^3)	Peak RL 100 yr ARI (m)
1	70	340.5	347.0	11,060,885	344.4
2	230	332.5	343.0	177,948,650	334.9
3	174	342.5	347.5	4,994,058	347.5
4	43	356.5	362.0	8,886,775	358.4

Due to the absence of a long-term rainfall record at the minesite, Hydstra Time Studio modelling software, recommended in the Australian Rainfall and Runoff (a guide to flood estimation published by Engineers Australia), was used to design all rainfall events. It was determined that:

- a one-in-100-year, 72-hour rainfall event can generate 170 mm of rain; and
- in no case was the catchment spill point exceeded. No runoff from the large upper catchment areas will flow into the Karara minesite area. All runoff up to the 100-year ARI event will be held in storage in the claypans until it evaporates or seeps to groundwater.

The mine itself, the process plant, waste rock dump and tailings storage facility are at the top of a separate catchment area, shown in detail on Figure 7.3. The total catchment area is 44.7 km^2 and in contrast to the catchments described above, run off from a 1-in-100 year rainfall event will run south, out of the catchment.

The key surface water features within 10 km of the LIC, based on desktop assessment, are listed in Table 6.4.

Table 6.4 Surface water features within 10 km of LIC

Approximate KP[1]	Feature	Description
3	Granite pavement with gnamma holes	Culturally significant, natural water hole in the granite rock.
3.5	Lizard granite gnamma hole	Culturally significant, natural water hole in a granite pavement.
30–35	Weelhamby Lake	Weelhamby Lake is one of many saline lakes in the Yarra Yarra drainage basin. It is ephemeral, filling during winter and contracting in spring. Water depth in winter is approximately 2 cm (Boggs *et al.* 2007).
75–85	Nullewa Salt Lake and Yarra Yarra salt lake system	The Yarra Yarra salt lake system comprises a chain of hundreds of loosely connected playa lakes and pans. The lakes are shallow and usually comprise an occasionally inundated edge zone and a central zone, which often has a permanent epicrust. (Boggs *et al.* 2007).
110–120	Large drainage crossings	Deep, man-made drainage channels for irrigation purposes.

[1] Kilometre Point (KP) is the distance along the LIC, where KP 0 is at the minesite and KP 140 is the end of the LIC near Mingenew (refer to Figure 6.9).

The access road intersects ephemeral watercourses, including Weelhamby Lake, but does not cross any permanent water features. The gnamma holes described in Table 6.4 above are also within 10 km of the Access Road.

6.1.5 Visual Amenity

The dominant land systems in the minesite area are hills with mixed shrublands and plains with deep, sandy soils. The hills, commonly identified as ridges of BIF, highlight the otherwise flat landscape (Plate 6.4, Plate 6.5 and Plate 6.6). The BIF and shrublands associated with them are in good condition and have been identified as important refuges for flora and fauna species. For many people, this natural environment is also a key component of the visual amenity of these areas.

There are reminders of past land uses in the area, including mining (existing open mine pits and haul roads) and pastoral (grazed understorey, fencing, stock grids and windmills).

Dominant uses of the area today are apparent, with mineral exploration tracks and drill sites visible from Mungada Road. Given the surrounding topography of the project area, a number of publicly accessible visual vantage points may provide views of the minesite for people engaged in recreational off-road activities. These vantage points, however, are limited by the screening provided by roadside vegetation along Mungada Road and by restricted access to the minesite area.

The LIC traverses a variety of land systems and land tenures along its route from the minesite to Mingenew, including pastoral, agricultural and former pastoral leases, now managed for conservation purposes (See Figure 6.9 and Plates 6.7-6.15).

The access road route traverses moderately undulating terrain with mixed pastoral shrublands and flat sandy plains for the initial 57.5 km from the mine. The access road then traverses open farmland for approximately 33 km, dominated by grazing and crop cultivation, predominantly lucerne and wheat. Dominant users of the Munckton and Morawa-Yalgoo roads include existing mine operators and local farmers. Munckton Road is a no through road, hence traffic is generally local and minimal.

Figure 6.7 Yarra Yarra Basin

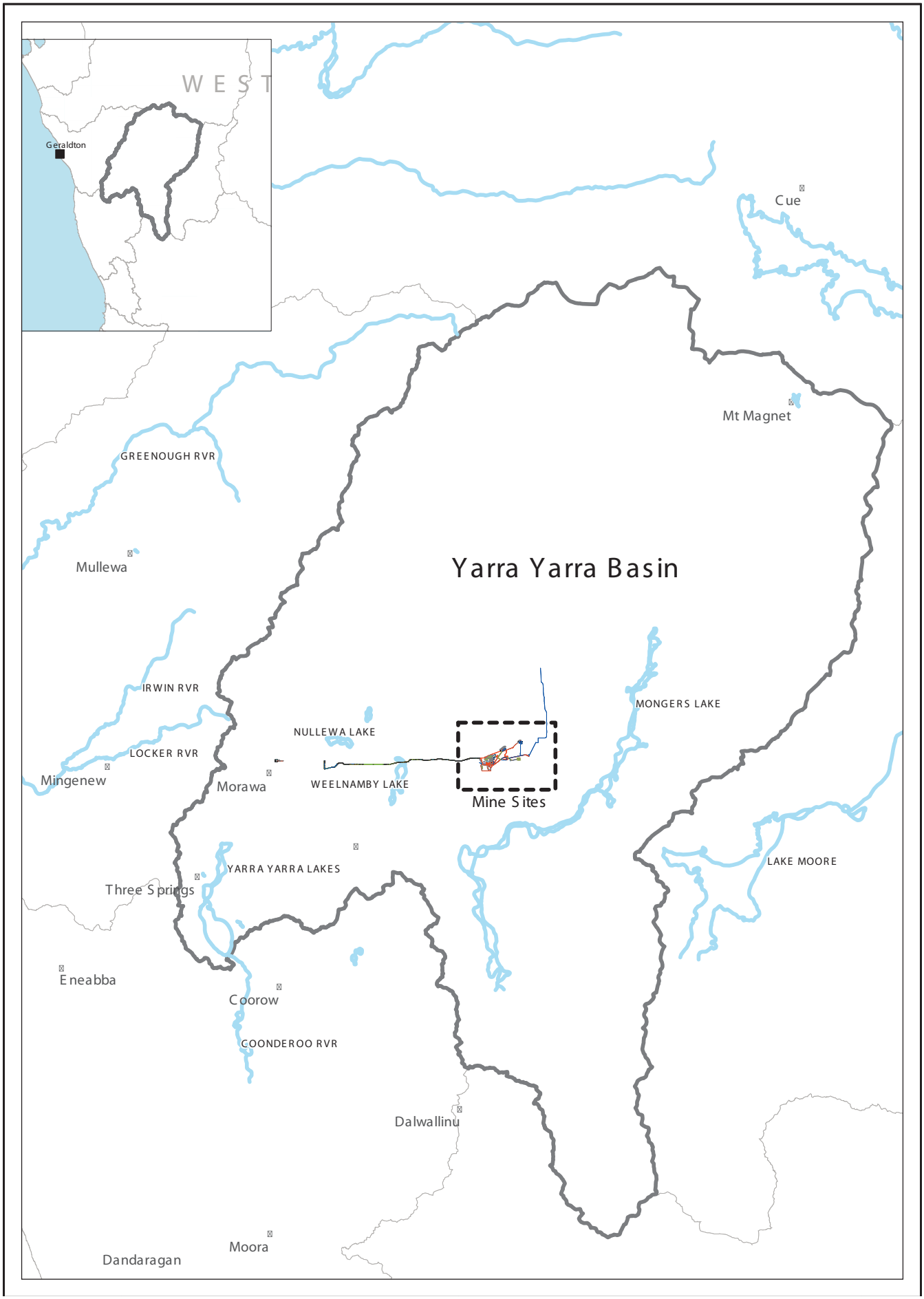
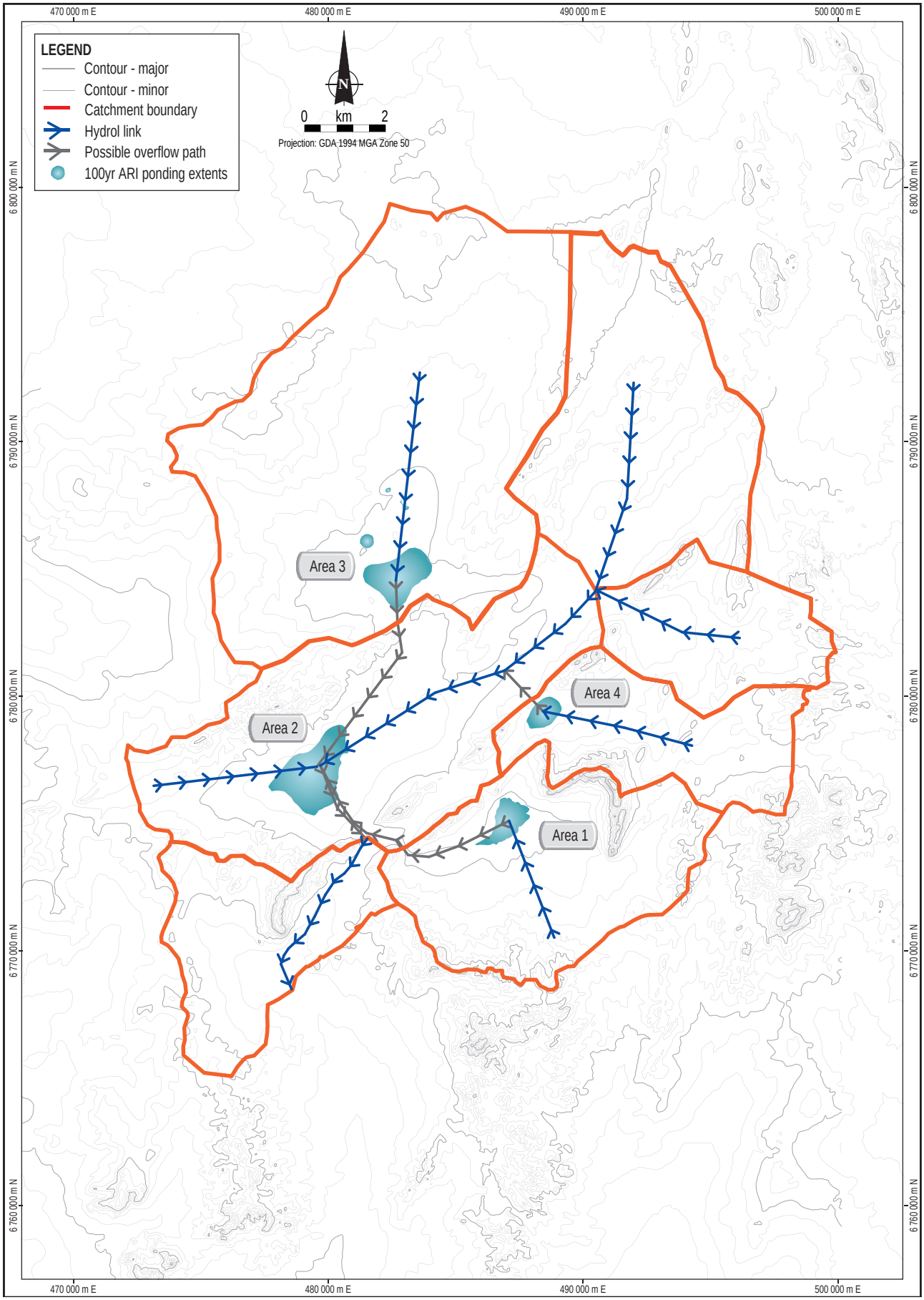


Figure 6.8 Minesite catchment 100yr ARI ponding extents and possible overflow paths



6.1.6 Recreation and Tourism

Several shires in the Mid-West Region, including Perenjori, Morawa and Mingenew, have prepared a cooperative Strategic Tourism Plan in 2002 to develop tourism in the area. This plan aims to 'stimulate economic growth and create employment' (MarkeTrade 2002) and recognises several attractions for tourists in the region (Table 6.5).

Tourism in the region peaks during the wildflower season, which extends from July to October. Wildflower viewing and bushwalking are popular activities during this time, although the carpets of annual flowers, notably *Asteraceae* sp., that predominantly attract tourism and recreation are not always as impressive within the proposed minesite area compared to other parts of the region.

There are no organised or publicised bushwalking trails or wildflower viewing areas in the immediate vicinity of the minesite. A number of nearby towns are developing wildflower walks in their local area, such as the Mullewa walk trail project.

Table 6.5 Morawa, Perenjori and Mingenew: regional tourist attractions

Attraction	Location	Season
Wildflower trail	Shire of Morawa	July to October
Morawa Visitor Information Centre	Shire of Morawa	June to October
Bilya Rock and War Rock	Shire of Morawa	Year-round
Morawa Museum	Shire of Morawa	Fridays
Koolanooka Springs	Shire of Morawa	Year-round
Koolanooka Mine	Shire of Morawa	Year-round
Historic churches	Shire of Morawa and Shire of Perenjori	Year-round
Perenjori Museum	Shire of Perenjori	Year-round
Perenjori Agricultural Show	Shire of Perenjori	One day annually in September
The Salmon's Walk Trail	Shire of Perenjori	Year-round
Rothsay Heritage Trail	Shire of Perenjori	Year-round
Museum	Shire of Mingenew	Year-round
Visitor Information Centre	Shire of Mingenew	June to October
Depot Hill (flora reserve, picnic area)	Shire of Mingenew	Year-round
The Common Walk Trail	Shire of Mingenew	Year-round
Cecil Newton Park	Shire of Mingenew	Year-round
Yandanooka Valley	Shire of Mingenew	June to October
Murals	Shire of Mingenew	Year-round
Coalseam Conservation Park	Shire of Mingenew	Year-round
Mingenew Hill	Shire of Mingenew	Year-round

Source: MarkeTrade 2002

Visitors to the inland shires of Mingenew, Morawa and Perenjori over the 1997 to 2001 period were mainly family groups staying in the area for one to two days (MarkeTrade 2002). The numbers of visitors recorded in these shires on the night of 7 August 2001 (census night) are shown in Table 6.6.

Table 6.6 Number of visitors Perenjori, Morawa and Mingenew shires on census night (2001)

	Western Australian	Other Australian	International	Total
Perenjori	26	0	3	29
Morawa	39	14	10	63
Mingenew	8	9	3	20

Sources: ABS 2002a, ABS 2002b, ABS 2002c.

6.1.7 Air Quality

The existing air quality conditions of the minesite, LIC and access road are associated with that of a rural environment; pristine, based on the predominant land use, with episodic elevated concentrations of particulate matter due to wind erosion and local vehicle movement (Appendix 7). The existing mines in the area may contribute to regional levels of particulate matter. However, their 15 km separation distances from the proposed minesite is considered to be a sufficient buffer to ensure the local air shed is not significantly influenced by existing mining activity.

Due to the absence of site specific or site representative air quality data, it is difficult to assign an ambient background level for dust or particulate in the minesite, LIC and access road. An existing ambient 24-hour PM_{10} concentration of 30 $\mu g/m^3$ has been estimated to represent the air quality for the area surrounding the town of Morawa. This higher level accounts for any additional potential sources of particulate in the area, including agricultural activities.

There are no existing potentially sensitive receptors near the minesite. Existing potentially sensitive receptors (buildings used for residential, commercial, educational or medical purposes) susceptible to impacts on air quality during construction or operation of the LIC were identified using aerial photography. These locations and the current use of each building will be verified during detailed design as buildings identified from aerial photography may actually be non-residential, such as sheds or industrial work places. The approximate location and distance of potentially sensitive receptors from the LIC are shown in Table 6.7.

Table 6.7 Potentially sensitive receptors along LIC

Location (approximate KP[1])	Approximate Distance from LIC (m)
102	700
115	1,500
120.8	200
121	1,000
132	300
141	500

[1] Kilometre Point (KP) is the distance along the LIC, where KP 0 is at the minesite and KP 140 is the end of the LIC near Mingenew (refer to Figure 6.9).

Plate 6.4 **Landscape of the minesite area: flat landscape of the minesite area with ridges of BIF**

Plate 6.5 **Landscape of the minesite area: ridges of banded ironstone formation in the minesite area**

Plate 6.6 **Landscape of the minesite area: view of Karara ridge from Mungada Road**

Figure 6.9 Photo locations along the linear infrastructure corridor

Plate 6.7 LIC Existing Environment - KP 29

Plate 6.8 LIC Existing Environment - KP 42

Plate 6.9 LIC Existing Environment- KP 48

Plate 6.10 LIC Existing Environment - KP 56

Plate 6.11 LIC Existing Environment - KP 63

Plate 6.12 LIC Existing Environment - KP 42

Plate 6.13 LIC Existing Environment - KP 88 (northern extension of the Yarra Yarra Salt Lake system)

Plate 6.14 LIC Existing Environment - KP 104

Plate 6.15 LIC Existing Environment - KP 123

6.1.8 Noise and Vibration

A study of noise and vibration of the KIOP was undertaken by Lloyd Acoustics Pty Ltd (Lloyd Acoustics) (Appendix 9).

Quantitative, existing ambient noise or vibration measurements are not available for the project areas with the only existing anthropogenic sources of noise and vibration in the minesite area associated with exploration work undertaken by KML.

Also, given the rural sparsely populated region crossed by the existing access road and the proposed alignment of the LIC, the background noise across the majority of these routes is expected to be relatively low, particularly at night, compared to most urban areas. In the vicinity of human populations, generators and pumps are more likely to be common sources of noise and, to a lesser extent, vibration. In the daytime, anthropogenic noise sources include farm machinery and occasional light vehicles and heavy transporters along roads.

6.1.9 Public Health and Safety

As described in Section 6.1, the minesite is relatively isolated, with the nearest, albeit unoccupied, residence located approximately 7 km distant.

Current conditions to be taken into account in public health and safety assessment and management relate to the access road and the LIC, and for the latter, crossing of existing road and railway infrastructure.

The LIC will traverse fairly sparsely populated agricultural and pastoral land until it approaches Mingenew. The major roads and railway crossings in the vicinity of the proposed LIC alignment are listed in Table 6.8.

Table 6.8 Major roads and railway crossings along LIC

Major Roads and Railway Crossings	Location – Approximate KP[1]
Lochada Road – alignment runs adjacent to this road for approximately 20 km, crossing it a number of times	42.4 to 63.5
Mullewa to Wubin Road and rail crossing	68.3
Midlands Road and rail crossing	132.1 and 149.8

[1] Kilometre Point (KP) is the distance along the LIC, where KP 0 is at the minesite and KP 140 is the end of the LIC near Mingenew (refer to Figure 6.9).

The proposed access road is a public road that is not heavily trafficked and is generally only used by local pastoralists and exploration personnel. The nearest resident is located approximately 60 m from the road and uses the road to access their property.

At the time of assessment, portions of the access road could be considered to have not been adequately maintained and do not comply with Austroads Rural Roads Design Publication (Austroads 2003). The road surface is rough with a number of potholes present, which could potentially be hazardous when driving at high speeds.

6.1.10 Socio-Economic Aspects

Demographics

Demographic information for the two statistical areas (Morawa and Perenjori shires), considered representative of the entire project area, is presented in this section. Statistics are sourced from the 2001 census data. It is recognised that this data has recently been surpassed by the release of the 2006 census data, but given that there have not been any significant changes in the KIOP region, the 2001 data is still considered relevant for this analysis.

Population in the inland shires of Morawa and Perenjori has been declining since 1999 due to a declining agricultural sector and greater job opportunities in growing regional centres, such as Dongara and Geraldton. The populations of the shires of Morawa and Perenjori are provided in Table 6.9.

Table 6.9 Population of Morawa and Perenjori

Population	1999	2000	2001	2002	2003	2004	2005[1]
Shire of Morawa	1,048	1,032	985	963	957	904	880
Shire of Perenjori	620	619	612	589	585	584	573

Source: ACIL 2007.

[1] Projected values.

In the shires of Morawa and Perenjori, a high proportion of the population was aged from 0 to 9 and 30 to 40 (Figure 6.10). This indicates a predominately family-orientated population and suggests that young adults (15 to 29 years of age) migrate away from the area. The presence of an agricultural boarding college in Morawa that is predominately attended by males (Chadwick 2006) explains the high number of males aged 15 to 19 in Morawa.

The median age in Morawa and Perenjori local government areas (32 and 35 years respectively) (ABS 2002a; ABS 2002b) was similar to the state median age of 34 years (ABS 2002d).

A high proportion of the population in the project area are Australian-born (ABS 2002a; ABS 2002b; ABS 2002c); and of the people born outside of Australia, most were born in the United Kingdom or New Zealand. The percentage of Aboriginal and/or Torres Strait Islanders in the project area (Morawa, 8%; Perenjori, 4%) was slightly higher than the Western Australian average, where 3% of the population was indigenous (ABS 2002d).

The majority of people in Morawa and Perenjori shires were affiliated with a denomination of Christian religion (68% and 70% respectively), most following either the Anglican or Catholic Church.

In 2001, a smaller proportion of the populations of Morawa and Perenjori aged over 15 years of age had obtained a qualification beyond secondary schooling compared to Western Australia overall (Table 6.10).

Table 6.10 Highest qualification level achieved for Morawa and Perenjori

Qualification[1]	Shire of Morawa (%)	Shire of Perenjori (%)	Western Australia (%)
Postgraduate degree	0.9	0.0	1.4
Graduate diploma and graduate certificate	0.9	0.7	1.2
Bachelor degree	7.1	3.6	9.4
Advanced diploma and diploma	6.4	5.2	6.4
Certificate	10.0	9.1	16.8
Not stated[2]	10.7	8.2	11.1
Not applicable[3]	64.0	73.1	53.7

Sources: ABS 2002a; ABS 2002b; ABS 2002d.

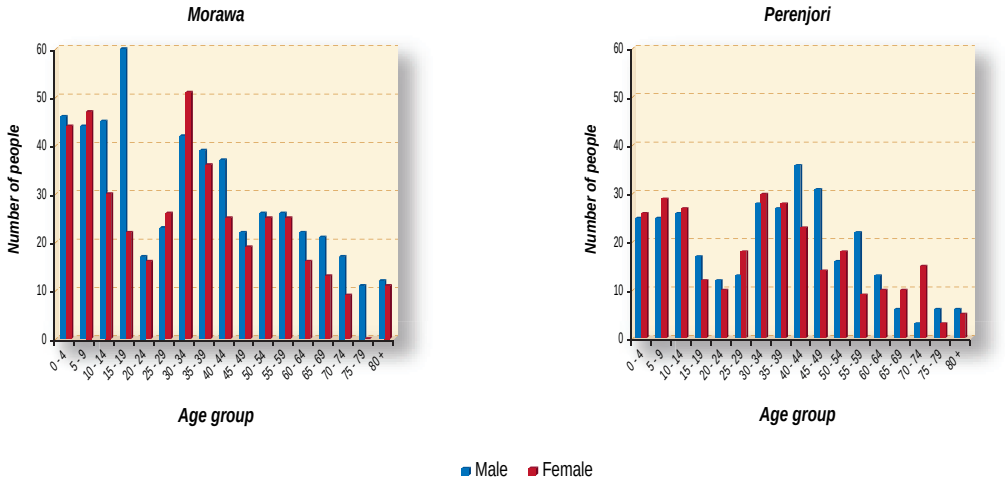
[1] Excludes schooling up to Year 12.

[2] Includes 'Inadequately described'.

[3] Includes persons who do not have a qualification and persons who have a qualification outside the scope of the Australian Standard.

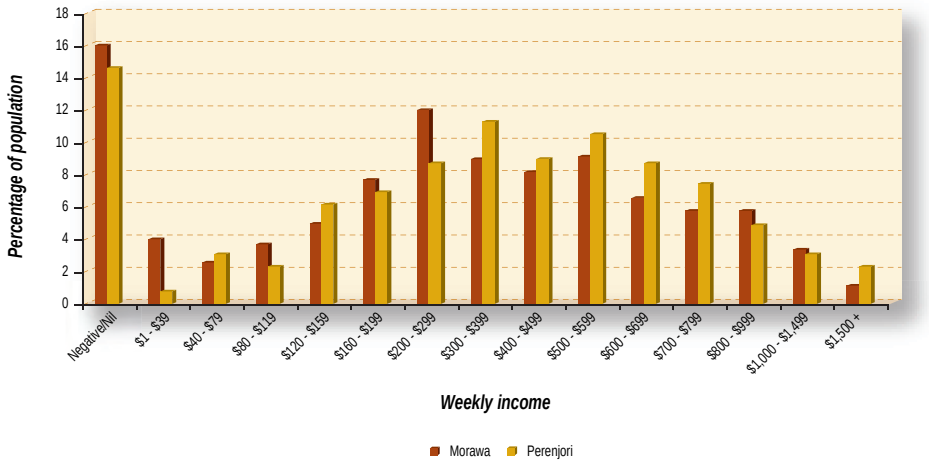
Figure 6.10 Demographics of Morawa and Perenjori

Age and gender of population 2001



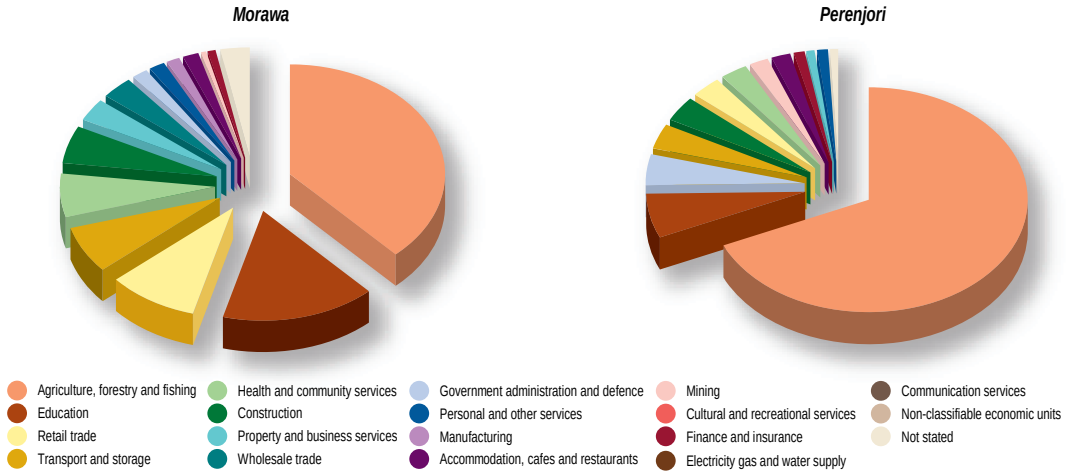
Source: ABS 2002a; ABS 2002b; ABS 2002c.

Weekly income 2001



Source: ABS 2002a; ABS 2002b; ABS 2002c.

Distribution of employment 2001



Source: ABS 2002a; ABS 2002d

Economy and Employment

According to the 2001 census data, employment of the labour force in Morawa and Perenjori was 93.2% and 95.6% respectively. The State employment rate was 91.9%. Excluding people with negative to nil income, the median individual weekly income was between $300 and $399 in Morawa and between $400 and $499 in Perenjori (ABS 2002a; ABS 2002b; ABS 2002d).

Employment distribution in Morawa and Perenjori underlines the importance of the agricultural sector to the local economies, with 37% of Morawa's workforce and 68% of Perenjori's workforce directly employed in the agriculture, forestry and fisheries sectors (see Figure 6.10). The education sector was the second largest industry in both towns, comprising 16% of Morawa's workforce and 6% of Perenjori's workforce. In 2001, the mining industry employed only 1% of the workforce in Morawa and 2% in Perenjori.

Facilities and Infrastructure

Morawa is relatively self-sufficient in terms of basic retail, health, education and financial services. It has medical facilities, primary and secondary schools, banks, supermarkets, a small range of retail outlets and services and some industrial services. In comparison, Perenjori has fewer facilities and relies on neighbouring towns for several services, including secondary schooling and full-time medical services. Both towns have numerous sporting and community groups (Shire of Morawa 2006; Shire of Perenjori 2006).

The Morawa District Health Service provides emergency, maternity, pediatric, palliative-care and radiology services (WA Country Health Service 2006).

Morawa and Perenjori are accessible by road, rail and air. The main road network and rail lines within the region are shown in Figure 1.1. Morawa and Perenjori both have an airstrip, and the nearest regional centre, Geraldton, has an airport that is serviced by Skywest and several charter companies.

Accommodation

Most of the region's population reside in separate houses (Table 6.11), particularly in Morawa and Perenjori, which is consistent with rural living. In 2001, the occupancy rate of private dwellings was 80% in Morawa and 72% in Perenjori. Most occupied dwellings were fully owned or being purchased (Table 6.12).

Table 6.11 Private dwelling types in Morawa and Perenjori

Dwelling Type	Shire of Morawa	Shire of Perenjori
Separate house	302	211
Semi-detached, row or terrace house, townhouse	7	4
Flat, unit or apartment	10	0
Other dwelling	10	11
Not stated	3	3
Unoccupied private dwellings	83	88
Total	**415**	**317**

Sources: ABS 2002a; ABS 2002b.

Table 6.12 Private dwelling ownership in Morawa and Perenjori

Private Dwelling Ownership	Shire of Morawa	Shire of Perenjori
Fully owned	160	136
Being purchased	38	180
Being purchased under a rent/buy scheme	0	3
Rented	96	33
Other or not stated	28	31
Total	**322**	**221**

Sources: ABS 2002a; ABS 2002b.

Morawa has a range of temporary accommodation, including farmstay homesteads, a caravan park with 20 powered sites, a bed and breakfast and a hotel/motel with 13 rooms and 10 units (Shire of Morawa 2006; ABS 2002a). Perenjori also has temporary accommodation facilities, specifically farmstay homesteads, a hotel with 9 rooms and a caravan park with 22 powered sites (MarkeTrade 2002).

6.1.11 Aboriginal Heritage

Australian Interaction Consultants (AIC) undertook an Aboriginal heritage impact assessment for the KIOP (Appendix 10).

There are no registered native title claims over the minesite area, however there are two unregistered claimants, the Widi Mob (unregistered WAG6193/98; WC97/072) and the Widi Binyardi (unregistered WAD286/04; WC04/008).

The study included desktop research which involved a search and analysis of the Department of Indigenous Affairs (DIA) database within the general minesite area. A synthesis of previously recorded sites is listed in Table 6.13.

Table 6.13 Synthesis of previously recorded sites identified during archival search

Site ID	Site Name	Category	Status	Type
5934	Karara Ochre Quarry	Archaeological	Permanent[1] Open	Quarry Artefacts Scatter Ochre
20857	Blue Hills Larger Cave	Archaeological	Interim[2] Closed[3]	Artefacts Scatter Rockshelter Natural feature
20858	Blue Hills Smaller Cave	Archaeological	Interim Open	Natural feature
20859	Blue Hills	Ethnographic	Stored[4] Open	Mythological

1 The Permanent Register includes only those sites that have been determined by the ACMC to be 'places to which this Act applies' under Section 5 of the *Aboriginal Heritage Act 1972*.
2 The Interim Register comprises information reported to the DIA on all sites of known and possible Aboriginal heritage that have not yet been considered by the ACMC.
3 Closed sites are those that have been requested by the informants to remain confidential.
4 Stored sites are deemed by the Aboriginal Cultural Material Committee (ACMC) not to fulfil any of the criteria under Section 5 of the *Aboriginal Heritage Act 1972* and are entered in the Archived Data index.

Table 6.13 Synthesis of previously recorded sites identified during archival search (cont'd)

Site ID	Site Name	Category	Status	Type
21374	Kar/02, Mt Karara (Women's Only Site)	Archeological and Ethnographic	Permanent Closed	Mythological Artefacts Scatter Ochre Rockshelter Natural feature Isolated artefacts
23326	Gindalbie Trees	Archaeological and Ethnographic	Interim Closed	Modified tree and camp
24145	Midwest Claypan	Ethnographic	Interim Closed	Mythological
24146	Midwest Gnamma Hole	Ethnographic	Interim Closed	Water source
24147	Midwest Ironstone Outcrop	Ethnographic	Interim Closed	Mythological
24148	Midwest Artefact Scatter 1	Archaeological	Interim Open	Artefacts
24149	Midwest Artefact Scatter 2	Archaeological	Interim Open	Artefacts
24432	Karara 01	Archaeological and Ethnographic	Interim Open	Mythological Ceremonial Artefacts
24433	Karara 03	Ethnographic	Stored Open	Mythological
24663	Karara 04	Archaeological	Stored Open	Artefacts Scatter
24664	Karara 05	Archaeological	Stored Open	Artefacts Scatter
24665	Karara 06	Archaeological	Stored Open	Artefacts Scatter
24666	Karara 07	Archaeological	Stored Open	Artefacts Scatter
24668	Karara 08	Archaeological	Permanent Open	Quarry Artefacts
24669	Karara 09	Archaeological	Stored Open	Artefacts Scatter
24670	Karara 10	Archaeological	Permanent Open	Artefacts Scatter
24671	Karara 11	Archaeological	Stored Open	Artefacts Scatter
24672	Karara 12	Archaeological	Stored Open	Artefacts Scatter

In addition to desktop research, numerous archaeological and ethnographic surveys have been conducted over the past five years. Archaeological sites (artefacts, quarries, modified trees, scatter, ochre source) have been located in the vicinity of the minesite, as well as ethnographic sites, underpinned by mythological stories that are important to the Aboriginal representatives. The Aboriginal representatives have been involved in consultation in this area since the earliest stages of exploration (Hames 2003).

Heritage surveys have also been undertaken for the original area designated for the airstrip and accommodation village facilities. These initial surveys resulted in identification of a site. This was one of the reasons this infrastructure was relocated. Additional surveys are now underway for the currently proposed location for this infrastructure.

Overall, the archaeological conclusions suggest that this area does not appear to have supported much occupational activity or prolonged habitation. Apart from the ochre quarry (DIA 5934) some distance away, there is little archaeological material around the minesite vicinity. This can be partly explained by the lack of permanent water sources; however, an absence of archaeological or ethnographic research in the Mid-West makes it difficult to contextualise these findings. Previous surveys and identified sites indicate that Mt Karara is indeed a place of ethnographic focus for the Widi Mob, however little archaeological material has been located across this feature (Appendix 11).

The native title claimant group, Badimia (registered WAS6123/98; WC96/098) overlays a small section of the Silverstone water pipeline. The pipeline will be laid above ground within the disturbed area of existing roads and tracks.

The native title claims that cover the areas crossed by the LIC are Amangu (registered WAD6002/4; WC04/2), Mullewa Wadjari (registered WAD6119/98; WC96/93), Widi Mob (unregistered WAG6193/98; WC97/072) and Widi Binyardi (unregistered WAD286/84; WC04/8).

AIC completed a desktop assessment as well as archaeological and ethnographic surveys along sections of the proposed LIC (Appendix 11) in order to identify and discuss heritage significance with a view to avoiding all known Aboriginal sites and to ascertain the likelihood of discovering new sites. Further archaeological investigation and ethnographic consultation along the modified LIC route is continuing and a further report is to be finalised prior to any disturbance. This will enable action to be taken in accordance with regulatory requirements, as necessary.

A search of the DIA database identified registered sites recorded within 100 m of the LIC. These sites are listed in Table 6.14

Table 6.14 Registered Aboriginal sites within 100 m of the LIC

Site ID	Location	Site Name	Status	Type
21374	Shire of Perenjori	Kar/02 - Mt Karara (Women's Only Site)	Permanent[1] Closed[2]	Mythological Artefacts Scatter Ochre Rockshelter Natural feature
23324	Shire of Perenjori	Lizard Granites	Permanent[1] Closed	Ceremonial Historical Mythological Man-made
20860	Shire of Perenjori	Granite Pavement with Rock Hole	Interim[3] Open	Artefacts Natural feature Water source

Table 6.14 Registered Aboriginal sites within 100 m of the LIC (cont'd)

Site ID	Location	Site Name	Status	Type
5408	Shire of Perenjori	Causeway Claypan	Interim Open	Artefacts Scatter
5406	Shire of Perenjori Shire of Morawa	Causeway 1	Interim[3] Open	Artefacts Scatter
5399	Shire of Perenjori Shire of Morawa	Claypan	Interim Open	Artefacts Scatter
5537	Shire of Morawa	Perenjori Artefact 09	Interim Open	Artefacts Scatter
5495	Shire of Morawa	Perenjori Artefact 17	Interim[3] Open	Artefacts Scatter
5405	Shire of Morawa	Causeway Quartz Quarry	Interim Open	Quarry
5365	Shire of Morawa	Cunningham Outcrop	Interim Open	Artefacts Scatter
4496	Shire of Morawa	Koolanooka Hills	Permanent[1] Closed[2]	Ceremonial/ Mythological/ Man-made

[1] The Permanent Register includes only those sites that have been determined by the ACMC to be 'places to which this Act applies' under Section 5 of the *Aboriginal Heritage Act 1972.*

[2] Closed sites are those that have been requested by the informants to remain confidential.

[3] The Interim Register comprises information reported to the DIA on all sites of known and possible Aboriginal heritage that have not yet been considered by the ACMC.

6.1.12 Non-Aboriginal Heritage

Geoheritage sites are areas that have distinct geological features that are valuable to our understanding of the Earth's evolution. These sites can include important fossil localities, rock relationships, type sections, significant landforms or other geological or geomorphological features (EPA 2006b). A search of the State Geoheritage Register was undertaken by the Western Australian Department of Industry of Resources (DoIR) to determine if there were any documented geoheritage sites in the project area (Freeman, DoIR Project Manager, pers. comm., 30 March 2007). No sites were identified within the minesite or LIC. The nearest site, Billeranga Hills, is located 1.8 km south of the proposed LIC at approximately KP 92 (see Figure 6.9).

AIC undertook a European cultural heritage impact assessment for the minesite (Appendix 10) and the proposed LIC (Appendix 11). The assessments involved searches of the files of the Heritage Council of Western Australia, the National Trust of Western Australia, the Register of the National Estate, the National Heritage List, the Commonwealth Heritage List and local government municipal inventory files.

This assessment revealed that no site of European heritage significance was found within the minesite area; however Rabbit Proof Fence No. 1 (Database Number 12080) was identified along the LIC.

The Rabbit Proof Fence is the longest fence in the world, extending from Port Hedland to Bedford Harbour, near Esperance. The fence passes through many local government areas, including the Shire of Perenjori. The fence was erected in 1901 using wire netting, mesh and barbed wire. The purpose of the fence was to protect agricultural land from rabbits, which were causing extensive damage to cereal crops as they spread across the country. A second fence was constructed in 1906 to combat shortfalls in the first fence. It is this second fence that is intersected by the LIC.

6.2 Existing Environment - Minesite

6.2.1 Groundwater

The existing groundwater environment is only discussed in relation to the minesite in this PER, given that this is the only component of the project with the potential to have a significant impact on groundwater.

The minesite is located within the proclaimed Gascoyne groundwater area – the Mullewa/Byro Sub Area. This area consists of metasediments and mafic volcanic rocks of Archaean age that are overlain in low-lying areas by a generally thin sequence of alluvium and colluvium. The hydrogeology of the region has been mapped by the Geological Survey of Western Australia (McGowan 1987 cited by Rockwater in Appendix 6). The mine-site area is described as "bedrock with no primary porosity or permeability," indicating that groundwater yields are likely to be very low and therefore the bores require careful siting for success. Pan evaporation is almost an order of magnitude greater than average rainfall and exceeds rainfall in every month of the year. The depth of the watertable in the project area is generally related to ground elevation and ranges from 2.7 m to 24.4 m. Groundwater salinity at the bores ranges from 290 to more than 80,000 mg/L TDS but is mostly in the range from 1,500 to 4,000 mg/L TDS.

Bores and wells recorded on the Department of Water (DoW) Water Information database (WIN)[1] in the minesite area are shown in Figure 6.11. These bores are pastoral bores associated with Karara Station, however, only two nearby bores, Mungada Bore and Van's Bore are still in use. It is understood that these bores are to be taken out of use by DEC, the owners of Karara Station. In addition, a number of production bores associated with preliminary and future mining activity are present at Karara. Only two, MKW039 and MGW082, are currently operational.

The more concentrated pattern of bores around the KIOP show that aquifers in and around the minesite are mainly fractured BIF, particularly where the BIF is intersected by cross-cutting features such as faults and dykes. The contact zone between the BIF and the adjoining metasediments is also permeable locally. There are aquifers near the base of weathering in basaltic and ultramafic rocks, and where these rocks are fractured or jointed, there could also be some minor perched aquifers within the BIF in the Mt Karara Ridge.

The groundwater is recharged by the infiltration of rainfall on the ridges, and by intermittent stream flows in the lower slopes and drainage paths. The rate of recharge will be low, probably around one percent of the annual rainfall and recharge will only occur after intense rainfall events. The magnitude of seasonal variations in groundwater level is not known, but is likely to be around 1 m.

(Footnotes)

[1] The DoW Water Information (WIN) database contains water quality information recorded at sites throughout the State.

The drainage depression to the east of Karara ridge (gilgai formation) collects water that runs off after heavy rainfall. This is likely to form a shallow aquifer which supports the Melaleuca vegetation in the area. The water table in the depression is probably less than 5 m deep, and the water is expected to be fresh (< 1,000 mg/L TDS). It is not known if these areas are underlain by a hydraulically isolated surficial aquifer or if the aquifer beneath these depressions is connected to the aquifer underlying the minesite as a whole. Groundwater in the depression would be recharged by surface water retained in the area, and would discharge by evapotranspiration and by flow to the south. There are two other similar, although relatively un-vegetated, claypans to the north and northeast of Karara. These are likely to be hydrogeologically similar to the gilgai formation and bore YGW011, located adjacent to the northern claypan, shows the shallowest depth to water table of the minesite bores (5.8 m).

The detailed drilling program has allowed the development of a conceptual hydrogeological model of the Mt Karara area as shown in Figure 6.12. It shows the nature and extent of aquifers present at Mt Karara, recharge and discharge zones, and groundwater flow directions.

6.2.2 Vegetation and Flora

Woodman Environmental Consulting (Woodman Environmental) assessed the vegetation and flora values of the Karara minesite over a number of surveys, between 2003 and 2008. Initial surveys were conducted for Gindalbie's Karara/Mungada exploration activities (2003 to 2005), while later surveys were conducted for the KIOP (2006 to 2008). The geographical area covered by these surveys is shown in Figure 6.13. The survey method was developed in consultation with DEC and is in line with methods established by A. Markey and S. Dillon during their regional flora survey of BIF ridges (Markey & Dillon 2006). The flora and vegetation surveys conducted for the KIOP exceed the requirements of a Level 2 survey, as defined by EPA Guidance Statement 51: Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia (EPA 2004c). The baseline survey report upon which much of this section is based is included as Appendix 12. A detailed description of the survey methods used is included in that document.

Biogeography

The IBRA system Yalgoo Bioregion (refer Section 6.1) within which this project is located is closely related to the classification developed by Beard (Beard 1990). Beard's system describes the project area as being in the Yalgoo sub-region of the Austin Botanical District, within the Murchison Botanical Region. The Austin Botanical District is characterised by a predominately Mulga (*Acacia aneura*) low woodland on plains, reduced to scrub on hills, with a tree steppe of *Eucalyptus* spp. on sand plains. The Yalgoo sub-region is distinctive as it is a transitional area between the Mulga areas and the southwest region and is dominated by a variety of *Acacia* species.

Vegetation

The vegetation of the minesite is generally in good condition, although, past pastoral practices are evident in some areas, where several relatively large, discrete areas have been over-grazed and have not yet started to regenerate.

There are three, broad groups (super-groups) (described below) of vegetation at the minesite that are clustered by the broad, physical processes that help to shape each plant community.

Super Group 1	*Eucalyptus* woodlands and *Acacia* shrublands on flat outwash and valley areas with no exposed rock.
Super Group 2	Woodlands and shrublands on rocky BIF or other substrates from lower slopes to crests.
Super Group 3	*Acacia* shrublands with emergent *Eucalyptus* species on mid-slopes with lateritic gravels. Super Group 3 does not generally occur on BIF ridge areas although it does occur on rocky hillslopes.

Figure 6.11 Bores and wells recorded on the DoW WINS database

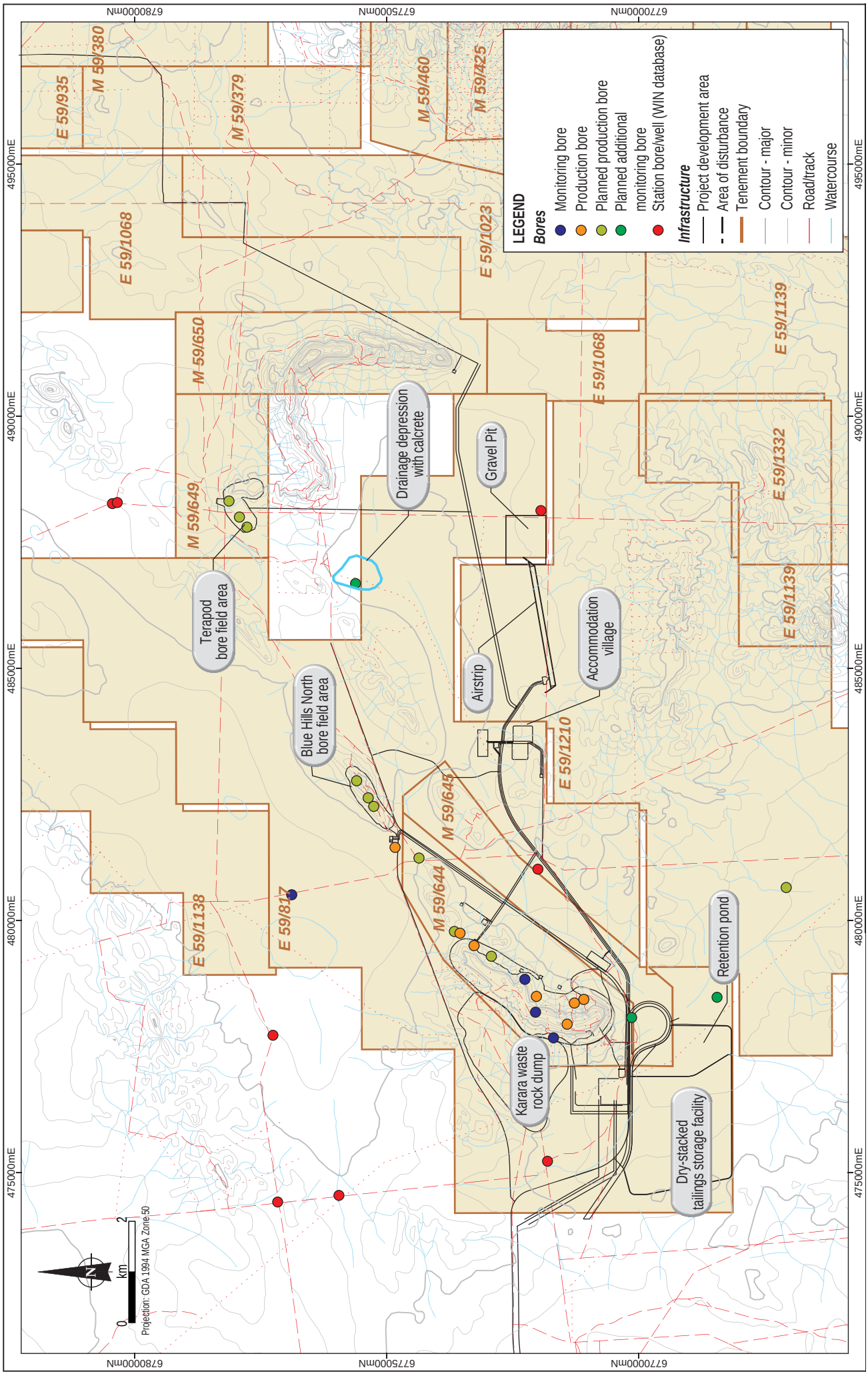
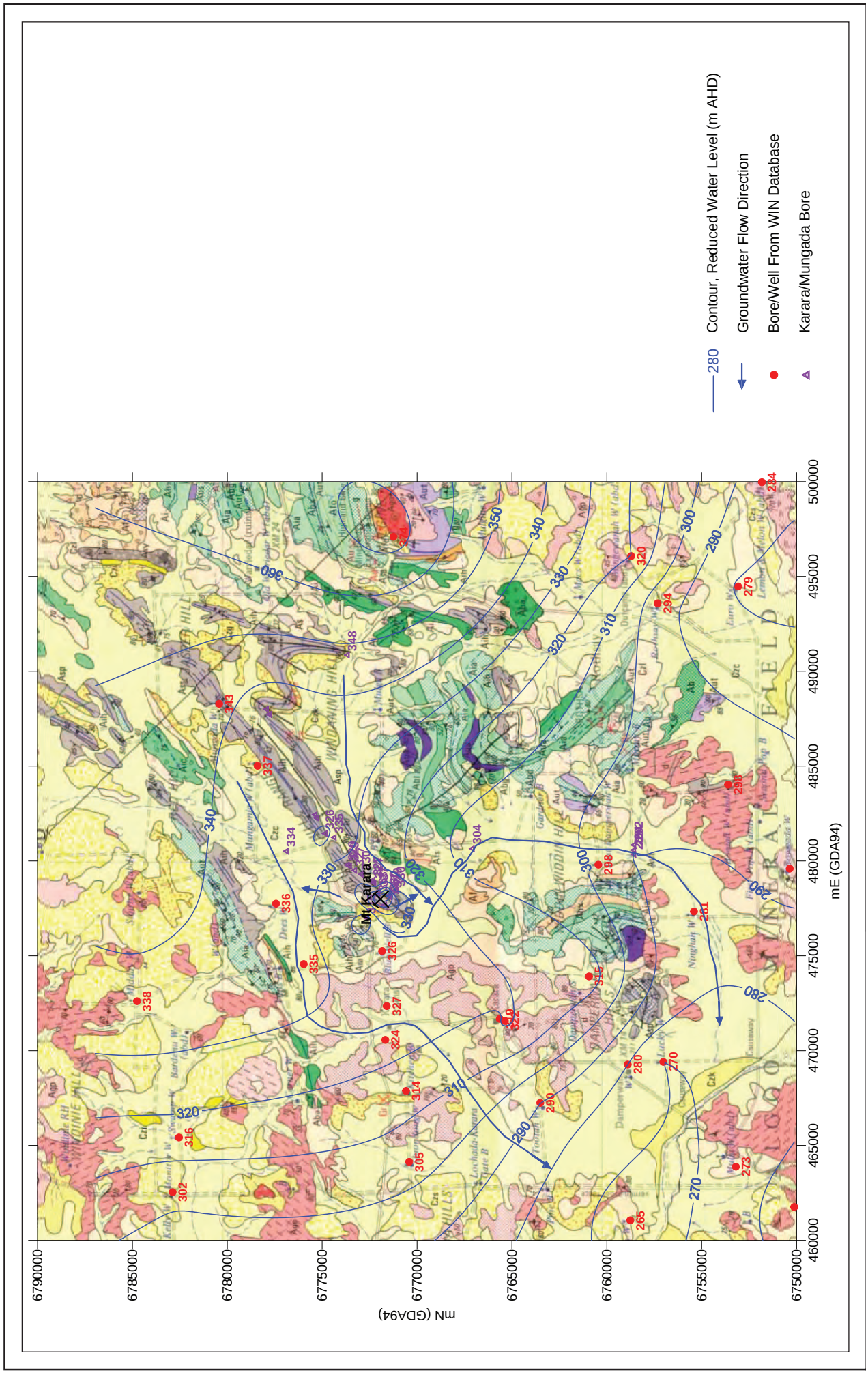


Figure 6.12 Groundwater model of minesite



These super-groups are further divided into 23 Floristic Community Types (FCTs), which have been grouped based on statistical similarities in species diversity. The conservation significance, surveyed area and key species for each FCT within the Karara-Mungada survey area is provided in Table 6.15. In general, FCTs from Super Groups 1 and 3 were given lower rankings of conservation significance that those from Super Group 2. This is primarily due to the wider distribution of soil types and habitats preferred by the FCTs from these groups and because there are fewer priority species. A map of FCTs is provided in Figure 6.14.

None of the FCTs mapped by Woodman Environmental are currently listed as Threatened Ecological Communities (TECs); however, the Blue Hills Range (including Karara and Mungada) has been listed as a Priority Ecological Community, level 2.

An indication of the regional distribution of each FCT can be gained from the flora survey of BIF ridges, conducted by Markey and Dillon in 2005. Of the eight FCTs described by Markey and Dillon (Markey and Dillon 2006), seven are present within the Karara-Mungada survey area.

In general, the other 20 FCTs mapped by Woodman Environmental, but not identified by Markey and Dillon, were either mapped on soils, substrate or topography that was not targeted by Markey and Dillon, were located on hills that were not surveyed by Markey and Dillon or were not statistically separated as FCTs in the combined analysis of the regional dataset. Most of these FCTs occur on soils and landforms that are widely distributed within the region; however four FCTs (FCT 8, 11, 12 and 13) are currently only known from the Karara-Mungada project survey area. Additional survey of an ironstone range located approximately 5 km north of Karara identified an area containing species indicative of FCT 13; however, the extent of this area is yet to be quantified.

Several of these FCTs may be groundwater and/or surface water dependent, especially those occurring on depressions and down slope of rocky ridges. The vegetation of FCTs 7a, 7b, 7c and 7d, all located on drainage depressions, will be dependent on groundwater (either as an aquifer or surface water retained in the clay soils) as the dominant flora species, including *Melaleuca lateriflora* subsp. *Acutiflroa*, *Muehlenbeckia florulenta*, *Teucrium racemosum* and *Sclerostegia disarticulate*, prefer to grow on drainage flats, claypans, salt pans and other wet areas. These drainage depressions, two claypans and a gilgai formation, collect surface water after heavy rainfall and are likely to have a shallow water table (approximately 5 m from the surface). It is not known if these areas are underlain by a hydraulically isolated surficial aquifer or if the aquifer beneath these depressions is connected to the aquifer underlying the minesite as a whole. FCT 1a, 1b, and 2 may also be dependent in the long term on either groundwater or sheet flow originating from higher ground during periodic, heavy rainfall events. These FCTs are located on flats between areas of higher relief that become a floodway during storm events.

Flora

A total of 514 plant taxa have been identified within the KIOP and MIOP survey area from 202 genera and 72 families. Of the plant taxa identified, 488 were native species, and 26 were introduced species. The families with the highest number of taxa were *Asteraceae* (76 taxa), *Mimosaceae* (41 taxa), *Chenopodiaceae* (38 taxa) and *Myrtaceae* (33 taxa).

A total of 23 taxa of conservation significance, or potential conservation significance, have been recorded within the project survey area, including one declared rare fauna (DRF) and 20 Priority flora species (Table 6.16).

In addition, two taxa have been identified by DEC as species of interest for this project. These are new species, or potential new species, that require further study or survey to have their taxonomic and conservation status determined.

Figure 6.13 Minesite flora survey area

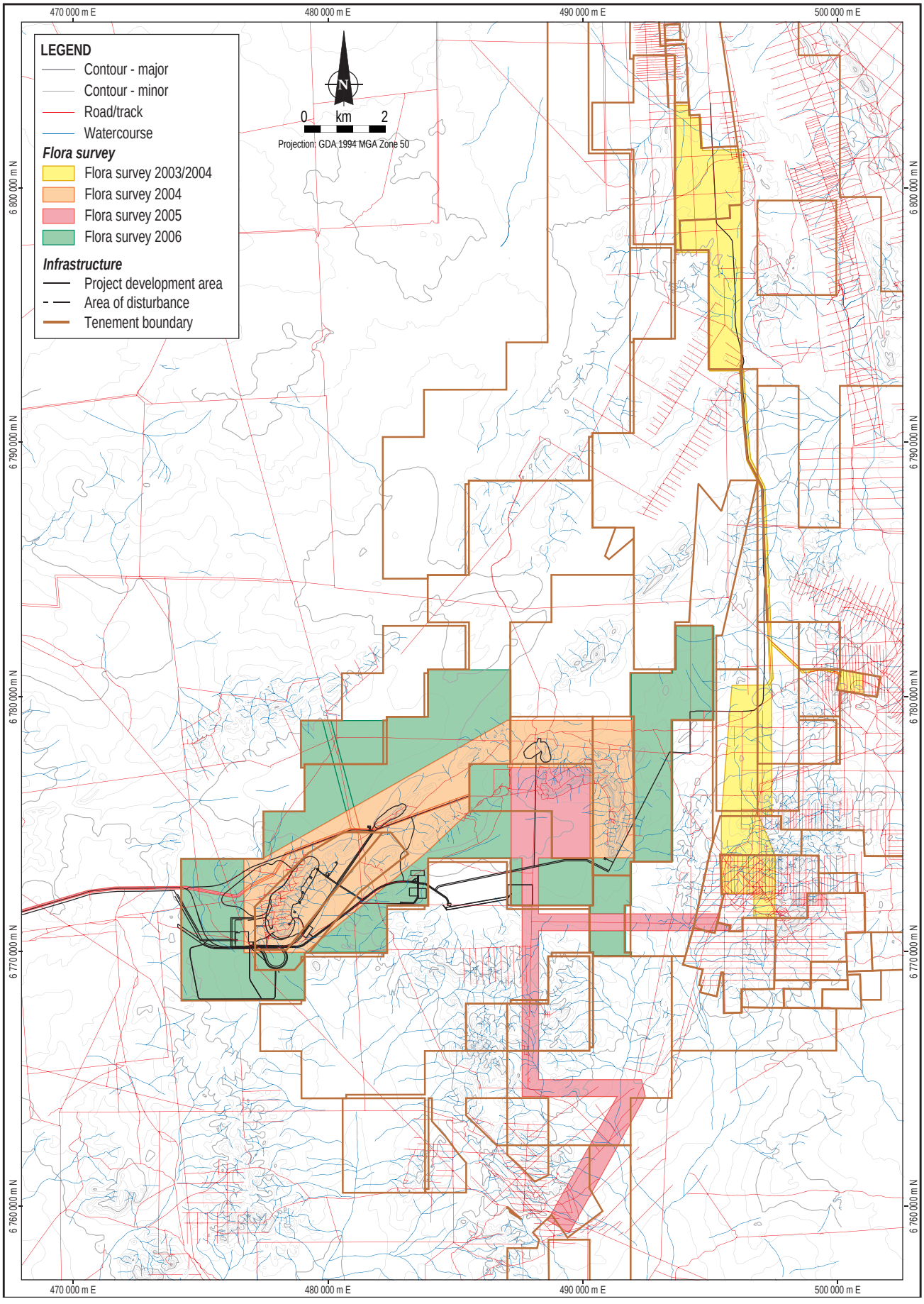


Table 6.15 Floristic community types in the Karara-Mungada survey area

FCT	Surveyed Area (ha)	Significant Species	Conservation significance ranking[1]
1a	795	*Gunniopsis divisa (P1)* *Gunniopsis rubra (P3)* *Persoonia pentasticha (P3)*	1
1a/2	3087	*Gunniopsis divisa (P1)* *Gunniopsis rubra (P3)* *Persoonia pentasticha (P3)* *Rhodanthe collina (P1)*	1
1b	1519	*Gunniopsis divisa (P1)* *Gunniopsis rubra (P3)* *Persoonia pentasticha (P3)*	1
2	964	*Gunniopsis divisa (P1)* *Rhodanthe collina (P1)* *Gunniopsis rubra (P3)* *Persoonia pentasticha (P3)*	1
3	932	*Acacia karina (P2)* *Drummondita fulva (P3)* *Persoonia pentasticha (P3)*	2
4	244	*Gunniopsis divisa (P1)* *Drummondita fulva (P3)* *Gunniopsis rubra (P3)* *Persoonia pentasticha (P3)* *Calotis sp. Perrinvale Station (R.J. Cranfield 7096) (P3)*	4
5a	292	*Rhodanthe collina (P1)* *Calandrinia kalanniensis ms (P2)* *Persoonia pentasticha (P3)*	1
5b	42	*Millotia dimorpha (P1)* *Rhodanthe collina (P1)* *Acacia karina (P2)* *Persoonia pentasticha (P3)*	2
6	5	No species of significance recorded from FCT 6.	1
7a	93	No species of significance recorded from FCT 7a. Declared Plant *Echium plantagineum* has a high level of infestation in this area.	1
7b	54	No species of significance recorded from FCT 7b.	3
7c	173	No species of significance recorded from FCT 7c.	3
7d	3	No species of significance recorded from FCT 7d.	1
8	386	*Rhodanthe collina* (P1) *Acacia karina (P2)* *Drummondita fulva* (P3) *Grevillea scabrida* (P3) *Micromyrtus trudgenii* (P3) *Lepidosperma* sp. Blue Hills (A. Markey & S. Dillon 3468)	5

[1]A conservation significance ranking of 5 indicates the highest conservation significance, 1 indicates lowest conservation significance. A detailed description of the method used to rank the conservation significance of each FCT is provided in Appendix 12. Mosaics were assigned the conservation significance of the most significant FCT within that mosaic.

Table 6.15 Floristic community types in the Karara-Mungada survey area (cont'd)

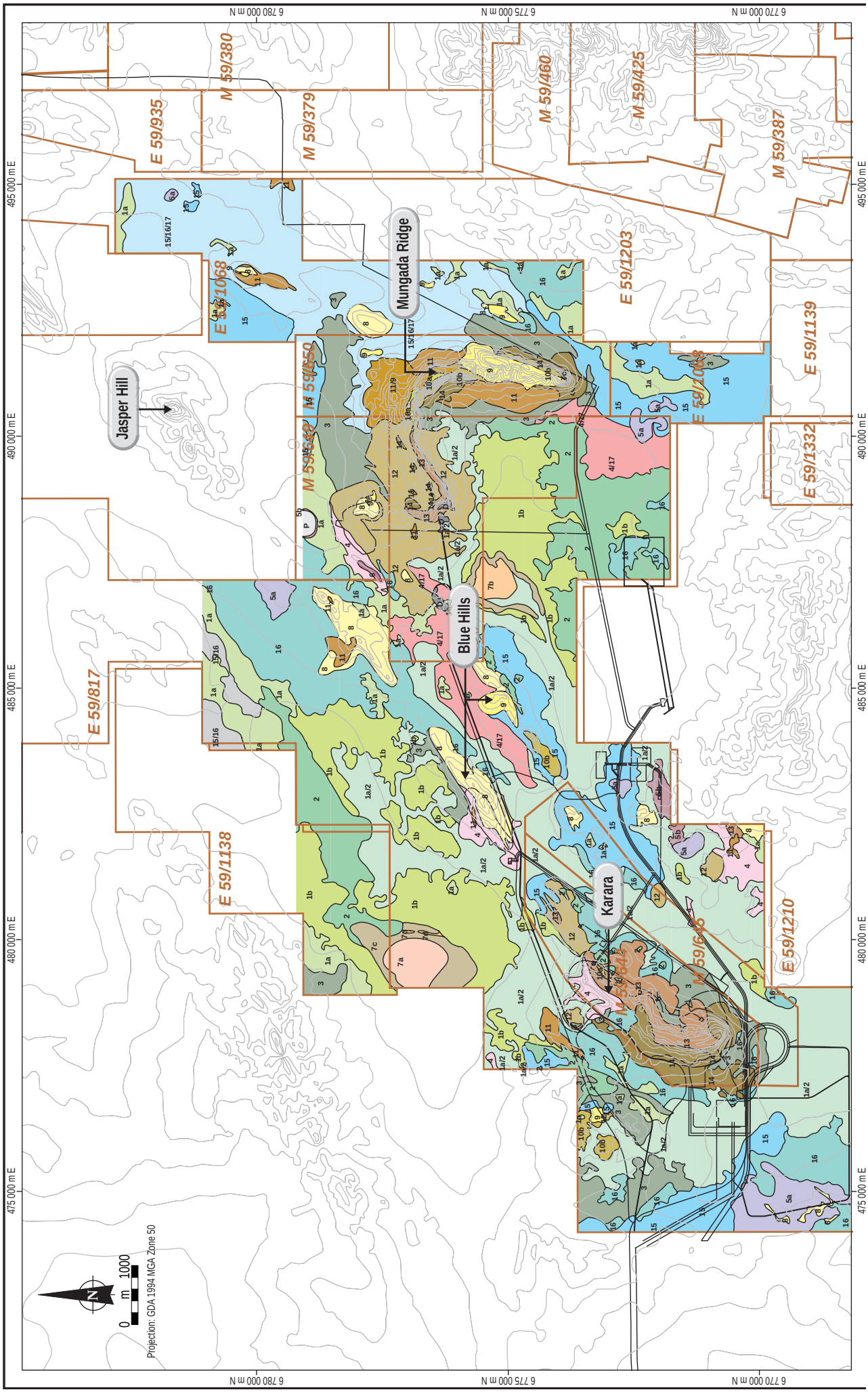
FCT	Surveyed Area (ha)	Significant Species	Conservation significance ranking
9	150	*Acacia woodmaniorum* (DRF) *Austrostipa blackii* (P1) *Micromyrtus acuta* (P1) *Rhodanthe collina* (P1) *Drummondita fulva* (P3) *Micromyrtus trudgenii* (P3) *Polianthion collinum* (P3) *Calotis* sp. Perrinvale Station (R.J. Cranfield 7096) (P3) *Lepidosperma* sp. Blue Hills (A. Markey & S. Dillon 3468)	4
10a	44	*Acacia woodmaniorum* (DRF) *Rhodanthe collina* (P1) *Micromyrtus trudgenii* (P3) *Polianthion collinum* (P3) *Lepidosperma* sp. Blue Hills (A. Markey & S. Dillon 3468)	4
10b	46	*Acacia woodmaniorum* (DRF) *Rhodanthe collina* (P1) *Acacia karina* (P2) *Drummondita fulva* (P3) *Micromyrtus trudgenii* (P3) *Polianthion collinum* (P3) *Lepidosperma* sp. Blue Hills (A. Markey & S. Dillon 3468)	4
11	219	*Melaleuca barlowii* (P1) *Micromyrtus acuta* (P1) *Rhodanthe collina* (P1) *Drummondita fulva* (P3) *Grevillea globosa* (P3) *Micromyrtus trudgenii* (P3) *Polianthion collinum* (P3) *Lepidosperma* sp. Blue Hills (A. Markey & S. Dillon 3468)	5
12	642	*Acacia woodmaniorum* (DRF) *Micromyrtus acuta* (P1) *Rhodanthe collina* (P1) *Acacia karina* (P2) *Drummondita fulva* (P3) *Micromyrtus trudgenii* (P3) *Calotis* sp. Perrinvale Station (R.J. Cranfield 7096) (P3) *Lepidosperma* sp. Blue Hills (A. Markey & S. Dillon 3468)	5
13	258	*Acacia woodmaniorum* (DRF) *Millotia dimorpha* (P1) *Rhodanthe collina* (P1) *Acacia karina* (P2) *Drummondita fulva* (P3) *Micromyrtus trudgenii* (P3) *Lepidosperma* sp. Blue Hills (A. Markey & S. Dillon 3468)	5

Table 6.15 Floristic community types in the Karara-Mungada survey area (cont'd)

FCT	Surveyed Area (ha)	Significant Species	Conservation significance ranking
14	324	*Acacia woodmaniorum* (DRF) *Millotia dimorpha* (P1) *Acacia karina* (P2) *Drummondita fulva* (P3) *Calotis* sp. Perrinvale Station (R.J. Cranfield 7096) (P3) *Lepidosperma* sp. Blue Hills (A. Markey & S. Dillon 3468)	4
15	1394	*Chamelaucium* sp. Yalgoo (Y. Chadwick 1816) (P1) *Grevillea globosa* (P3) *Gunniopsis rubra* (P3) *Micromyrtus trudgenii* (P3) *Persoonia pentasticha* (P3)	1
16	1406	*Melaleuca barlowii* (P1) *Drummondita fulva* (P3) *Grevillea globosa* (P3) *Gunniopsis rubra* (P3) *Persoonia pentasticha* (P3)	2
4/17[2]	469	*Gunniopsis divisa* (P1) *Drummondita fulva* (P3) *Gunniopsis rubra* (P3) *Persoonia pentasticha* (P3) *Calotis* sp. Perrinvale Station (R.J. Cranfield 7096) (P3)	1
11/9	124	*Acacia woodmaniorum* (DRF) *Austrostipa blackii* (P1) *Micromyrtus acuta* (P1) *Rhodanthe collina* (P1) *Drummondita fulva* (P3) *Micromyrtus trudgenii* (P3) *Polianthion collinum* (P3) *Calotis* sp. Perrinvale Station (R.J. Cranfield 7096) (P3) *Lepidosperma* sp. Blue Hills (A. Markey & S. Dillon 3468) *Melaleuca barlowii* (P1) *Grevillea globosa* (P3)	4
15/16	105	*Chamelaucium* sp. Yalgoo (Y. Chadwick 1816) (P1) *Grevillea globosa* (P3) *Gunniopsis rubra* (P3) *Micromyrtus trudgenii* (P3) *Persoonia pentasticha* (P3) *Melaleuca barlowii* (P1) *Drummondita fulva* (P3)	1
15/16/17	1262	*Chamelaucium* sp. Yalgoo (Y. Chadwick 1816) (P1) *Grevillea globosa* (P3) *Gunniopsis rubra* (P3) *Micromyrtus trudgenii* (P3) *Persoonia pentasticha* (P3) *Melaleuca barlowii* (P1) *Drummondita fulva* (P3)	1

[2]Although FCT 17 can be described statistically as an individual FCT, it was only mapped within the Karara-Mungada survey area in a mosaic with FCT 4 or FCT 15 and FCT 16. Mosaics are defined as areas where changes in FCTs cannot be differentiated by the use of aerial photography although these changes can be identified on the ground as small, interspersed pockets of the different FCTs. For further details, see Appendix 13.

Figure 6.14a – Floristic community types



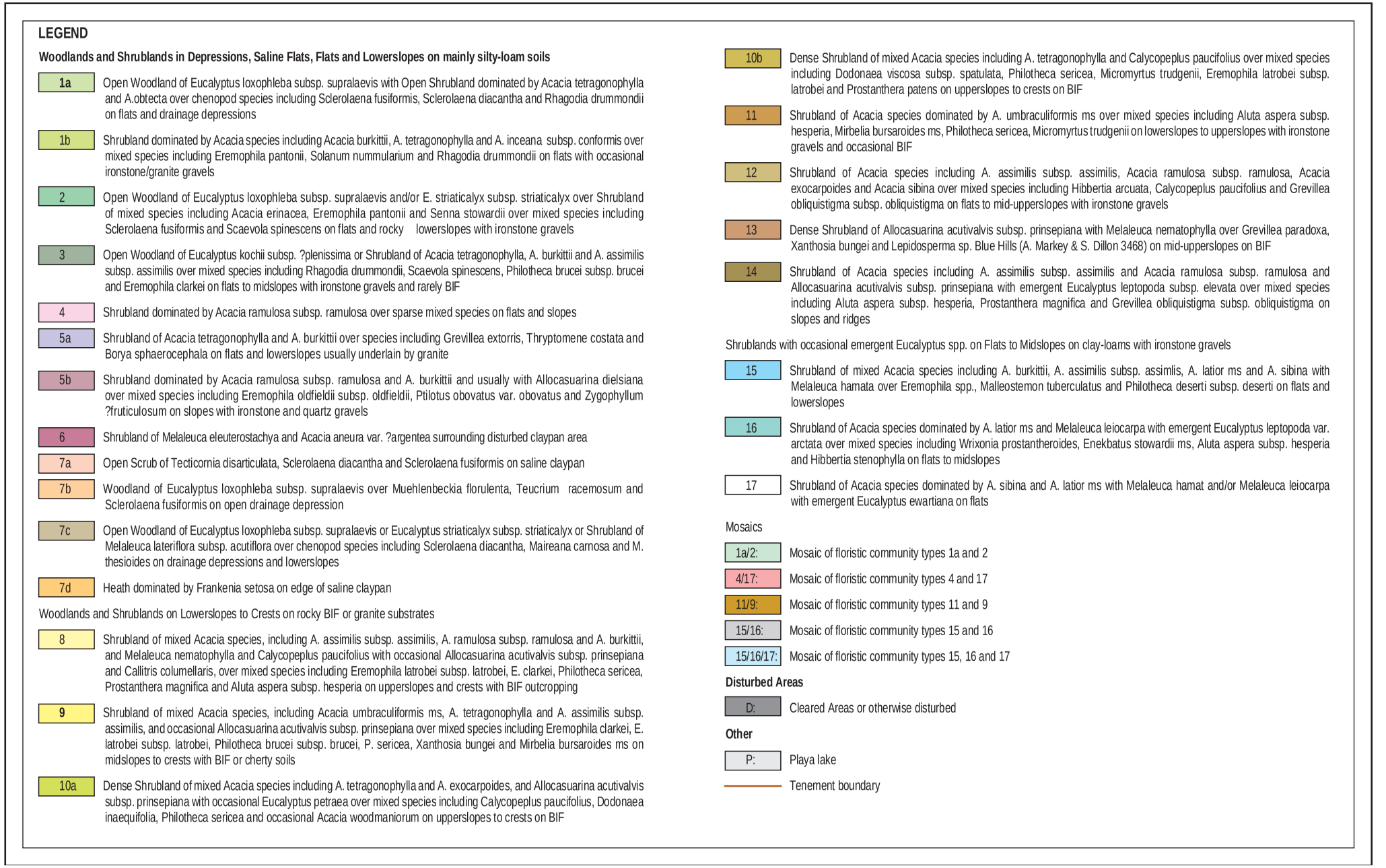


Figure 6.14b Floristic community types legend

Table 6.16 Flora species of conservation significance at the minesite

Species[1]	Conservation Status
Acacia karina	P2
Acacia woodmaniorum	DRF
Austrostipa blackii	P3
Calandrinia kalanniensis ms	P2
Calotis sp. Perrinvale Station (R.J. Cranfield 7096)	P3
Chamelaucium sp. Yalgoo (Y. Chadwick 1916)	P1
Drummondita fulva	P3
Grevillea globosa	P3
Grevillea scabrida	P3
Grevillea subtiliflora	P1
Gunniopsis divisa	P1
Gunniopsis rubra	P3
Lepidosperma sp. Blue Hills (A. Markey & S. Dillon 3468)	Species of interest
Melaleuca barlowii	P1
Micromyrtus acuta	P1
Micromyrtus trudgenii	P3
Millotia dimorpha	P1
Persoonia pentasticha	P3
Polianthion collinum	P3
Prostanthera affin. *campbellii* (A. Markey & S. Dillon 3386)	Species of interest
Rhodanthe collina	P1
Spartothamnella sp. Helena & Aurora Range (P.G. Armstrong 155-109)	P3
Stenanthemum poicilum	P2

[1]Several species have had name changes since surveying was initiated, and the most up-to-date name is being used for the purposes of this report.

The known local and regional distribution of each of the species listed in Table 6.16 is presented in Appendix 12. The local distribution has been mapped as the known locations of these species within the project survey area. The regional distribution has been mapped as the known locations within 100 km radius of the project survey area. For some species, additional known locations occur outside of this radius.

Markey and Dillon (Markey & Dillon 2006) identified a large number of annual flora species during their survey in 2005 of Karara and Mungada Ridges, which were not identifiable during surveys in 2006. Flowering of annual species is particularly dependent upon adequate rainfall, and therefore surveys undertaken during years with below average rainfall will result in lower species richness than those conducted in years with higher rainfall. The rainfall experienced by the region in 2006 was poor in comparison to 2005, and in comparison to the long-term average. It was noted in the field that, in general, compared to the hillslopes, a higher coverage of annual species were seen on the flats and that some areas south of the survey area had limited 'carpets' of annual *Asteraceae* species.

Four species (described below), in particular, appear to be restricted to the minesite and its immediate surrounds and are of key interest for the KIOP. There are very few nature reserves or other conservation estate in the Mid-West Region and no A-class reserves. Thus none of the species listed below occur in secure land tenure (i.e. on conservation estate). Much of the land in and surrounding Karara is owned by the DEC and is managed for conservation purposes, however it has not yet been placed in the formal reserve system and there are mining tenements held by various companies, over much of this land.

- *Acacia karina* (Plate 6.16 and Figure 6.15) was first collected approximately 6 km east of Mungada Ridge by Woodman Environmental in 2004 but was first recognised as a new species by Markey and Dillon during their survey of the Central Tallering region (Markey and Dillon 2006). *Acacia karina* is known to occur widely over Karara and on granite and ironstone rises to the north and south. It also occurs over a portion of Blue Hills, on Mungada Ridge and on gentle ironstone rises east of Mungada Ridge. *Acacia karina* is not restricted to BIF ridges. The regional distribution of this species is currently limited by lack of survey effort in areas outside of the Karara-Mungada project survey area. *Acacia karina* has also been recorded at Mt Gibson and is likely to be found on granite and BIF ridges or low rises between Karara and Mt Gibson and possibly also on suitable habitat further a field. In addition, known locations of suitable habitat have not yet been exhaustively surveyed and additional locations for this species are likely to be found in and around Karara, particularly to the east of the project area (see Section 4.2.2, Appendix 12). This species was added to the Priority Flora list on 21st December 2006.

- *Lepidosperma* sp. Blue Hills (A. Markey & S. Dillon 3468) (Plate 6.17 and Figure 6.16) has not yet been taxonomically described but is potentially a new species. It was first recorded at Karara by Woodman Environmental in 2004 but was first recognised as a new species by Markey and Dillon during their survey of the Central Tallering region (Markey & Dillon 2006). *Lepidosperma* sp. Blue Hills (A. Markey & S. Dillon 3468) is most commonly found at Karara but has also been recorded at Mungada Ridge, Blue Hills, north of Karara and at Jasper Hills. *Lepidosperma* sp. Blue Hills (A. Markey & S. Dillon 3468) has been recommended for either a high Priority Flora listing or for listing as DRF (Markey and Dillon 2006). Again, the regional distribution of this species is currently limited by lack of survey effort in areas outside of the Karara-Mungada project survey area. Several areas of prospective habitat for *Lepidosperma* sp. Blue Hills are known around Karara and Mungada, such as east at Mt Mulgine and south around John Forrest Lookout (Section 4.2.2, Appendix 12). This species is also likely to occur north of Karara and Mungada, along the northern extension of the Blue Hills range.

- *Acacia woodmaniorum* (Plate 6.18) was first collected from a previously cleared mine to the west of Mungada Ridge in 1992 but was first recognised as a new species by Markey and Dillon during their survey of the Central Tallering region (Markey and Dillon 2006). *Acacia woodmaniorum* is known from Mungada Ridge and Jasper Hills (north of Mungada Ridge); however it has not been recorded at Karara or on other ironstone ridges to the north of the project survey area as surveyed by Markey and Dillon (2006). It occurs on exposed ironstone ridges within a limited range. *Acacia woodmaniorum* was added to the Priority Flora list on 21 December 2006, with a status of P2, however the conservation status was upgraded to DRF on 22 January 2008.

- *Millotia dimorpha* (Figure 6.17) is an annual species and was first recorded within the project survey area by Markey and Dillon (2006). It is currently only known from two other localities: Koolanooka Hills and adjacent to Kadji Kadji Station. It has been recommended that the conservation status of this species be revised from P1 to DRF (Markey and Dillon 2006), although this did not occur during a revision of the conservation status of species in 2007 due to lack of regional survey for this species.

Several other taxa of interest were reported by Woodman Environmental and further work is proposed to confirm their status. These taxa have not been included in Table 6.16 either due to unclear taxonomy (that is, whether they are new species or not) or, because they are reported from the region but were not located by Woodman Environmental within the project survey area. These species include *Acacia* sp. nov 3, *Acacia* affin. *subsessilis* and *Grevillea* affin. *zygoloba*. Bruce Maslin from the Western Australian Herbarium has been contracted by Gindalbie to undertake taxonomic studies of six *Acacia* species recorded within the project area, including the species aforementioned. Specimens have been submitted to the Western Australian Herbarium, however further flowering and fruiting specimens are required.

Photo credit : Woodman Environmental Consulting

Photo credit : Woodman Environmental Consulting

Plate 6.16

***Acacia karina* in typical habitat**

Photo credit : Woodman Environmental Consulting

Photo credit : Woodman Environmental Consulting

Plate 6.17

***Lepidosperma* sp. Blue Hills in typical habitat**

Photo credit : Habitat photo - B. Maslin

Plate 6.18

***Acacia woodmaniorum* in typical habitat**

Figure 6.15 ***Acacia karina*** **distribution**

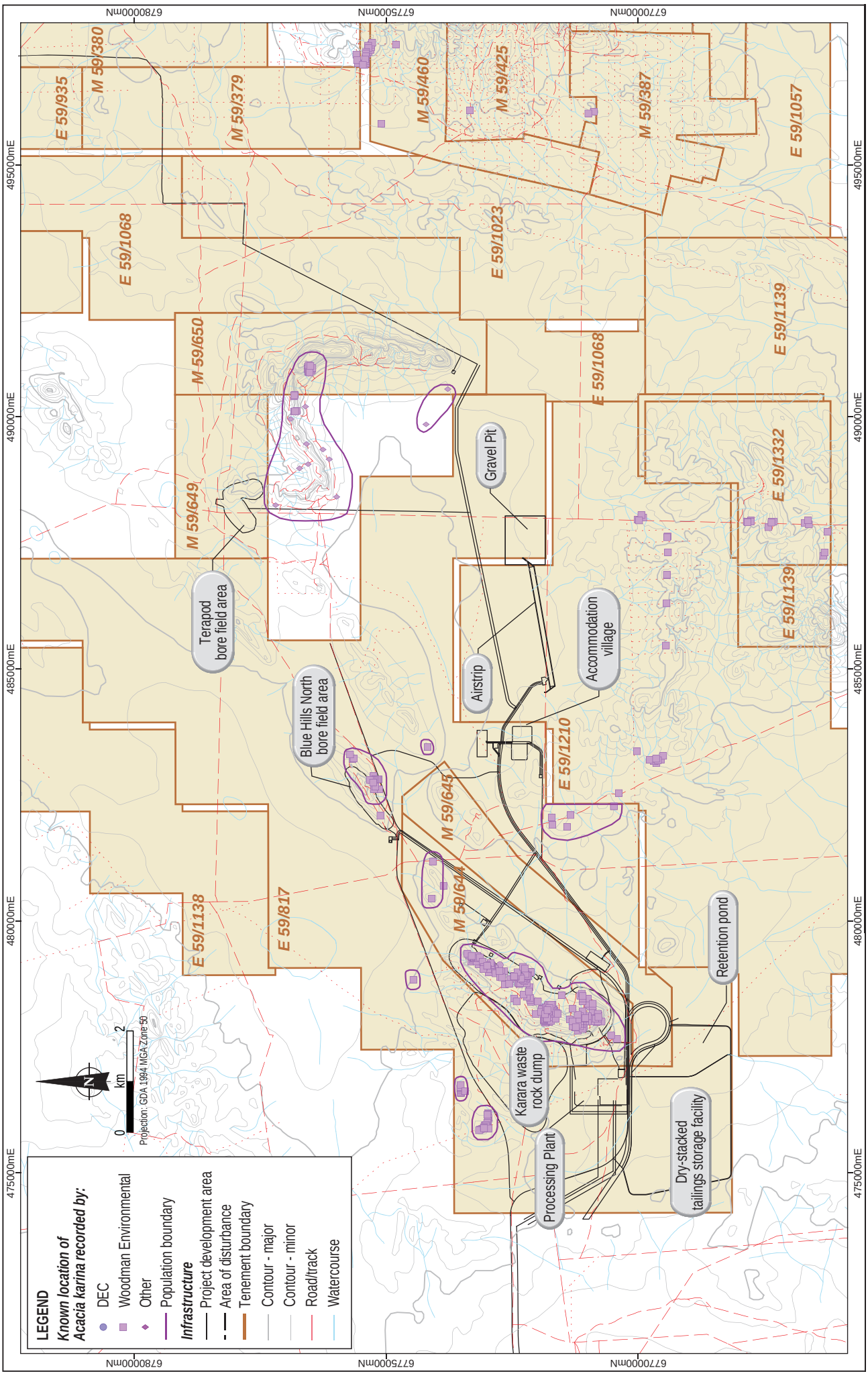


Figure 6.16 ***Lepidosperma*** **sp. Blue Hills (A. Markey and S. Dillon 3468) distribution**

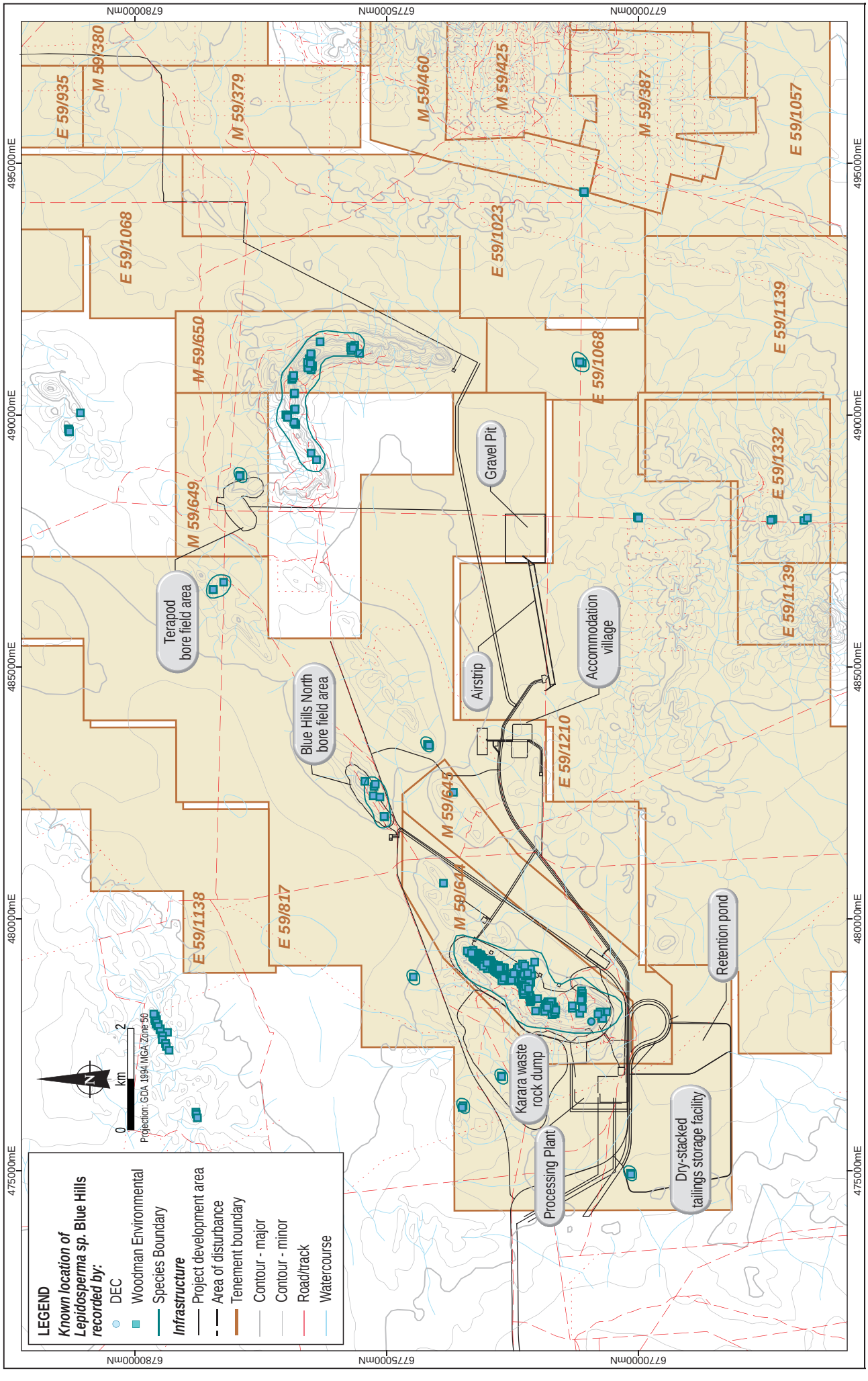
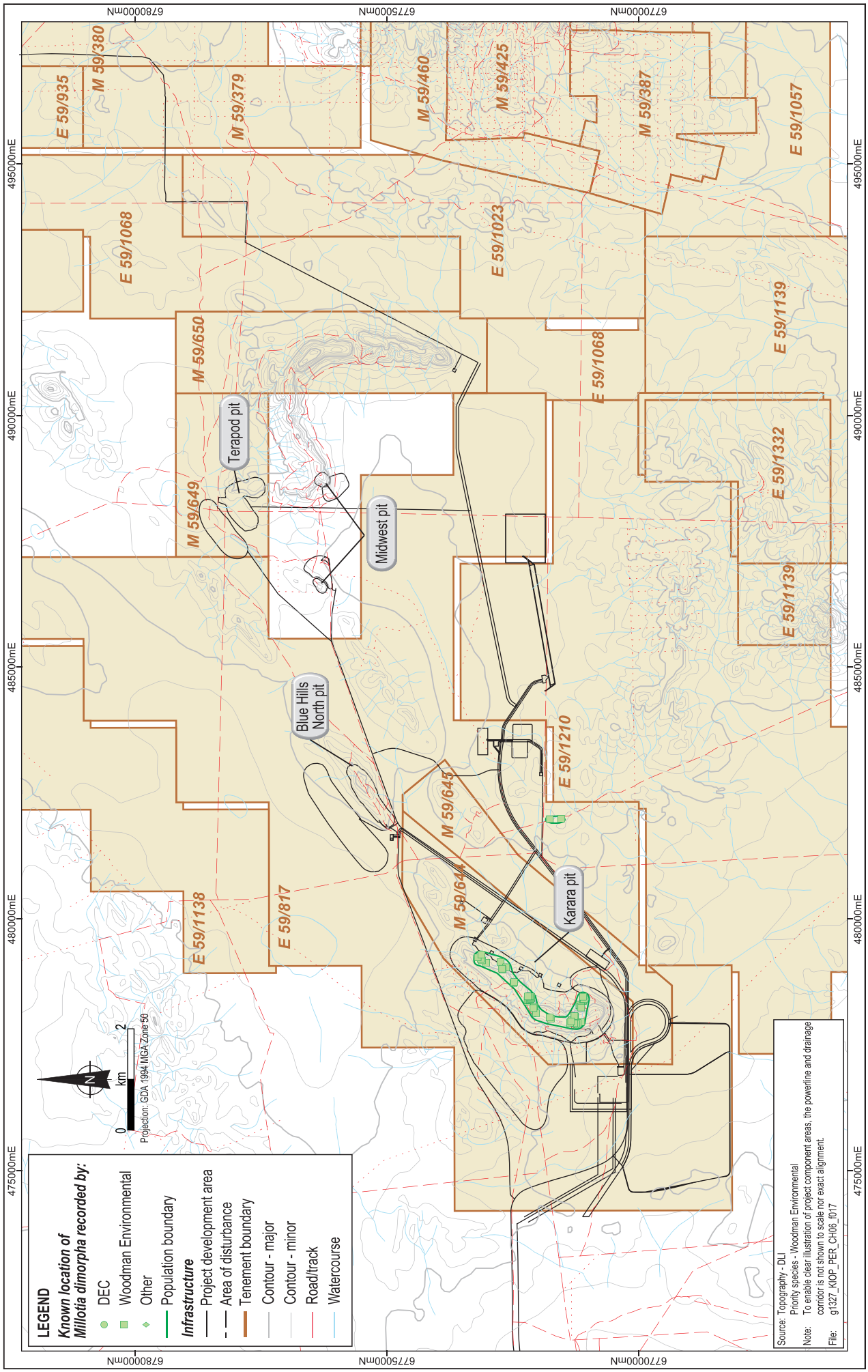


Figure 6.17 *Millotia dimorpha* distribution



There is generally very low weed cover throughout the project survey area. A large percentage of the 26 weed species identified during the surveys are relatively non-invasive, annual species that have been introduced from the grazing of stock (prior to destocking of Karara Station) and feral animals or by mechanical means. Two weed species, *Echium plantagineum* (Paterson's Curse or Salvation Jane) and *Galium aparine* (cleavers or goosegrass) are listed under the *Agriculture and Related Resources Protection Act 1976*. These species were recorded during Markey and Dillon's survey in 2005 (Markey and Dillon 2006) but were not recorded by Woodman Environmental; most likely due to low rainfall in 2006. These species are described below.

- Paterson's Curse is listed as a P1 Declared Plant for the whole of Western Australia, and movement of the plant or its seeds through contaminated livestock or machinery is prohibited. Due to its invasive nature, this species will be managed within the project area. *E. plantagineum* was recorded on low-lying areas mainly near tracks and water bores; it was also especially prevalent within the saline flat located in the northwestern section of the project survey area (FCT 7a).

- Cleavers is listed as a P1 and P2 Declared Plant for the whole of Western Australia. The P1 listing prohibits the movement of the plant or its seeds within the state, including indirect movement via livestock or machinery. In addition, the P2 listing requires all known populations of this species to be eradicated. *G. aparine* was recorded in three locations, two on Mungada Ridge and one on Karara, during Markey and Dillon's survey in 2005 (Markey and Dillon 2006).

6.2.3 Fauna

Bamford Consulting Ecologists (Bamford) were commissioned in 2006, 2007, and 2008 to conduct an assessment of the fauna values (vertebrate and terrestrial invertebrates) in the immediate region, including Karara and other ridges.

Field surveys to assess the potential impact of mining on terrestrial fauna were undertaken in April, August and October 2006, July 2007, June and July 2008, with work carried out in the vicinity of Karara Ridge, Mungada Ridge, Blue Hills and Jasper Hill. Surveys were undertaken in accordance with the requirements of EPA Guidance Statement No. 56: Terrestrial fauna surveys for Environmental Impact Assessment in Western Australia (EPA 2004d). The survey areas are shown in Figure 6.18. The findings of these assessments and surveys are summarised in this section and the full reports are included as Appendices 16, 17, 24 and 25.

Biota Environmental Scientists (Biota) were commissioned in 2006 to conduct an assessment of the subterranean fauna values of the project area. The findings of their assessment are also summarised in this section and the full report is included as Appendix 20 and Appendix 21. The Sampling Plan for the subterranean Fauna Assessment was prepared by Bennelogia Consultants (Appendix 23). Following this assessment, field sampling was undertaken by Ecologia (Appendix 23). This field work consisted of a three phase survey, occurring back to back from October 2007 to February 2008 primarily in the summer months. All investigations were undertaken consistent with the EPA Guidance Statement No. 54: Consideration of Subterranean Fauna in Groundwater and Caves during Environmental Impact Assessment in Western Australia (EPA 2003).

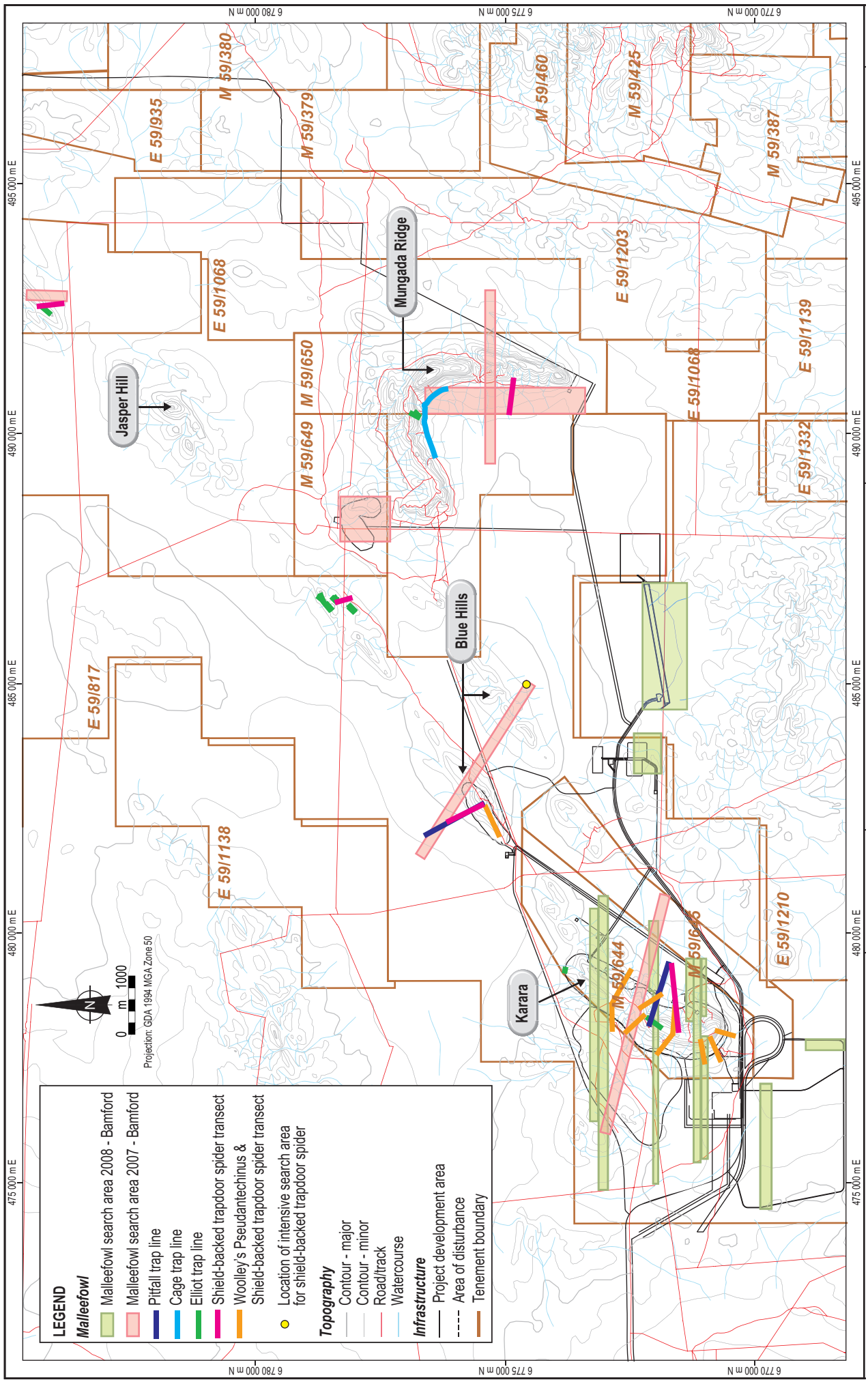
Biogeography

As noted in Section 6.1, the proposed minesite falls within the Yalgoo Bioregion IBRA classification system. The faunal richness of this area is enhanced by its biogeographic location, as faunal elements from the Southwest, Murchison and Arid zones effectively overlap within the project area.

Fauna Habitat

There are no wetlands or World Heritage properties in close proximity to the project area. Importantly, none of the habitats or ecosystems within the Minesite area is listed as threatened ecological communities under the provisions of the EPBC Act.

Figure 6.18 Minesite fauna survey area



The most distinctive habitats in the minesite area are those associated with BIF ridges, which are prominent within the wider area. Four habitats in the minesite area have been identified as locally significant:

- BIF ridges (Land System 1);
- the mid to lower slopes of the BIF ridges (nominally Land System 2);
- temporary pools of fresh water in low-lying areas (Land System 3); and
- well-developed eucalypt woodlands (Land System 4).

Faunal Assemblages

Thirty-three vertebrate species of conservation significance occur, or potentially occur, in the minesite area (via database searches and results of field surveys). Of these, 11 were recorded at Karara or other nearby locations (Table 6.17). Obligate waterbirds were largely excluded from the species lists because of the low frequency of waterbodies in the vicinity of the proposed minesite.

Mammals

No CS1 mammal species were found in the minesite area, which may be attributed to these species being locally extinct. While not recorded during the field survey, the CS2 brush wallaby (*Macropus irma*) was sighted in the area (near Mt Gibson Station) and could occur in the minesite area. Studies indicated that four CS3 species may be present in the minesite area, two bat species (not formally described), the brush-tailed possum (*Trichosurus vulpecular*) and Woolley's pseudantechinus (*Pseudantechinus woolleyae).*

Only two mammals were caught in the surveys in July 2007: a single male Woolley's pseudantechnius at North Blue Hills on 21st July in Elliott 24, and a single House Mouse, (*Mus musculus)* at Mungada on 21st July in Elliott 12. In addition, however, scats of Woolley's pseudantechnius were found at all transects. The single Woolley's pseudantechnius was in poor condition, suggesting that the breeding season had recently finished.

A further survey undertaken in 2008 (Appendix 24) resulted in the capture of two adult male Woolley's pseudantechnius both in good form, which indicated they were in breeding condition. In addition, an abundant amount of scats of Woolley's pseudantechnius were found in all areas of rocky habitat inspected, while no scats were found in less rocky areas or areas of lower slopes and plains. The presence and location of scats indicates that Woolley's pseudantechnius is common and widespread in the region but confined to rocky habitats. Fresh scats were also found near drill pads and tracks suggesting that this species is tolerant to disturbance.

Birds

Bird species that occur in thickets and dense shrublands are well represented among species of conservation significance that may occur in the vicinity of the project area. A total of 12 bird species that potentially occur in the greater project region were listed on the DEC or EPBC databases. The likelihood of birds being present was assessed against their known distribution as described by Johnstone and Storr are summarised below (Johnstone and Storr 1998, Johnstone and Storr 2005).

- Malleefowl (*Leipoa ocellata*) (Plate 6.19). KIOP is within the described distribution range, and the species was recorded within the project area.
- Carnaby's Cocktatoo (*Calyptorhynchus latirostris*). KIOP area is outside the described distribution range, and the species was not recorded within the project area.
- Night Parrot (*Pezoporus occidentalis*). KIOP area is outside the described distribution range, and the species was not recorded in the project area.

Table 6.17 Significant fauna recorded during minesite field surveys

Fauna Species	Conservation significance	Karara	Other	Comments
Mammals				
Woolley's pseudantechinus (*Pseudantechinus woolleyae)*	CS3[1] - Southern edge of range	No	Yes.	Solitary male *Pseudantechinus woolleyae* at North Blue Hills on 21st July 2007 in Elliott 24. Two more males found in June 2008 survey. Scats at all transects
Birds				
Malleefowl (*Leipoa ocellata)*	CS1 - Schedule 1 (Vulnerable) *Wildlife Conservation Act* and Vulnerable (EPBC Act).	Yes	Yes	Distributed widely across the landscape in the minesite region.
Peregrine Falcon (*Falco peregrin)*	CS1 - Schedule 4 (Other Specially Protected Fauna) of the *Wildlife Conservation Act.*	No	Yes	Eastern flank of Mungada Ridge.
Major Mitchell's Cockatoo (*Cacatua leadbeater)*	CS1 - Schedule 4 (Other Specially Protected Fauna) of the *Wildlife Conservation Act.*	Yes	No	Southwest of Karara Ridge (Karara Station).
Rainbow Bee-eater (*Merops ornatus*)	CS1 - Listed as Migratory Bird (EPBC Act)	Yes	Yes	This is a wide-spread species.
Reptiles				
Gilled Slender Blue-tongue (*Cyclodomorphus branchialis)*	CS1 - Schedule 1 (Vulnerable) *Wildlife Conservation Act.*	Yes	Yes	One specimen found on Karara and one specimen found on Mungada Ridge.
Reticulated Velvet Gecko (*Oedura reticulata)*	CS3 - Northern edge of known distribution.	No	Yes	One specimen found in the eucalypt woodland on Mungada Ridge.
Mulga Dragon (*Caimanops amphiboluroides)*	CS3 - Southern edge of known distribution.	Yes	Yes	Commonly found in pitfall traps on Karara Ridge and Blue Hills.
Western Spiny-tailed Skink (*Egernia stokesii badia)*	CS1 - Schedule 1 (Vulnerable) *Wildlife Conservation Act* and *Endangered* (EPBC Act)	No	No	Not recorded during field surveys but included here because of presence of suitable habitat. Further investigations are planned.
Amphibians				
Desert Trilling Frog (*Neobatrachus centralis)*	CS3 - Known from the Mt Magnet region.	No	To be confirmed	Possibly collected in Jan 2004 at Blue Hills.
Invertebrates				
Shield-backed Trapdoor Spider *(Idiosoma nigrum)*	CS1 - Schedule 1 (Endangered) under *Wildlife Conservation Act.*	Not found	Yes	Burrows found west of Mungada Ridge and southeast of Jasper Hills (distributed across all transects and widely across all landscapes, though concentrated on the mid slopes).
Scorpion *Urodacus* - Mt Gairdner (*Urodacus* sp. nov. (Mt Gairdner)	CS3 - short-range endemic, an undescribed species that has not been formally assessed.	Yes	Yes	One specimen found on Karara and one specimen found on Mungada Ridge.

1 Classification of species of conservation significance is described by Bamford as follows:

- Conservation Significance 1 (CS1): Species listed under State or Commonwealth Acts.
- Conservation Significance 2 (CS2): Species not listed under State or Commonwealth Acts, but listed in publications on threatened fauna or as priority species by DEC.
- Conservation Significance 3 (CS3): Species not listed under Acts or in publications, but considered to be of at least local significance due to their distribution pattern. Species at this level have links to preserving genetic biodiversity, may be at the edge of their range or may be sensitive to impacts such as habitat fragmentation.

- Peregrine Falcon (*Falco peregrine).* KIOP is within the described distribution range, and the species was recorded within the project area.
- Major Mitchell's Cockatoo (*Cacatua leadbeateri*). KIOP is within the described distribution range, and the species was recorded within the project area.
- White-browed Babbler (*Pomatostomus superciliousus ashbyi*). KIOP is within the described distribution range, and was recorded within the project area.
- Crested Bellbird *(Oreoica gutturalis gutturalis*). KIOP is within the described distribution range, and the species was recorded within the project area.
- Samphire (Slender-billed) Thornbill (*Acanthiza iredalei*). Disjunct populations regionally, KIOP is not within the described distribution range, and the species was not recorded within the project area.
- Great Egret (*Ardea alba*). KIOP is not within the described distribution range, and the species was not recorded within the project area.
- Cattle Egret (*Ardea ibis*). Occasional visitor to better watered parts of the State. KIOP is not within the described distribution range, and the species was not recorded within the project area.
- Fork-tailed Swift (*Apus pacificus*). Highly aerial migrant. KIOP is within the described distribution range (although uncommon to rare or scarce in the region), and the species was not recorded within the project area.
- Rainbow Bee-eater (*Merops ornatus*). KIOP is within the described distribution range, and the species was recorded within the project area.

Four of the potential six bird species listed as CS1 were recorded in the minesite area during field surveys. The distribution of Malleefowl (Figure 6.19) and Major Mitchell's Cockatoo were common. An active nest of the Peregrine Falcon was found on Mungada Ridge, and the Rainbow Bee-eater was also present in the minesite area (this is a widespread species that is listed as significant as it is listed as migratory under the EPBC Act). Of the remaining two CS1 bird species, the Fork-Tailed Swift may be an irregular visitor to the area; this is an arboreal species that is largely independent of small-scale disturbance within terrestrial environments. The Slender-Billed Thornbill is likely to be absent due to the lack of suitable habitat in the minesite area.

Two out of the potential seven CS2 bird species were recorded in the area. The Crested Bellbird and White-browed Babbler were both widespread in thickets and woodlands of the plains and mid to lower slopes of the BIF ridges.

Six of the potential nine CS3 bird species were recorded, with the Regent Parrot (*Polytelis anthopeplus anthopeplus*) only observed once in January 2006. The Redthroat (*Pyrrholaemus brunneus)* and the Golden Whistler (*Pachycephala pectoralis*) were frequently recorded in the dense thickets. The only records of Gilbert's Whistler (*Pachycephala gilberti*) and the Western Yellow Robin (*Eopsaltria griseogularis rosinae*) were west of Mungada Ridge in the thickets on the lower slopes.

Malleefowl mounds, found during 17 systematic survey transects as well as opportunistic sightings, were widely distributed across the landscape (Figure 6.19) (Appendices 16 and 25), with mounds being widespread occurring to the east, west and south of Karara Ridge within both impacted and non-impacted areas. A total area of 1,160 ha was surveyed, of which 747 ha is within the KIOP project area.

A total of 121 Malleefowl mounds were found during the surveys. One hundred and five of these mounds were found to be inactive, and may be categorised as old to very old. Only eight active mounds and eight recently used mounds were found within the systematically surveyed areas. A total of 32 mounds were recorded opportunistically; of these, four were identified as active and three as recently used. The categories used to describe Malleefowl mounds are:

- Active: Fresh scratchings, loose soil and mound dug out in preparation for the breeding season or mounded for breeding. Mounds contain abundant but weathered plant material and shell fragments and have been used regularly over at least the previous few years.
- Recently used (one to five years old): No signs of recent activity, such as scratchings. The soil surface is compacted and plant material is deficient; however, mound slopes are still steep, and no plants are found to be growing in the mound.
- Greater than five years old: No recent activity, the soil is compacted and plant material is absent. Loose soil and debris in the centre are indicative signs of the mound weathering; some plant colonisation is possibly present.
- Old (20 to 100 years old): Mound moderately to very weathered, often with a veneer of gravel on the slopes because of removal of fine materials from the surface. Some bushes on ground.
- Very old (100+ years): Mound very weathered, with profile low and central depression poorly defined. Bushes or small trees growing on mound.

The distribution of Malleefowl within Western Australia appears to be widespread (Figure 6.20); however, it is important to note that its range has been highly fragmented by land clearance for agriculture.

Reptiles

Two reptiles were listed on the DEC or EPBC databases; the CS1 Gilled Slender Blue-tongue (Plate 6.21) and the CS1 Western Spiny-tailed Skink. Two reptile species of local conservation significance (CS3) were recorded during field surveys at KIOP, the Mulga Dragon (Plate 6.20) and the Reticulated Velvet Gecko, but not the Western Spiny-tailed Skink. Field surveys resulted in the collection of a Gilled Slender Blue-tongue from Mungada Ridge.

Further surveying on likely habitats on the minesite may record the presence of the Western Spiny-tailed Skink.

Plate 6.19

Malleefowl (CS1)

Photo credit : Dick Walker

Plate 6.20

Mulga Dragon (CS3)

Photo credit : Greg Harold

Plate 6.21

Gilled Slender Blue-tongue (CS1)

Photo credit : Greg Harold

Figure 6.19 Location of known Malleefowl mounds at the minesite

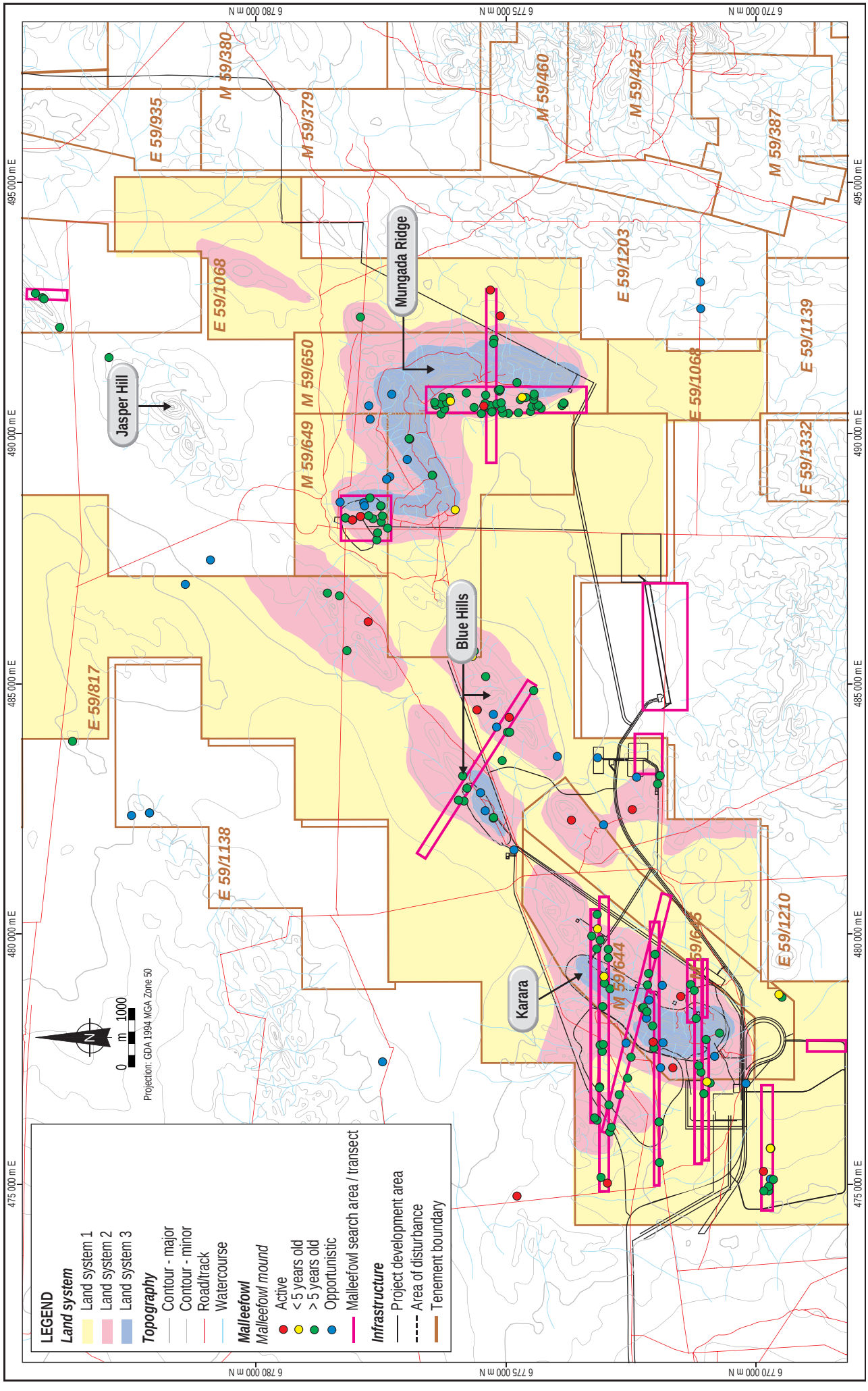
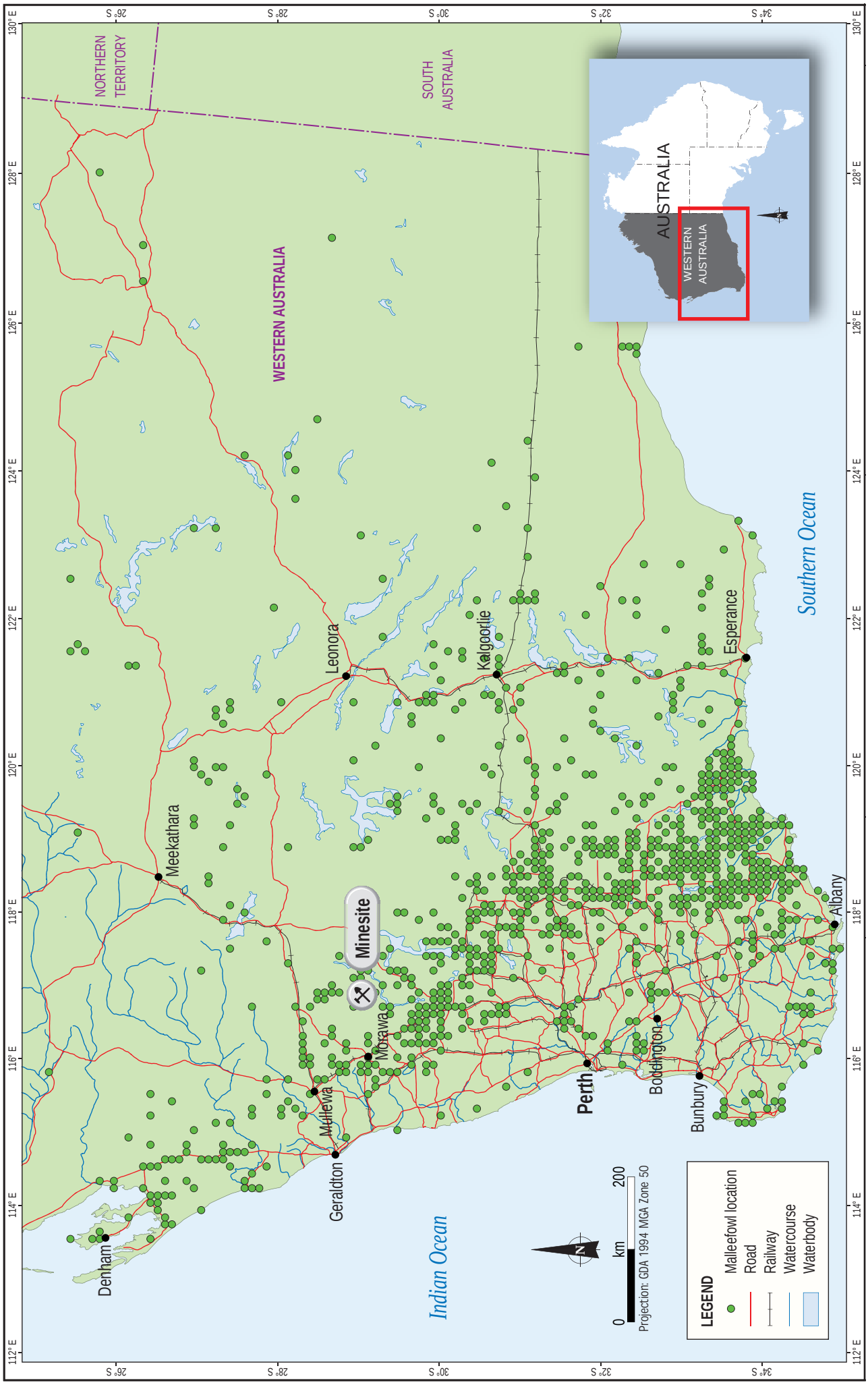


Figure 6.20 Malleefowl distribution in Western Australia



Amphibians

No amphibians were listed on the DEC or EPBC databases. However, the Desert Trilling Frog, listed as CS3, may potentially occur in the minesite area. A single specimen was found during a previous survey at Blue Hills.

Subterranean Fauna

Troglofauna. Eleven diamond drill cores from Karara were reviewed in order to assess the suitability of the subterranean habitats for troglofauna. All lacked evidence of vugs, cavities or fracture zones, other than breaks in the core itself, indicating that the habitat is not suitable for troglofauna. This contrasts with the geology at Terapod bore field area, where one troglofauna specimen was found during a pilot study (Appendix 21) but no further specimens found during the full study. The borehole from which the first specimen was recovered could not be sampled again as the borehole was closed (Appendix 23). There appears to be a low to very low probability that troglofauna occur in the ridge to be mined as part of KIOP (Appendix 20, Appendix 21). Field surveys undertaken by Ecologia (Appendix 23) did not collect any troglobitic specimens from either the phase one, phase two or phase three components of the troglofauna survey.

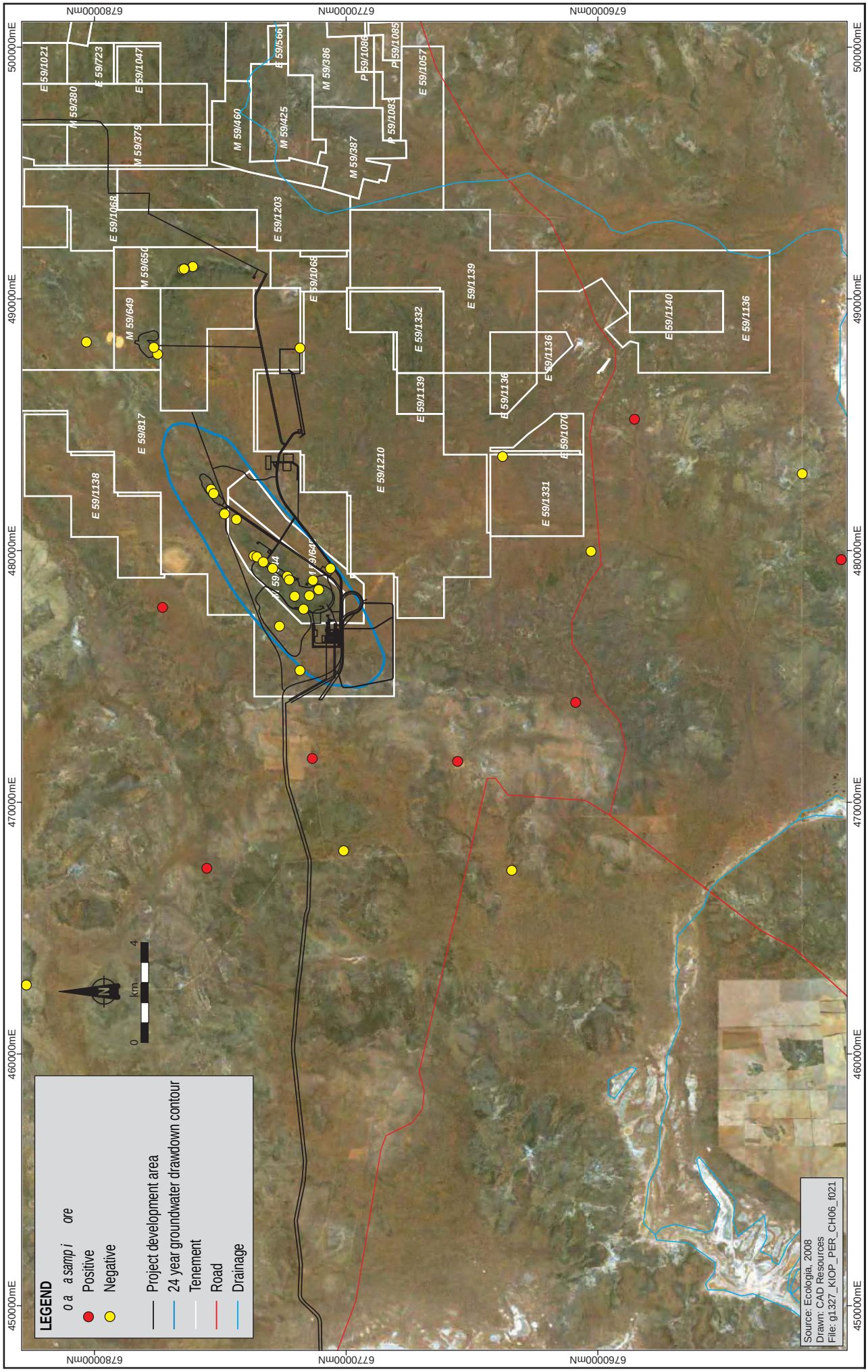
Stygofauna. Specimens were not collected from sampling within the drawdown footprints of the proposed Karara areas during phase one, phase two or phase three of surveying (Appendices as above).

Outside the impact area however, seven pastoral wells or bores recorded five orders of stygobites (Figure 6.21). These bores and wells are situated outside of the Karara and Mungada impact areas and thus neither project is expected to cumulatively impact upon stygobitic species or communities. These included Ostracods, Syncarids, Oligochaetes, Copepods (Harpacticoida and Calanoida) and Isopods, which are listed in Table 6.18. Due to the paucity of stygofauna sampling in the region, it has been assumed that these are new species. Examination by Ecologia laboratory assistants has concluded that there is likely only a single species represented in each respective group. Samples have been given to Brenton Knott (UWA stygofauna researcher) for determination and the identifications are expected during the PER Assessment period. These species are also located within the unconfined alluvial aquifers that surround the BIF ranges and appear to be widespread locally. Within the ranges, groundwater is held within fractured rock aquifers. The general geology and geochemistry of Karara is not considered suitable habitat for stygofauna.

Table 6.18 Stygofauna presence (outside of KIOP area)

Site ID	Sample Type	Phase One (Nov 07)	Phase Two (Feb 08)	Phase Three (May 08)
Murray's Bore	Bore	Ostracoda sp. 1	Absent	Isopoda sp. 1
Well Good	Well	Absent	Ostracoda sp. 1	Absent
Dees Well	Well	Absent	Copepoda (Harpacticoida)	Absent
Shearing Shed Well	Well	Absent	Syncarida sp.1	Absent
Old Homestead Well	Well	Absent	Copepoda (Calanoida) sp. 1 Ostracoda sp. 1	Absent
Little Damperwah Well	Well	Absent	Ostracoda sp. 1 Copepoda (Calanoida) sp. 1	Absent
Bowgada Well	Well	Absent	Oligochaeta	Absent

Figure 6.21 Stygofauna sample locations



Other Invertebrates

The potential exists for short-range endemic invertebrate fauna to occur in the vicinity of the proposed minesite. This is due to the BIF ridges being surrounded by broad plains, which act as a barrier and provide for the persistence of relictual populations and consequently, the evolution of short-range endemic species.

No invertebrate species of conservation significance were identified in the minesite area during searches of the DEC database. However, a field survey did recover three species of conservation significance: the CS1 Shield-backed Trapdoor Spider (*I. nigrum*) and two other invertebrate species identified as short-range endemic species, the CS3 millipede *Antichiropus sp.* nov 'PM1' and the CS3 scorpion *Urodacus sp.* nov. (Mt Gairdner).

Shield-backed Trapdoor Spider. Field surveys to determine the distribution of the Shield-backed Trapdoor Spider (*I. nigrum*) within the minesite area and surrounds were carried out in July 2007. These investigations (Appendix 17) involved survey of five transects, all starting on banded ironstone formation ridges.

Three transects were located on ridges that are proposed to be disturbed by the KIOP on the east side of Karara Ridge and the Mungada proposal: two on the west side of Mungada Ridge and one on the north-west side of the Blue Hills Ridge. These three transects coincide with pit-trap transects used in earlier investigations (Appendix 16). The remaining two transects were on ridges that are currently not being considered for mining: one on Jasper Hills, and the other on a small ridge approximately 3 km north of the Blue Hills Ridge (North Blue Hills). A total of 71 quadrats were searched.

The end points for the transects are based on datum WGS 84 in Zone 50 (refer Figure 6.18).

Subsequent to the field surveys carried out in July 2007, additional field studies were undertaken in June 2008 to further investigate the distribution of the Shield-backed Trapdoor Spider within the minesite area (Appendix 24). This latter investigation involved nine survey transects beginning from low-lying land adjacent to the ridge. A total of 88 quadrats were searched.

The end points for the transects are based on datum WGS 84 (Figure 6.18).

In July 2007, burrows of *I. nigrum* were found along all transects except that near the Blue Hills North bore field area with a total of 70 (61 active) being recorded. The Blue Hills North area lacked large areas of exposed and outcropping rock, but the environment in the spider survey quadrats appeared similar to the environment in survey areas along other ridges.

Burrows were most common on Jasper Hills (20 burrows in 9 quadrats), Mungada (23 burrows in 14 quadrats) and a small ridge northeast of Blue Hills North (24 burrows in 7 quadrats), with only three burrows in the 25 quadrats on the Karara transect (refer Figure 6.22).

The distribution of burrows was very uneven, making calculation of burrow density and interpretation of environmental associations difficult. Over half the burrows were in two quadrats (JS3 and NB4, see Table 2, Appendix 17), suggesting that the distribution of the species is highly clumped. This clumping may explain the absence of burrows from the Blue Hills transect, and their scarcity along the Karara transect, as clumps of burrows in these areas may simply not have been intersected by the sampling transects.

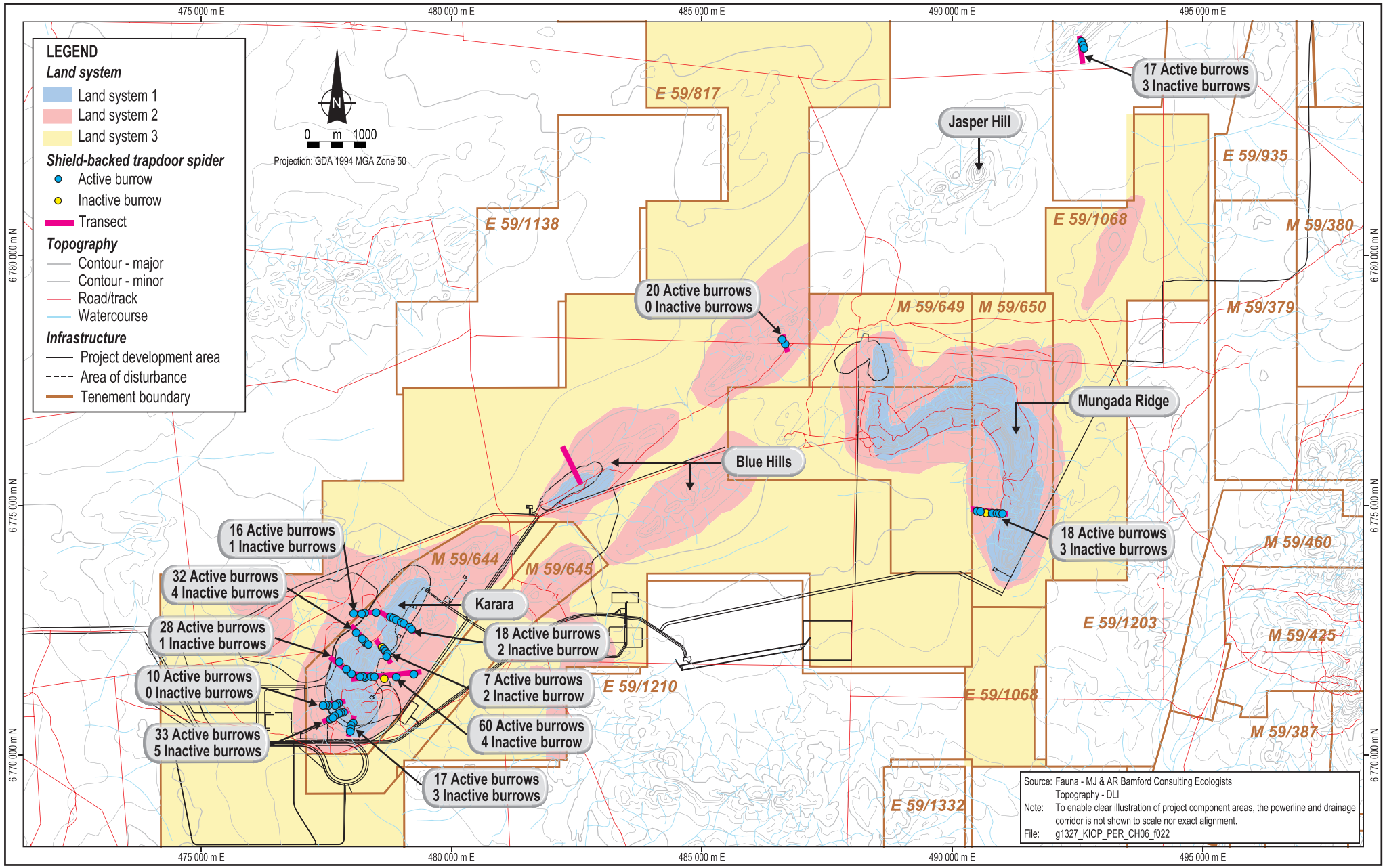


Figure 6.22 Location of Shield-backed Trapdoor Spider burrows at the minesite

All but one of the burrows were on the lower to mid-slopes of the ridges and the soil was almost always a gravely loam. Although the reason for the clumping of burrows is unknown, it is not obviously related to the environment around the quadrat, as quadrats with many burrows were not distinctive in soil, slope or vegetation.

In June 2008 (Appendix 24) a total of 238 *I. nigrum* burrows (219 active) were found across the 88 quadrats with a further 63 burrows (55 active) found when moving between quadrats (refer Figure 6.22).

Burrows were found on all transects and were distributed widely across the landscape, with higher densities on the mid-slopes (90 burrows in 20 quadrats) and on top of the ridge (29 burrows in 8 quadrats). These areas consisted of gravely-loam soils.

As determined on previous studies (Appendix 17), burrows were clumped with half the quadrats having no burrows and two quadrats each having over 20 burrows. Measurement of active burrows indicated a large number of small burrows which suggests a thriving population from successful recruitment of juveniles.

Results of the later investigation (Appendix 24) indicate that the Shield-backed Trapdoor Spider (*I. nigrum*) is abundant at Karara and occurs both in impact and non-impact areas with highest concentrations being in areas with gravely-loam soils. As previously noted, burrows were highly clumped which is likely to be due to juvenile spiders colonising around burrows of adult females.

Introduced Fauna

Rabbits, foxes, cats and goats were all recorded in field surveys of Karara and other nearby ridges.

6.3 Existing Environment – Linear Infrastructure Corridor

6.3.1 Vegetation and Flora

Woodman Environmental Consulting assessed the vegetation and flora values of the proposed LIC over three surveys, in October 2006, May 2007 and July 2007 (Appendix 13). This included an initial desktop assessment and literature review over a broad area, which contributed to the constraints mapping process for route selection, followed by flora and vegetation surveys of the optimised route. A distance of 50 m either side of the centre line of the LIC route was surveyed for its entire length from the minesite to Mingenew. Since completion of these surveys, the route alignment has changed to address safety issues. As a result of this, sections of the total LIC length (15.45 km in total, representing approximately 11% of the total LIC length) have not been surveyed (Figure 6.23). However, based on aerial photography, 91% of the unsurveyed sections are cleared paddocks while the remaining 9% has remnant vegetation. According to the DEC and Western Australian Herbarium databases, the remnant vegetation may contain *Verticordia spicata* subsp. *squamosa* (DRF), *Verticordia comosa* (P1), and other priority flora (Appendix 13). KML considers that these species could be avoided by appropriate alignment of the raw water pipeline trench and construction methods within the LIC. As such, prior to construction, the alignment along the these sections will be surveyed, and designed to avoid priority flora species as far as possible, with permits to take species applied for if necessary.

Vegetation

The eastern portion of the corridor (the first approximately 34 km) passes through relatively intact vegetation of good quality on former pastoral stations, currently owned by DEC. This section of the route runs parallel to the access road (Mungada Road at this location) and consists of 11 different structural vegetation communities plus an additional four degraded or disturbed communities. This vegetation comprises intact thickets, scrubs and low woodlands, as well as several areas that are degraded due to grazing, gravel extraction and other minor historical clearing.

The western portion of the corridor (approximately 100 km), from where it deviates from the access road to Mingenew, passes through cleared agricultural land with widely dispersed patches of good quality, intact vegetation. This section of the route consists of 18 different structural vegetation communities plus an additional eighteen degraded or disturbed communities. This vegetation comprises thickets, shrubs, woodlands, dwarf scrubs and salt pan communities. The route passes around the boundary of the Bowgada Nature Reserve (Nature Reserve C 40161).

There are three TECs known to occur within 5 km of the proposed route, but not on the route, none of which is listed under the EPBC Act:

- *Billeranga System.* This system was mapped by Beard (Beard 1976) between the Old Three Springs Road and Colgate Road, approximately 15 km southwest of Morawa. Five occurrences of this TEC are known, however all but one occurrence is on private property and 85 ha of this TEC is currently within the conservation estate (Mount Nunn Nature Reserve). There are seven Priority Flora known from the Billeranga System (Hamilton-Brown 2000a). This TEC is listed as vulnerable.

- *Koolanooka Hills System.* This system was mapped by Beard (Beard 1976) and is located adjacent to Lochada Road, approximately 25 km east of Morawa and near the Bowgada Nature Reserve. The Koolanooka Hills System is known from two chains of hills, the Koolanooka Hills situated east of Morawa, and a separate fork-shaped range situated to the south-east of the Koolanooka Hills. The known occurrences of the Koolanooka Hills System are currently under private ownership, leasehold or in shire reserves, with none reserved in the conservation estate. This TEC is listed as vulnerable.

- *Morilla Swamp*. This system is known from only one location, approximately 28 km east of Mingenew. This TEC is a small swamp, approximately 600 m in diameter, known to contain an isolated, potentially genetically unique population of River Red Gums (*Eucalyptus camaldulensis*) (Speed *et al* 1994). The Morilla Swamp is currently not included within the conservation estate. This TEC is listed as presumed totally destroyed.

Flora

The flora and vegetation survey of the eastern portion of the LIC identified 206 vascular plant taxa while the survey of the western portion identified 244 taxa. This includes plant species from 124 genera and 52 families. A full list of these species is included in Appendix 13.

The literature review and database search identified one DRF and 15 Priority Flora known to occur within 2 km of the corridor route. Flora and vegetation surveys recorded five of these species within the corridor survey area (Table 6.19).

Table 6.19 Flora species of conservation significance along linear infrastructure corridor

Species	Conservation Status
Baeckea sp. *Perenjori (J. W. Green 1516)*	Priority 2
Melaleuca barlowii	Priority 1
Persoonia pentasticha	Priority 3
Pityrodia viscid	Priority 3
Stenanthemum poicilum	Priority 2

There were seven introduced flora taxa identified in the eastern portion of the corridor and 14 introduced flora taxa identified in the western portion (see Appendix 13). These species include two Declared Plants under the *Agriculture and Related Resources Act 1976*, Paterson's Curse (*Echium plantagineum*) and Saffron Thistle (*Carthamus lanatus*).

6.3.2 Fauna

A desktop review of the fauna values along the proposed LIC was undertaken by Coffey Environments (formerly ATA Environmental) (see Appendix 18). The review covered Western Australia's online fauna database '*FaunaBase'*, DEC's threatened and priority species list, the EPBC threatened species list and past fauna survey reports to identify species that may occur within 10 km of the proposed corridor. The findings of the assessment are summarised below and provided in full in Appendix 18.

Fauna Habitat

The initial 50 km of the proposed alignment passes through native vegetation and a variety of fauna habitats including:

- open low eucalypt woodland over *Acacia* species;
- open low woodland of *Callitris glaucophylla*;
- thicket to dense thicket dominated by *Acacia* species;
- *Acacia* shrubland over a heath of *Thryptomene* on gravely loams of mid-slopes;
- mixed thicket on red loams and loamy-clays of rocky rises;
- *Acacia* thicket on rocky (granite) ridge; and
- *Chenopod* shrublands associated with the margins of salt lakes.

Appendix 18 provides and assesses the fauna values along this section of the LIC.

The remainder of the corridor is located within land that has been mostly cleared or altered by agricultural activities. Some remnant vegetation is present along roadsides and around Wheelhamby Lake. Three main fauna habitats have been identified in these remnant areas.

- low open woodland dominated by various *Eucalyptus* species;
- tall open shrubland containing dominant species of *Acacia rostellifera; and*
- open low heath of mixed species.

Faunal Assemblages

Fauna species with special conservation status under State and/or Commonwealth legislation having the potential to occur in the vicinity of the proposed corridor are identified in Table 6.20.

Table 6.20 Potentially-occurring significant fauna species along LIC

Priority Fauna Species[1]		Threatened Fauna Species under the EPBC Act	
Species	**Schedule/ Priority**	**Species**	**Status**
Mammals			
Western Brush Wallaby (*Macropus irma)*	Priority 4	Nil.	NA
Birds			
Malleefowl *(Leipoa ocellata)*	Schedule 1	Malleefowl *(Leipoa ocellata)*	Vulnerable
Carnaby's Black Cockatoo *(Calyptorhynchus latirostris)*	Schedule 1	Carnaby's Black Cockatoo *(Calyptorhynchus latirostris)*	Endangered
Peregrine Falcon *(Falco peregrinus)*	Schedule 4	Rainbow Bee-eater *(Merops ornatus)*	Migratory

[1] Listed under the *Western Australian Wildlife Conservation Act 1950* and DEC Priority Fauna List.

Table 6.20 Potentially-occurring significant fauna species along LIC (cont'd)

Priority Fauna Species[1]		Threatened Fauna Species under the EPBC Act	
Species	**Schedule/ Priority**	**Species**	**Status**
Birds (cont'd)			
Major Mitchell's Cockatoo (*Cacatua leadbeateri*)	Schedule 4	Fork-tailed Swift (*Apus pacificus*)	Migratory
Hooded Plover (*Charadrius rubricollis*)	Priority 4	Great Egret (*Ardea alba*)	Migratory
Australian Bustard (*Ardeotis australis*)	Priority 4	Cattle Egret (*Ardea ibis*)	Migratory
Bush stone-curlew (*Burhinus grallarius*)	Priority 4	Glossy Ibis (*Plegadis falcinellus*)	Migratory
Shy Heathwren (*Hylacola cauta whitlocki*)	Priority 4	Grey Plover (*Pluvialis squatarola*)	Migratory
Rufous Fieldwren (*Calamanthus campestris montanellus*)	Priority 4	Common Greenshank (*Tringa glareola*)	Migratory
White-browed Babbler (*Pomatostomus superciliosus ashbyi)*	Priority 4	Wood Sandpiper (*Tringa glareola*)	Migratory
Crested Bellbird (*Oreocia gutturalis gutturalis*)	Priority 4	Common Sandpiper (*Tringa hypoleucos*)	Migratory
		Sharp-tailed Sandpiper (*Calidris acuminata*)	Migratory
		Curlew Sandpiper (*Calidris ferruginea*)	Migratory
		Red-necked Stint (*Calidris ruficollis*)	Migratory
		Long-toed Stint (*Calidris subminuta)*	Migratory
		White-bellied Sea-eagle (*Haliaeetus leucogaster*)	Migratory
		Osprey (*Pandion haliaetus*)	Migratory
		White-winged Black Tern (*Sterna leucoptera*)	Migratory
Reptiles			
Western Spiny-tailed Skink (*Egernia stokesii badia*)	Schedule 1	Western Spiny-tailed Skink (*Egernia stokesii badia*)	Endangered
Carpet Python (*Morelia spilota imbricata*)	Schedule 4		
Woma or Ramsay's Python (*Aspidites ramsayi*)	Schedule 4		
Gilled Slender Blue-tongue *(Cyclodomorphus branchialis)*	Schedule 1		
Invertebrates			
Shield-backed Trapdoor Spider (*Idiosoma nigrum*)	Schedule 1	Nil.	
Tree Stem Trapdoor Spider (*Aganippe castellum*)	Schedule 1		
Snail (*Bothriembryon whitleyi*)	Schedule 2		
Cricket (*Psacadonotus seriatus*)	Priority 1		

[1] Listed under the *Western Australian Wildlife Conservation Act 1950* and DEC Priority Fauna List.

Mammals. 27 native and nine introduced mammal species may occur in the vicinity of the proposed LIC. The mammal assemblages along the corridor are expected to be similar to those recorded in the region and there are no obvious features of the mammal assemblage that warrant special attention or protection.

Birds. Database searches identified 197 bird species that may occur along the proposed infrastructure corridor. It is however, unlikely that the specific micro-habitat requirements for all these species will be present. The bird assemblages in the project area are likely to be similar to the assemblages recorded at Mt Gibson, White Wells, Karara and Mungada Ridge and therefore, not likely to be significant in a regional context.

Reptiles. Up to 82 reptile species may occur in the vicinity of the corridor including three species of conservation significance: carpet python, Western Spiny-tailed Skink and Gilled Slender Blue-tongue.

Amphibians. Up to 12 species may be present, however, many of these species are only present after rainfall events. No species have been identified that warrant special attention or protection from project activities.

Invertebrates. Four species of conservation significance potentially occur along the corridor.

Introduced Fauna. Rabbits, foxes, cats and goats were all recorded in field surveys of Karara and other nearby ridges and are likely to occur along the corridor.

6.4 Existing Environment - Access Road

6.4.1 Vegetation and Flora

Woodman Environmental Consulting assessed the vegetation and flora values of the proposed access road over three survey periods, in November 2005, November 2006 and February 2007 (Appendix 15). Surveys were undertaken along the entire length of the proposed access road from the minesite to the intersection with Morawa Road, 3 km north of Morawa, and at five proposed borrow pits along the route. A distance of 50 m either side of the existing access road was surveyed, utilising the same methods that were applied in the surveying of the minesite.

The access road route consists of 23 different structural vegetation communities plus an additional nine degraded or disturbed communities (refer Appendix 15 for figures). These include thickets, scrubs, woodlands and dwarf scrubs.

The eastern portion of the proposed access road, along Mungada Road, passes through relatively intact, good quality vegetation on former pastoral stations, currently owned by DEC, however, there are several areas that are degraded due to grazing, gravel extraction and minor historical clearing. In the agricultural areas surrounding Morawa, the route mainly passes through cleared paddocks with some, usually degraded, remnant patches of native vegetation, often occurring in thin strips along the road verge.

There is a sizeable portion of remnant native vegetation on private property, along Koolanooka Spring Road, however this has been degraded by stock grazing. This area is part of TEC 59 (Plant Assemblages of the Koolanooka System), which has a Vulnerable listing at a State level but is not listed under the Commonwealth EPBC Act. The TEC ranges over the Koolanooka Hills, surrounding footslopes, and the fork-shaped range to the south-east, referred to as the Perenjori Hills, covering a total area of approximately 3,496 ha (Hamilton-Brown 2000b). Woodman Environmental Consulting mapped four different structural vegetation communities along this portion of the route (T27, T28, T29 and W18) with vegetation dominated by thickets or scrubs mainly of *Acacia* species (including *A. acuminata*, A. *duriscula*, *A. tetragonophylla* and *A. quadrimarginea*), interspersed with open, low woodlands dominated by *Eucalyptus ebbanoensis* subsp. *Ebbanoensis*.

The Woodman Environmental Consulting flora and vegetation survey of the access road recorded a total of 285 discrete vascular plant species (from 129 genera and 51 families). Flora species of conservation significance identified within the proposed access route survey area are listed in Table 6.21.

Table 6.21 Flora species of conservation significance along proposed access road

Species	Conservation Status
Baeckea sp. Perenjori (J. W. Green 1516)	P2
Cryptandra imbricate	-
Tecticornia bulbosa	DRF
Melaleuca barlowii	P1
Persoonia pentasticha	P3
Stenanthemum poicilum	P2

Since completion of Appendix 8: *Cryptandra imbricata* ms has been published and is now no longer considered a Priority Flora species and *Halosarcia bulbosa* has been renamed *Tecticornia bulbosa* (Paul G.Wilson) K.A.Sheph. & Paul G.Wilson

The DRF species, *Tecticornia bulbosa*, was recorded adjacent to Munckton Road, as part of a previously recorded population. This species is listed as Vulnerable under both the *State Wildlife Conservation Act 1950,* and the Commonwealth EPBC Act. This population of *T. bulbosa* is under threat from grazing and changes to surface water drainage.

The priority flora species recorded along the access road are briefly described below:

- *Baeckea* sp. Perenjori (J. W. Green 1516) was identified in one location in Nature Reserve C40161, near Morawa. It is also known from other locations near Koolanooka, Wubin and Caron.
- *Cryptandra imbricata* was recorded in two locations along the proposed access road route. This species occurs throughout the region and has been recorded in numerous locations within the minesite area.
- *Melaleuca barlowii* was recorded at one location along the proposed access road route. This specimen was unable to be identified to species level due to a lack of flowering or fruiting material. *M. barlowii* is known from a number of locations within the region, including locations in the minesite area and within 2 km of the Access Road.
- *Persoonia pentasticha* was recorded in two locations along the proposed access road route and at one of the proposed borrow pit locations. *P. pentasticha* is widely scattered over a variety of habitats as single individuals or in small groups.
- *Stenanthemum poicilum* was recorded in five locations along the proposed access road route. *S. poicilum* is known from a number of locations, including Canna, Wilroy, Bremer Range and Warriedar Station. Although this species is not known from within the minesite area, it has been recorded on ironstone south of the project survey area.

In addition, five unusual flora specimens were collected, including one *Acacia* specimen that may be determined to be a new species. The collection of these species, represent range extensions, variations in type and potentially new taxon. Details of these species are provided in Appendix 15.

There are ten weed species identified along the route, none of which are listed under the *Agriculture and Related Resources Protection Act 1976*. However, Paterson's Curse (*Echium plantagineum*), a Declared Plant under the *Agriculture and Related Resources Act 1976*, is likely to occur in the area.

6.4.2 Fauna

The findings of fauna assessments (refer Section 6.2.3) as they relate to the access road are summarised in this section.

The faunal assemblage along the access road is expected to be rich as the route passes through a region of transition between pastoral and agricultural zones. The composition of the vertebrate faunal assemblage is shown in Table 6.22.

A number of species of conservation significance are known from the access road area, including CS1 Malleefowl, CS1 Major Mitchell's Cockatoo, CS1 Peregrine Falcon, the CS1 Skink *(Cyclodomorphus branchialis)* and the CS1 Western Spiny-tailed Skink *(Egernia stokesii)*.

There have been no sightings of any Malleefowl, or their mounds, along the access road route either during flora surveys of the route (Godden, Woodman Environmental Consulting Pty Ltd, pers. comm., 2007) or by site personnel undertaking road verge rubbish collection along the route (Harris, Karara Mining Services Pty Ltd Environmental Advisor, pers. comm., 2007).

Table 6.22 Vertebrate fauna expected along the access road

Fauna	Status[1] and number of fauna					
	CS1	CS2	CS3	Introduced	Extinct	Total
Amphibians (frogs)	-	-	2	-	-	8
Reptiles	4	1	13	-	-	69
Birds	11	7	3	2	2	168
Mammals	-	1	3	5	21	31

1 - Conservation Significance 1 (CS1): Species listed under State or Commonwealth Acts.
- Conservation Significance 2 (CS2): Species not listed under State or Commonwealth Acts, but listed in publications on threatened fauna or as Priority species by the DEC.
- Conservation Significance 3 (CS3): Species not listed under Acts or in publications, but considered to be of at least local significance due to their distribution pattern. Species at this level have links to preserving genetic biodiversity, may be at the edge of their range or may be sensitive to impacts such as habitat fragmentation.

Figure 6.23 Linear Infrastructure Corridor flora survey: unsurveyed section