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Kanmantoo Copper Project Mining Lease Proposal

Main Report

HILLGROVE
RESOURCES





Kanmantoo Copper Project

Mining Lease Proposal
Main Report



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Prepared by:
Enesar Consulting Pty Ltd
Level 1, 2-3 Greenhill Road Wayville South Australia 3510
p 61-8-7221 3588 f 61-8-7221 3510
e office@enesar.com.au www enesar.com.au

Project Director	David Browne
Project Manager	Tara Halliday
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Guide to the Kanmantoo Copper Project Mining Lease Proposal

The MLP comprises six volumes:

- Executive Summary.
- Main Report.
- Appendices Volume 1.
- Appendices Volume 2.
- Appendices Volume 3.
- Appendices Volume 4.

Information on how to view or obtain copies of this documentation and how to make a submission on the MLP is provided overleaf.

Viewing or Obtaining a Copy of the MLP

This document will be available for public review at the following locations:

- Department of Primary Industries and Resources South Australia, Level 7, 101 Grenfell Street, Adelaide, South Australia.
- District Council of Mount Barker, 23 Mann Street, Mount Barker, South Australia.

The report can also be examined for the duration of the public review on the Department of Primary Industries and Resources South Australia internet site at http://www.pir.sa.gov.au/minerals/public_notices.

Hard copies of the MLP Executive Summary together with a CD-Rom of the entire document are available on request from:

Hillgrove Resources Limited
42 Back Callington Road
Callington SA 5254
Telephone: +61 8 8538 5100
Facsimile: +61 8 8538 5255

Making a submission on the MLP

Persons wishing to comment on the MLP are invited to make submissions to:

Mining Regulation & Rehabilitation Branch
Department of Primary Industries and Resources South Australia
GPO Box 1671
Adelaide SA 5001
Fax: +61 8 8463 3109

Submissions will be treated as public documents unless confidentiality is requested. Copies of all submissions will be forwarded to Hillgrove Resources.

Summary Information

Mine owner:	Hillgrove Copper Pty Ltd and Kelaray Pty Ltd
Mine operator:	Hillgrove Copper Pty Ltd
Contact person:	Marty Adams Project Manager
Contact details:	Hillgrove Resources Limited Callington Project Office 42 Back Callington Road Callington SA 5254 Telephone: 08 8538 5100 Email: martya@hillgroveresources.com.au
Tenements:	MC 3510, MC 3833, MC 3834, MC 3835, MC 3836
Name of mining operation:	Kanmantoo Copper Project
Commodity to be mined:	Copper, gold, silver and garnet
MLP date:	October 2007

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2	Kanmantoo Copper Project Visual Assessment Report
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3B	Surface water quality data
4	Kanmantoo Copper Project Groundwater Impact Assessment
5	Kanmantoo Copper Project Flora Assessment
6	Kanmantoo Copper Project Fauna Baseline Survey and Impact Assessment
7	Kanmantoo Copper Project Socio and Economic Impact Assessment
8	Kanmantoo Copper Project Indigenous Archaeology and Cultural Heritage Assessment
9	Kanmantoo Copper Project Non-Indigenous Heritage Survey and Archaeological Assessment
10	Kanmantoo Copper Project Traffic Impact Assessment
11	Kanmantoo Copper Project Geochemistry (Acid Rock Drainage) Assessment
12	Kanmantoo Copper Project Integrated Waste Landform Design

- 13 Kanmantoo Copper Project Surface Water Management Conceptual Design
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- 15 Kanmantoo Copper Project Noise Assessment
- 16 Kanmantoo Copper Project Blasting Impact Assessment
- 17 Kanmantoo Copper Project Mine Closure and Rehabilitation Plan

Attachments

- 1 Kanmantoo Project Update Newsletter

1. Introduction

Hillgrove Copper Pty Ltd (Hillgrove) and its joint venture partner Kelaray Pty Ltd (Kelaray), are proposing the development of the Kanmantoo Copper Project (hereafter referred to as 'the project'), located approximately 44 km southeast of Adelaide within the Mount Barker District Council area in South Australia (Figure 1.1). The project involves the redevelopment of the former Kanmantoo Copper Mine, an open pit mine that last operated in 1976.

The project will use open pit mining techniques and a conventional crushing, grinding and flotation circuit to produce approximately 70,000 to 80,000 tonnes per annum (tpa) of copper-gold concentrate. Ore will be mined and processed at a rate of 250 tonnes per hour (tph), over an initial mine life of eight years. The copper-gold concentrate will be transported by road to the Port of Adelaide for shipment to an overseas smelter.

Information about Hillgrove and Kelaray is provided in Chapter 2.

1.1 Project History

The Kanmantoo Copper Project lies in an area that has a long history of mineral exploration and mining. Mining at Kanmantoo began in 1846 and continued to 1874 when a collapse in world copper prices forced the mine to close. Intermittent prospecting continued in the area until the late 1960s when exploration by a joint venture between North and South Broken Hill Metals led to the discovery of the main deposit at Kanmantoo.

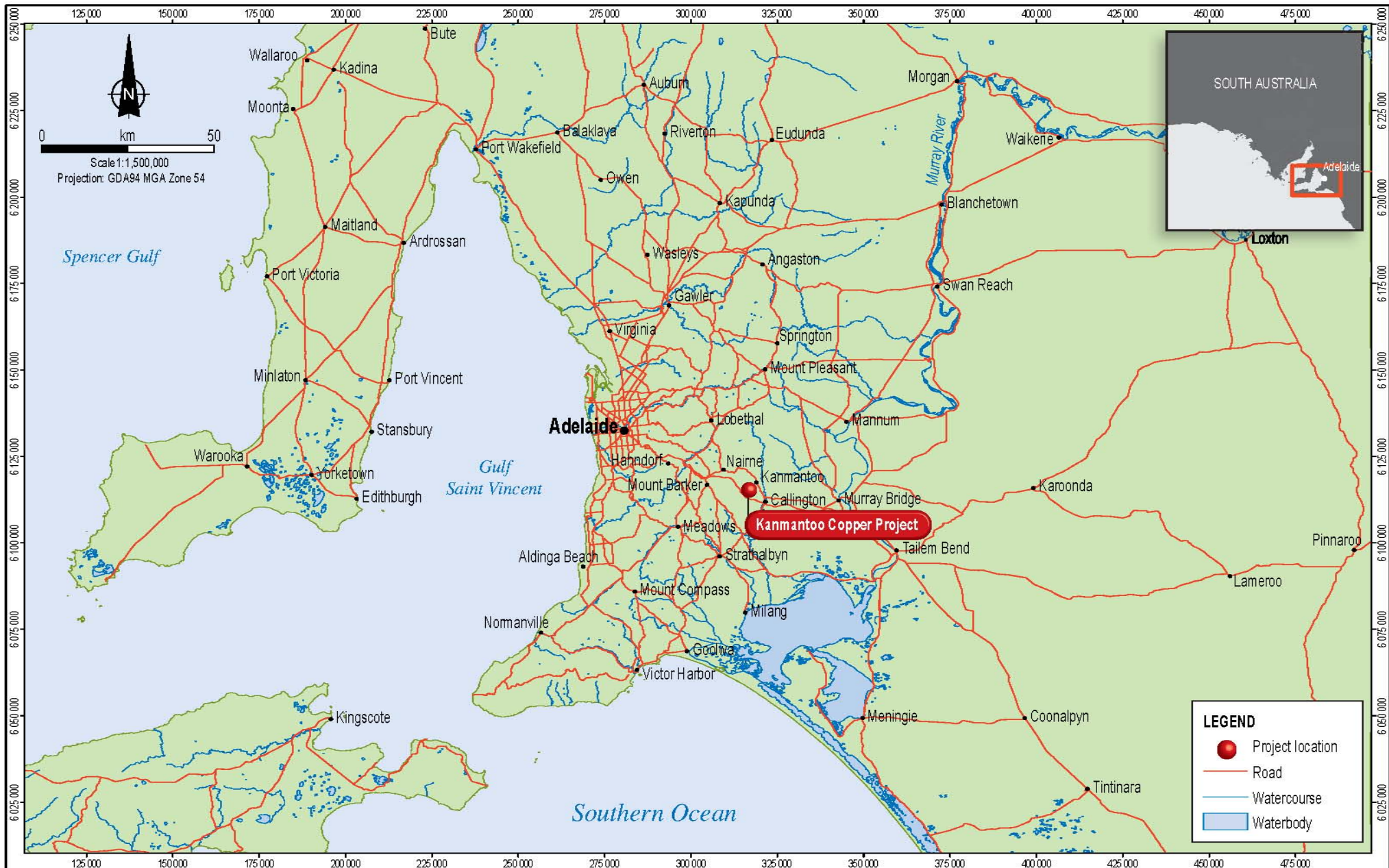
In the early 1970s, Kanmantoo Mines Limited (a joint venture between North and South Broken Hill Metals) commenced open pit mining over the northernmost workings of the earlier Kanmantoo mines. The mine operated for six years when, once again, low copper prices forced the operation to close. Remnant mining infrastructure includes an open pit (approximately 120-m deep), processing plant infrastructure (currently used as a fertiliser manufacturing facility) and a partially revegetated waste rock dump and tailings dam (Figure 1.2).

In late 2003, Hillgrove began an exploration program in the Kanmantoo area; and, in April 2004 the company exercised an option to acquire the Kanmantoo Copper Mine mining lease (ML 5776). In October 2006, Hillgrove completed a preliminary feasibility study (PFS) for the Kanmantoo Copper Project; and, based on the favourable results of the study, a definitive feasibility study (DFS) was commenced in December 2006. The DFS is scheduled for completion in the third quarter of 2007 and will lead to a decision by the Hillgrove board as to the future of the project.

1.2 The Mining Lease Proposal

1.2.1 Objectives and Context

This mining lease proposal (MLP) is the principal document used by the Department of Primary Industries and Resources South Australia (PIRSA) to formally obtain stakeholder comment on the mining proposal and to make an informed judgement on whether or not the proposal should proceed, i.e., will the project deliver a net public



Source:
 Place names, road, rail and drainage from GEODATA TOPO 250K (optimum scale 1:250,000)



Date:
 14.02.07
 MKD:
 Hillgrove Resources - Kanmantoo GIS
 Job No:
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Hillgrove Copper Pty Ltd

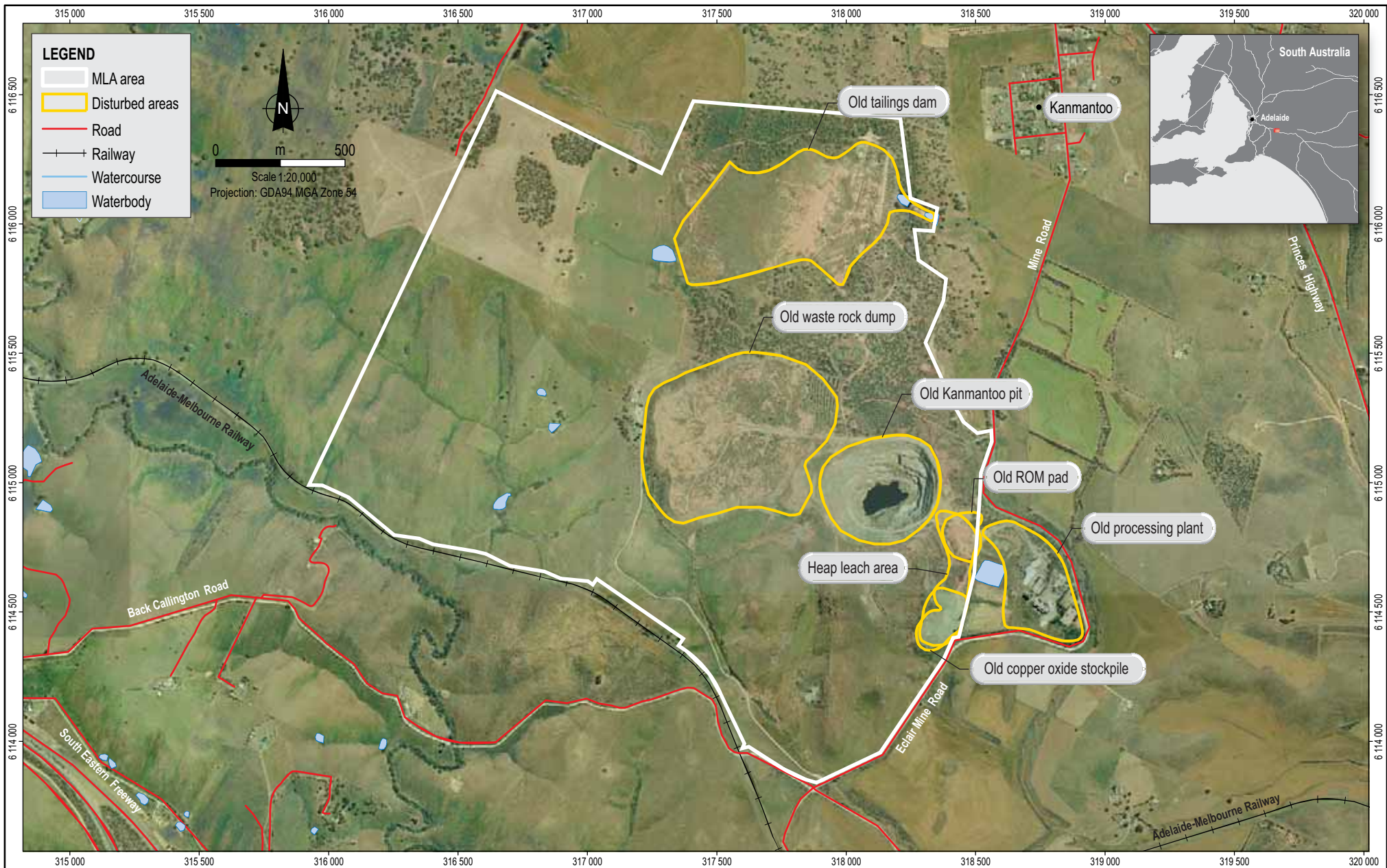
Kanmantoo Copper Project



Project location

Figure No:

ES1



benefit (PIRSA, 2007a). The MLP is also used by PIRSA to establish appropriate lease or licence conditions for the operation.

The MLP has therefore been prepared in accordance with the requirements of the South Australian *Mining Act 1971* with the following objectives:

- To provide details of the project to the regulatory authorities, public and other stakeholders.
- To identify the environmental and social risks of the proposal.
- To outline management measures to minimise these risks.
- To demonstrate that there is a net public benefit for the proposal and social, environmental and economic outcomes that are broadly acceptable to stakeholders.

Statutory requirements for the project are discussed in more detail in Chapter 4.

The MLP is based on PIRSA's guidelines Mining Approvals in South Australia, version 1.4¹ (PIRSA, 2007a) and Guidelines for the Preparation of a Mining and Rehabilitation Program, version 3.12 (PIRSA, 2006). Revised guidelines (Preparation of a Mining Lease Proposal or Mining and Rehabilitation Program, Revision 4.8 (PIRSA, 2007b)) were released publicly by PIRSA in July 2007 (during the final stages of the preparation of this report), and these guidelines have also been addressed where possible. In addition to meeting PIRSA's requirements, Hillgrove is committed to undertaking a comprehensive environmental and social impact assessment of the project, and this commitment is reflected in the detail and scope provided in the MLP.

The MLP also contains a number of environmental objectives (see Chapter 9) to which Hillgrove is committed. Where possible, these commitments are specific and quantitative. However, this is not always achievable since final engineering design will not be undertaken until after project approval. More prescriptive commitments will be developed in parallel with the detailed design and these will be documented in the Mining and Rehabilitation Program (MARF).

1.2.2 Structure and Content of the MLP

The MLP is in three parts (Table 1.1):

- The Executive Summary, which provides an overview of the project and the MLP.
- The Main Report (this report), which is written to be understood without reference to the specialist studies reports on which it is based.
- A series of appendices containing the specialist studies reports whose content is summarised in the main report.

¹ Version 1.7 of these Guidelines was released on 28 June 2007, after the MLP was drafted.

Table 1.1 Kanmantoo Copper Project MLP documentation

Appendix No.	Title/Subject	Author
	MLP Executive Summary	Enesar Consulting/Hillgrove
	MLP Main Report	Enesar Consulting/Hillgrove
1	Air Quality, Odour and Greenhouse Gas	Tonkin Consulting
2	Visual	Wax Design Space
3	Surface Water (Water Quality)	Enesar Consulting
4	Groundwater	Resource & Environmental Management
5	Flora	Ecological Associates
6	Fauna	Ecological Associates
7	Socio-economic	Enesar Consulting
8	Indigenous Cultural Heritage	Pacifica Sené
9	Non-Indigenous Cultural Heritage	Australian Heritage Services
10	Traffic	Maunsell Australia
11	Geochemistry	Environmental Geochemistry International
12	Integrated Waste Landform Design	Coffey Mining
13	Surface Water (Management)	Aquaterra
14	Native Vegetation Management Plan	Enesar Consulting
15	Noise	Sonus
16	Blasting	Blastotechnology
17	Mine Closure and Rehabilitation	Enesar Consulting

The main report comprises 15 chapters, a title page and a table of contents that outlines figures, tables and plates in the relevant chapters. The format of the main report is:

- Chapter 1 (this chapter) – background, project history, project objectives, report structure and report conventions.
- Chapter 2 – details of the project proponent.
- Chapter 3 – potential benefits of the project.
- Chapter 4 – legislative context (including international conventions, national policies and codes of practice) within which the project will be evaluated and under which it will be constructed and operated.
- Chapter 5 – description of the existing environment, including the physical, socio-economic and heritage aspects.
- Chapter 6 – detailed description of the project.
- Chapter 7 – description of alternatives considered during project design and planning, including reasons for selection of particular options.
- Chapter 8 – description of stakeholder consultation to date, and that proposed for the future.

- Chapter 9 – for each environmental aspect, identification of the potential issues (risks); description of the proposed avoidance, mitigation and management measures; detailed assessments, of the residual impacts in terms of likelihood and consequence; description of Hillgrove’s environmental and social objectives, the related assessment criteria and a summary of the control measures; and description of monitoring.
- Chapter 10 – summary of proposed monitoring and reporting regime.
- Chapter 11 – conceptual mine closure and rehabilitation plan.
- Chapter 12 – description of the environmental management system that will be adopted for the project.
- Chapter 13 – bibliographic details of each reference used in the MLP.
- Chapter 14 – glossary.
- Chapter 15 – details of the study team.

1.2.3 Report Conventions

The Kanmantoo Copper Project is a proposed development, and its implementation is conditional on a number of factors such as a favourable DFS result, project approvals and successfully raising the required finance. For reason of style, however, the project and related proposed activities have been described in the active mood ‘will’ rather than ‘would’.

Information contained herein that describes existing conditions, avoidance, management and mitigation measures, and residual impacts is taken from both literature sources and the specialist studies reports listed in Table 1.1. To avoid excessive repetition, the number of references in the text to these sources, particularly when summarising information from the specialist studies reports in Chapters 5 and 9, has been minimised.

2. Proponent Details

2.1 Project Proponent

The proponent of the Kanmantoo Copper Project (hereafter referred to as 'the project') is Hillgrove Copper Pty Ltd (Hillgrove), a fully owned subsidiary of Hillgrove Resources Limited. The project will be developed under a joint venture agreement with Kelaray Pty Ltd (a fully owned subsidiary of Argonaut Resources¹), which holds a 10% interest in EL 3277, part of one of the mining lease application (MLA) areas.

Hillgrove Resources Limited is an Australian resources company listed on the Australian Stock Exchange, that focuses on identifying opportunities that can be brought into production readily or have a clearly defined value-adding route within a clearly understood risk environment. Commodities that are of particular interest to the company include copper, gold, garnet, silver, lead, zinc, uranium and natural gas.

Hillgrove Resources Limited has a strategic alliance with Sempra Metals and Concentrates, a subsidiary of Sempra Energy a Fortune 500 Company, involving a \$12 million equity and debt package to assist the development of the project.

Hillgrove Resources Limited has a 31% shareholding in InterMet Resources Limited, which has an extensive portfolio of exploration interests in South Australia.

The company has offices in Sydney and Perth and a project office for the Kanmantoo Copper Project in Callington. Contact details are given in Table 2.1.

Table 2.1 Hillgrove contact details

Perth Exploration Office 20 Howard Street Perth WA 6000 Telephone: 08 9322 6377 Facsimile: 08 9322 6640 Contact: Dale Ferguson Director – Exploration and Operations dalef@hillgroveresources.com.au	Callington Project Office 42 Back Callington Road Callington SA 5254 Telephone: 08 8538 5100 Facsimile: 08 8538 5255 Contact: Marty Adams Project Manager martya@hillgroveresources.com.au
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2.2 Project Location and Mining Tenements

The project is located approximately 44 km southeast of Adelaide in the southern Mount Lofty Ranges of South Australia. The closest towns to the proposed mine are Kanmantoo, approximately 1.5 km northeast of the mine, and Callington, approximately 4 km southeast of the mine.

¹ Argonaut Resources is an international mineral exploration company listed on the Australian Stock Exchange (ASX code ARE). The principle activities of Argonaut Resources are joint ventures with partners on its South Australian tenements and to progress the exploration and development of its two Laos-based tenements.

The mine footprint and associated infrastructure are located within a 436-ha area, which is covered by three separate MLA areas and is defined in this report as the MLA area (Figure 2.1). The first MLA area comprises mineral claims: MC 3833, MC 3834 and MC 3510 (which is located over an existing mining lease (ML 5776) registered to Hillgrove Resources Limited). The second MLA area comprises mineral claim MC 3836 and covers part of an exploration licence, which is a joint venture between Hillgrove Resources Limited (90%) and Kelaray Pty Ltd (10%). The third MLA area comprises mineral claim MC 3835.

The mining lease (ML 5776) was granted to South Australian Mining Resources Pty Ltd in 1991 for the purpose of processing copper and associated minerals from the existing ore stockpiles at Kanmantoo. Hillgrove acquired the rights to the hard rock minerals in 2003 and is now the registered holder of the lease.

The status of tenements within the MLA areas is summarised in Table 2.2 and shown on Figure 2.1.

Table 2.2 Summary of tenements within the MLA areas

Existing Tenements/ Land Ownership	
MLA 1—Mineral Claims: MC 3833, MC 3834 and MC 3510	Landowner
Mining lease—ML 5776	Hillgrove Resources Limited
Old Integrated Landfill—DP 20509 A59 CT5123 folio 515	Kanmantoo Properties Pty Ltd
MLA 2—Mineral Claim: MC 3836	Landowner
Paringa Station—DP 20509 A58 CT5366 folio 650	Kanmantoo Properties Pty Ltd
MLA 3—Mineral Claim: MC 3835	Landowner
Paringa smelter block—DP 20509 A57 CT5123 folio 514	Kanmantoo Properties Pty Ltd

2.3 Land Tenure

The underlying tenure of the MLA area is freehold and all three land titles (Paringa station, old integrated landfill and Paringa smelter block) are held by Hillgrove's wholly owned subsidiary, Kanmantoo Properties Pty Limited (see Figure 2.2 and Table 2.2).

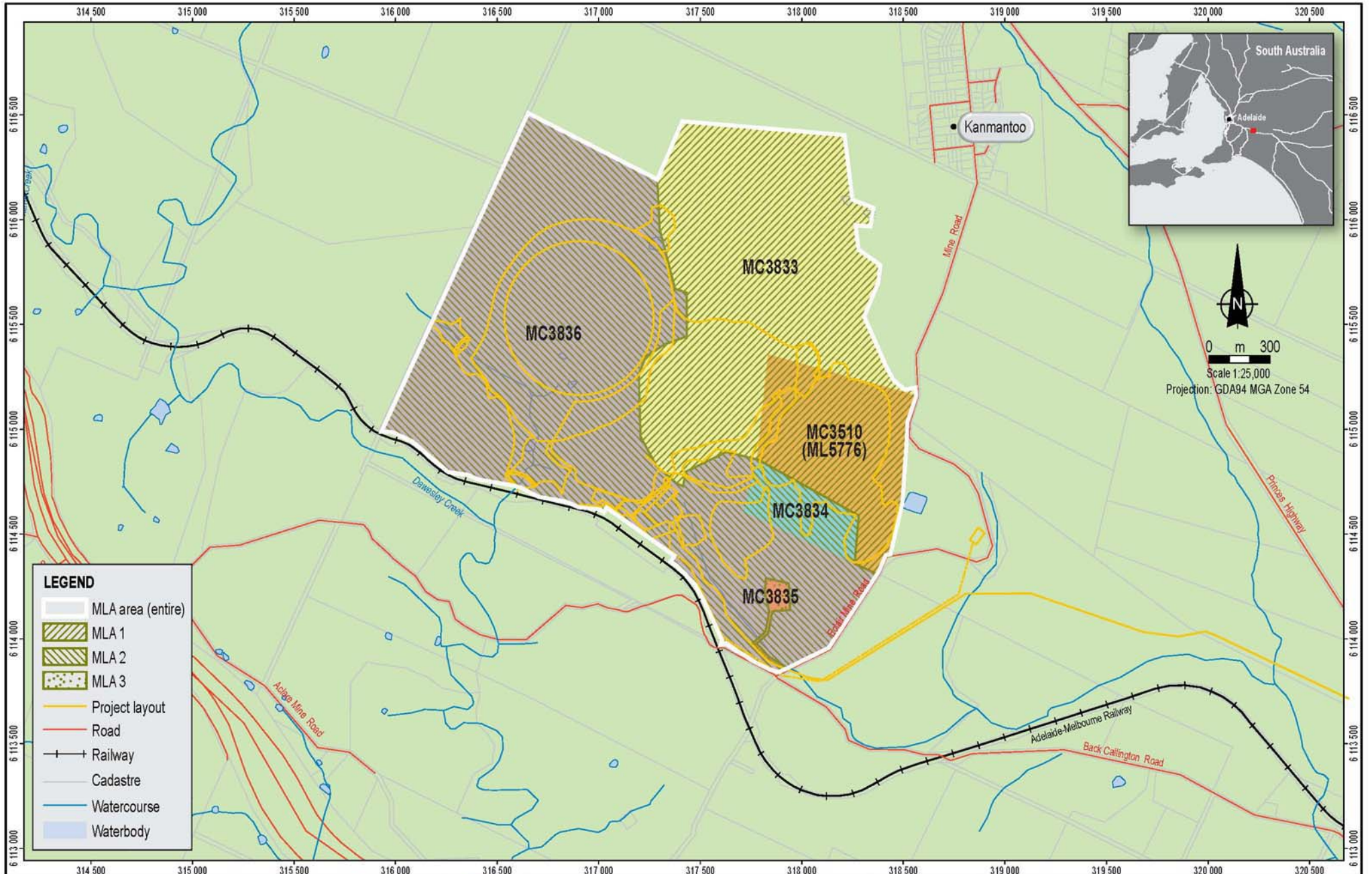
Hillgrove has purchased a number of properties surrounding the MLA area and has other forms of arrangements with the other surrounding landowners. The different landholders adjacent to the MLA area are shown in Figure 2.2.

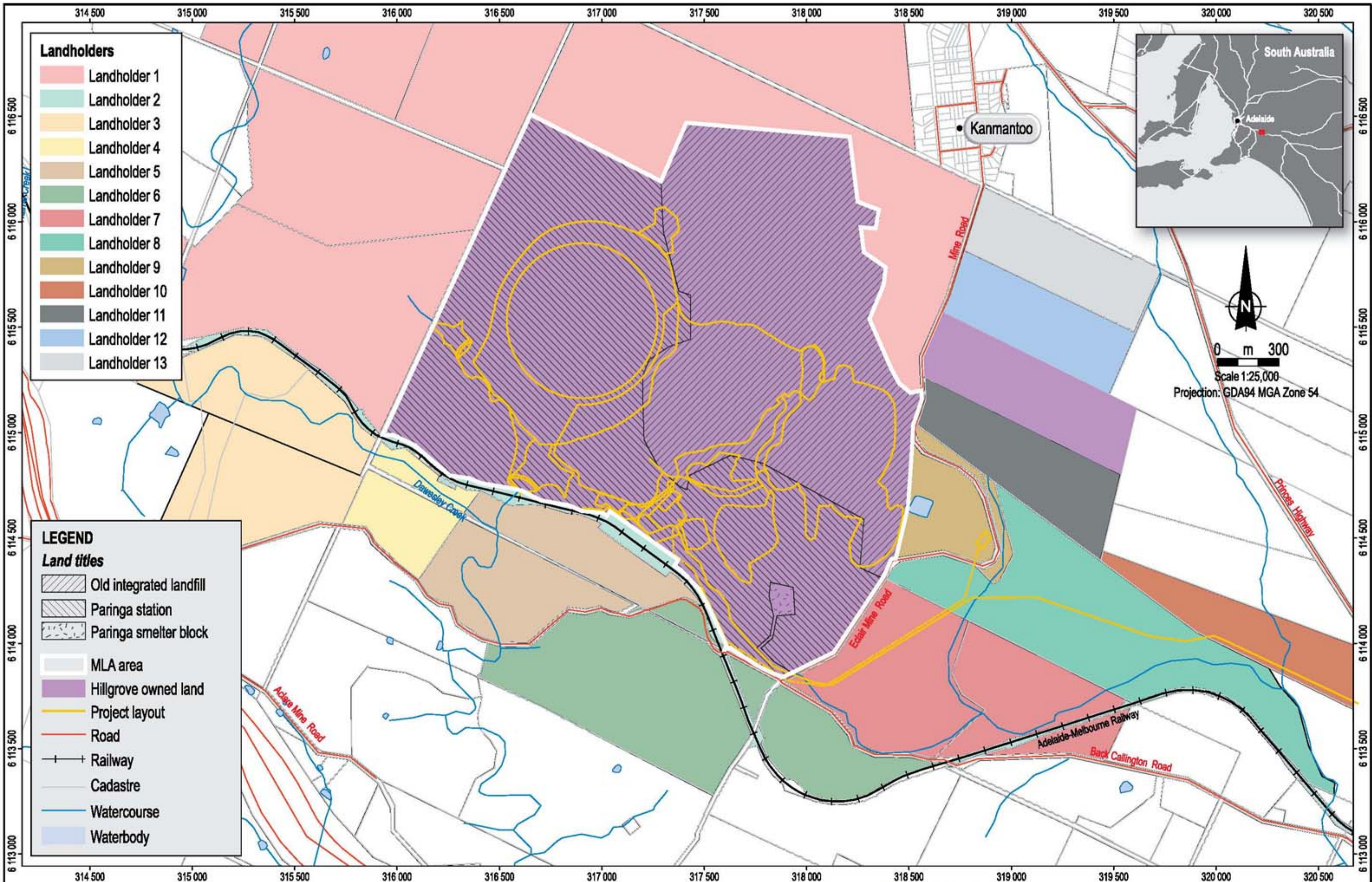
There are no Native Title applications or registered claims in place over the MLA area. The Kurna Peoples Native Title claim lies approximately 12 km to the west of Mt Barker and the Ngarrindjeri and Others Native Title Claim lies approximately 17 km to the east, along the western border of the Ferries McDonald Conservation Park.

There are no state heritage listed places in the MLA area.

2.4 Local Government

The MLA area is in the Mount Barker District Council local government area. It is also within the Tributary Zone of the River Murray Protection Area (Figure 2.3), meaning that the application for a mining production tenement requires referral to and assessment by the Minister for the River Murray. This is discussed further in Section 4.1 of this report.





- Landholders**
- Landholder 1
 - Landholder 2
 - Landholder 3
 - Landholder 4
 - Landholder 5
 - Landholder 6
 - Landholder 7
 - Landholder 8
 - Landholder 9
 - Landholder 10
 - Landholder 11
 - Landholder 12
 - Landholder 13

- LEGEND**
- Land titles**
- Old integrated landfill
 - Paringa station
 - Paringa smelter block
 - MLA area
 - Hillgrove owned land
 - Project layout
 - Road
 - Railway
 - Cadastre
 - Watercourse
 - Waterbody

Source:
 Land parcels from Hillgrove
 Place names, cadastre, roads, rail and drainage from DEH (optimum scale 1:50,000)
 Project layout from Hillgrove Resources

enesar
 people + places

Date: 18.09.07
 MXD: HillgroveResources_KanmantooGIS
 Job No: 5000_02_F02.02_GIS_AI

Hillgrove Copper Pty Ltd
 Kanmantoo Copper Project

HILLGROVE
RESOURCES

Land tenure

Figure No:
2.2



Source:
Place names, roads, rail and drainage from GEODATA TOPO 250K (optimum scale 1:250,000)
Prescribed water resource areas and River Murray protected area from DWLBC

Date: 16.08.07
 WRD:
 Hillgrove Resources, Immerb-GIS
 Job No: 5000_02_F02.03_GIS_AI

Hillgrove Copper Pty Ltd
 Kanmantoo Copper Project



River Murray Protection Area
 and Ramsar-listed wetland

Figure No:
2.3

3. Project Benefits

3.1 Introduction

This chapter provides an overview of the potential benefits of the project. PIRSA guidelines (PIRSA, 2007a) require that the MLP demonstrate that there is a net public benefit¹ for the proposal.

The project is expected to result in:

- Economic benefits, such as expenditure during construction and operation, royalty payments and salaries.
- Social benefits, such as employment opportunities, training and education.
- Environmental benefits, such as rehabilitation of areas of disturbance from previous mining activities, the provision of a significant environmental benefit offset area for native vegetation, the potential use of recycled water from the Laratinga Effluent Treatment Facility as the primary water source during project operations, and potential use of the open pit as a water storage post-closure.

These benefits are discussed below, with reference provided to the section of the MLP where they are discussed in detail.

3.2 South Australian Context

The South Australian Government has identified the mineral and energy resources industries as key sectors for the state's prosperity and development of regional communities. In 2003, the value of mineral production for South Australia was \$1.01 billion, with mineral royalties contributing \$28.4 million to the State Government (PIRSA, 2005).

This section outlines how the project is consistent with, and will help assist, the objectives under the relevant South Australian and local government strategic initiatives.

3.2.1 South Australia's Strategic Plan

South Australia's Strategic Plan was launched in 2004, with the following broad objectives (SASP, 2007):

- Growing prosperity.
- Improving wellbeing.
- Attaining sustainability.
- Fostering creativity and innovation.

¹ This MLP presents an environmental and social impact assessment for the project and includes information and feedback obtained during stakeholder consultation. PIRSA, through the public consultation process, will determine if this project presents a net public benefit.

- Building communities.
- Expanding opportunities.

In July 2004, the government introduced the Plan for Accelerating Exploration (PACE) initiative to promote mineral exploration and assist the state to achieve its Strategic Plan objectives of (i) maintaining mineral exploration expenditure at \$100 million per annum, and (ii) growing mineral production and processing expenditure to \$4 billion per annum by 2014 (PIRSA, 2007c). One of the key objectives of the PACE program is to increase exploration expenditure by the mineral and petroleum resources sectors and promote new discoveries and opportunities for regional development, employment and exports. The PACE initiative has been highly successful with mineral exploration expenditure totalling \$171.8 million for the four quarters to September 2006 compared with \$77.1 million for the four quarters to September 2005 (Government of South Australia, 2006).

The development of the project is consistent with Objective 1 of South Australia's Strategic Plan and PACE initiative, particularly as the project will grow prosperity by bringing benefits to the regional, state and national economies in the form of royalties and taxes, and will provide employment opportunities across a range of industries.

3.2.2 Planning Strategy for Regional South Australia

The Planning Strategy for Regional South Australia (Inter Region Planning and Development–Central Hills) (Planning SA, 2003) sets a range of broad and industry-specific targets for development. The development of the project is consistent with the objectives of this strategy by:

- Encouraging a large new development with high levels of investment.
- Protecting a mineral resource against competing development and encouraging value-adding in the district.
- Encouraging opportunities in extractive industries.
- Developing manufacturing to support primary industries.

3.2.3 Planning Strategy for Outer Metropolitan Adelaide Region

The Planning Strategy for Outer Metropolitan Adelaide Region (Planning SA, 2006) also sets a range of broad and industry-specific targets for development. The development of the project is consistent with the objectives of this strategy by:

- Utilising well-located and suitably serviced land for industrial and commercial development.
- Providing increased opportunities for the development of alternative water re-use schemes in an appropriate location.
- Developing infrastructure to improve trade and export capabilities.
- Protecting an existing mining site from encroachment of incompatible or conflicting uses.

- Ensuring mineral resources are identified and access to land for exploration, mining and value-adding industries is maintained.
- Rehabilitating a disused mine site and progressively rehabilitating existing operations.

3.2.4 Adelaide Hills Regional Development Board Strategic Plan

The Adelaide Hills Regional Development (AHRD) 2006-2009 Strategic Plan (AHRD, 2006) sets a range of targets for development in the region. The development of the project is consistent with the objectives of the plan and will help the AHRD Board meet its targets by:

- Increasing business investment through a major project in the region (Objective 2–Investment).
- Increasing inter-regional, national and international export business originating from the region (Objective 3–Exports).
- Developing the small business sector in the region (Objective 4–Jobs).
- Maintaining a business environment in the region that is competitive at an inter-regional, national and international level (Objective 5–Infrastructure).
- Fostering the development of innovative, inter-regionally, nationally and globally competitive business in the region (Objective 6–Innovation).

3.2.5 Adelaide Hills Council Strategic Management Plan

The Adelaide Hills Council Strategic Management Plan (AHC, 2004) is a high-level document that provides the focus for the council's service delivery over the three-year period from 2004 to 2007. The development of the project is consistent with the objectives of this plan by delivering appropriate infrastructure (in concert with other stakeholders) to meet special needs such as fire risk and regional freight transport corridors.

The revised Strategic Management Plan for the next three years (i.e., 2008 to 2011) has not been released.

3.2.6 Mount Barker District Community Strategic Plan

Mount Barker's District Community Strategic Plan (2004-2007) (DCMB, 2004) sets out the community's expectations for its local area until 2007. The plan is to be used as a principal reference document in the planning and provision of services in the district that have either a direct or indirect influence on the economic, physical, community, social and environmental aspects of the area.

The development of the project is consistent with the objectives of this plan by:

- Encouraging partnerships between the community and business.
- Providing local employment opportunities in a diverse business environment.

- Ensuring the continued availability of mining activity by restricting incompatible development.

The revised Strategic Plan for the next three years (i.e., 2008 to 2011) has not been released.

3.3 Economic Benefits

Hillgrove predicts the following benefits over the life of the mine:

- Total capital investment (e.g., project expenditure and investment in additional infrastructure) of approximately \$100 million.
- Total, unescalated revenues of approximately \$650 million.
- Annual operating expenditure of approximately \$55 million.
- Annual government royalties of approximately \$1.3 million per annum for the first five years then approximately \$3.5 million per annum.
- Annual salaries for Hillgrove employees of approximately \$4.8 million per annum (excluding on-costs) and for contractors, approximately \$7.0 million.
- Increased incomes for people elsewhere in the region, including local and peripheral communities of approximately \$20 million per annum.

The economic benefits outlined above will also be experienced at the local and peripheral community level:

- The local communities, i.e., the residents of Callington and Kanmantoo, will receive indirect benefits through corporate support of sporting teams, community activities and spending in local businesses.
- Sponsorships and donations will also be made to peripheral communities.
- All local and peripheral communities will also experience economic benefits associated with direct and indirect employment of local residents, spending in businesses and general increased levels of economic activity.

In addition, the project is expected to:

- Have economic benefits to Hillgrove shareholders.
- Improve South Australia's balance of trade.
- Be a more profitable utilisation of land, compared to the current land use of MLA area.
- Have demonstration benefits for other small mineral companies who are considering investing in South Australia.

Further detail on the economic benefits of the project are provided in Section 9.10.6.

3.4 Social Benefits

The project is likely to result in a range of social benefits, including:

- Increased employment opportunities.
- Increased support for communities.
- Training and education.

These benefits are summarised below. It is also likely that a 'flow-on' of social (and economic) benefits will result if more regionally based industry is encouraged to take advantage of the opportunities presented by the development of the project. Targeted programs by local council or regional development groups, in collaboration with the Industry Capability Network South Australia, will maximise the potential for this.

A more detailed analysis of socio-economic impacts is provided in Section 9.10.6.

3.4.1 Employment

Workforce

The project will increase the number and variety of employment opportunities at local, peripheral, state and possibly national level.

The operations workforce at the Kanmantoo mine is likely to comprise over 150 people including 65 Hillgrove staff (in fields such as mining, processing, maintenance, administration, and health, safety and environment) and 85 mining contractors (truck, front-end loader, excavator and bulldozer drivers, electrical and mechanical fitters, and surveyors) as well as other contractors (construction, transport, mechanical servicing, cleaners, couriers and maintenance staff).

Flow-on Employment

The REMPLAN model, built by La Trobe University in Victoria to assess direct and flow-on implications across industry sectors and Gross Regional Product for a region, predicted that for every job created directly as result of the Kanmantoo Copper Project, the potential exists within the local and regional areas for 2.2 additional jobs to be created (ERU, 2006). Therefore, it is anticipated that 150 direct jobs and up to 330 flow-on jobs could be created by the project. The flow-on jobs are predicted to occur within the following industries:

- Retail trade (104 positions).
- Wholesale trade (34).
- Manufacturing (23).
- Transport (21).
- Property and business services (18).
- Health and community services (18).
- Agriculture, forestry and fishing (18).
- Health and community services (18).
- Other industries (76).

Sources of Labour

The workforce will be initially sourced from the local, regional, state and national level. Benefits for the local community will be determined by the 'employability' of people living in Callington and Kanmantoo. Employees will generally be South Australian-based during operation of the project, i.e., there is no designated fly-in, fly-out workforce.

Sourcing labour from within the existing, local labour market will increase local employment opportunities and may provide incentives for more skilled workers to move to the area and for skilled workers who have left the area to return. This type of structural adaptation in the workforce is common to the entry of any new industry into an area and is likely to create opportunities for both the existing and future workforce.

3.4.2 Community Support

The project is likely to result in:

- Increased support to communities, with this centred on peripheral communities with accommodation suitable for employees (i.e., the larger towns of Strathalbyn, Mount Barker and Murray Bridge) and local communities (i.e., those closest to the mine) which will benefit from sponsorship of local sporting clubs and grants for the local school (e.g., Callington and Kanmantoo).
- Improved service provision for local and peripheral communities due to additional funding for schools and other services.

3.4.3 Training and Education

Hillgrove employees and contractors will receive training and education associated with their work on the project. This will have significant consequences for those trained, as skills and knowledge can be applied elsewhere after the project is completed. However, there is the potential for the benefits of this training to remain highly localised.

3.5 Environmental Benefits

3.5.1 Best Practice Mine Rehabilitation

Legacy from Previous Mining Operations

A significant environmental legacy has been left by previous mining operations in the MLA area, with approximately one-quarter of the MLA area affected. The last period of mining ceased in 1976, with limited rehabilitation occurring after mine closure. Legacy issues are associated with the following features (see Section 11.4 for further detail):

- Old open pit:
 - Standard industry practice is to construct an earth bund around the perimeter of the pit to prevent accidental vehicle access. Currently no such bund exists.
 - The old open pit currently contains approximately 100,000 kL of water which has a pH of 2.8 and is high in metals (see Section 5.7.4 for further detail).
- Old waste rock dump:

- Separation of non–acid-forming (NAF) waste rock and potentially acid-forming (PAF) waste rock does not appear to have been undertaken with evidence of PAF rock on the waste rock dump.
- Evidence of acid rock drainage.
- Visual assessment of the waste rock dump indicates that vegetation on the top of the old waste rock dump is being impacted by the presence of salts, likely as a result of oxidation of pyrite and the subsequent formation of acid conditions.
- Revegetation of the old waste rock dump has been limited to the top of the dump where native species have been planted. However, vegetation establishment and colonisation of the surface has been poor. No attempts have been made to revegetate the batters of the old waste rock dump and these remain largely devoid of vegetation.
- There has been no final contouring of the waste rock dump to make it blend with the surrounding landscape; as a result, the landform has a relatively high visual impact, particularly since it is largely devoid of vegetation.

The old tailings dam was constructed as a valley fill facility with a wall constructed across a valley and tailings contained behind. While the design of the tailings dam required a compacted clay layer for the base of the facility, it is understood that this clay liner was not constructed. No engineered cover system for the old tailings dam was developed to prevent acid drainage. PIRSA acknowledges that Hillgrove, as the tenement holder, has no liability for the environmental impacts arising from earlier mining activities including the old tailings dam. Hillgrove's operations will have no impact on the facility.

Further detail on the existing conditions resulting from previous mining operations at Kanmantoo is provided in Section 11.4.

Post-Closure Rehabilitation

The legacy issues listed above will be addressed by:

- Open pit:
 - Surrounding the open pit by an abandonment bund to prevent inadvertent access.
 - Backfilling, reshaping and revegetating the Emily Star and part of the Main pit.
- Old waste rock dump:
 - Covering the old waste rock dump with waste rock from mining operations and subsequently revegetating the top of the dump with *Eucalyptus odorata* woodland and the batters with *Lomandra effusa*.
 - Installation of a dry cover of compacted clay and uncompacted soil or oxidised waste rock to minimise the potential for the generation of ARD.
 - Contouring the final batters of the new waste rock stockpile to more closely reflect the surrounding area.

Hillgrove will rehabilitate the area in accordance with best practice environmental management. Section 11.5 outlines the closure principles that will guide the rehabilitation of areas disturbed by the project which will include:

- Protection of the environment, public health and safety by using safe and responsible closure practices.
- Rehabilitation of the area to an agreed land use developed in consultation with Hillgrove, the community, government and other stakeholders.
- Rehabilitation of the area to safe, stable and non-polluting land systems that exhibit environmental characteristics consistent with the surrounding environment.

This will help restore the MLA area to a condition over and above its current state.

3.5.2 Management for a Significant Environmental Benefit

Hillgrove will ensure that the project has significant benefits for the ecology and native vegetation of the MLA area and surrounds. Under the *Native Vegetation Act 1991* and in accordance with the Guidelines for a Native Vegetation Significant Environmental Benefit Policy for the Clearance of Native Vegetation Associated with the Minerals and Petroleum Industry (DWLBC, 2005), there are several options for a proponent to achieve a SEB, including:

- Acquiring land, protecting and funding ongoing management of those areas (this may include monetary donations to organisations for conservation) and/or undertaking revegetation or restoration activities on that land to re-establish habitats.
- Supporting regionally based natural resource management projects with a biodiversity focus.
- Removal of threats and management of existing vegetation, e.g., weed management on roadsides.
- Working with local government or other bodies to undertake environmental remediation or revegetation in areas under the control of such bodies.
- Other approved activities, as identified by the proponent, that are likely to have a significant environmental benefit.
- Payment into the Native Vegetation Fund, managed by the Native Vegetation Council.

Hillgrove's preferred option, as described in Section 9.8.2, is to meet its SEB obligations (see Section 4.1.2) for the project by rehabilitating and managing an offset area. The fall-back option will be to make a payment to the Native Vegetation Fund.

The primary management objectives of the offset area will be the protection and enhancement (and control of threatening processes such as weed invasion and grazing) of the *Eucalyptus odorata* open woodland, the *Lomandra effusa* tussock grassland vegetation communities, and habitat for dependant fauna species. The management measures will include the prevention of impacts from stock grazing, overgrazing by

native species, weed invasion and revegetation, with Hillgrove proposing to meet its SEB obligations by:

- Providing for the ongoing protection and management of approximately 86 ha of remnant native vegetation within the MLA area.
- Excluding stock from the offset area.
- Upon project onset, commencing rehabilitation of areas dominated by introduced pasture (approximately 20 to 100 ha to the south and west of the tailings storage facility (TSF) and waste rock storage area).
- Revegetating approximately 60 ha of the TSF and 70 ha of the waste rock storage area.
- Managing weeds in areas of remnant native vegetation in the MLA area, and in remnant *E. odorata* woodland in particular.
- Supporting community initiatives occurring offsite through donation of plants, equipment and funding (if necessary).

Further detail regarding the significant environmental benefit associated with the project is provided in Section 9.8.2.

3.5.3 Acquisition of New Baseline Environmental Data

During the planning of the project and preparation of this MLP, considerable baseline environmental data has been collected, including data relating to:

- Native flora, including two vegetation communities listed as critically endangered at the national level.
- Native fauna, including one species of bird (the diamond firetail finch) listed as rare in South Australia.
- Groundwater quality in the Kanmantoo region.
- Indigenous cultural heritage.
- Socio-economic characteristics of the local and peripheral communities.
- Infrastructure and transport activities (e.g., traffic) in the local communities.

This data is presented in Chapter 5. It will lead to an environmental benefit as it improves understanding of the local environment and provides a baseline for future monitoring of these environmental aspects for this, and other, projects in the region.

3.5.4 Water Storage

The current closure concept for the open pit, as described in this document (see Chapter 11), is for it to remain as a void. There is, however, potential for the open pit void to be used as a water storage for the region following completion of the project. This option will be subject to a detailed assessment and would require the endorsement of key stakeholders such as Hillgrove, SA Water, DWLBC and PIRSA and the community.

If viable, this would have significant environmental benefits at the local, regional and state level, as water resources are at critically low levels in South Australia.

It is estimated that, following mining, the open pit will have a storage capacity of 25,000 to 35,000 ML, placing the pit as the fourth largest storage in South Australia behind Mt Bold, South Para and Blue Lake.

Further detail regarding this is provided in Section 11.7.2.

3.5.5 Water Efficiency

Hillgrove and the Mount Barker District Council have entered into a memorandum of understanding for the supply of treated effluent water from the Laratinga Effluent Treatment Facility to meet the majority of the project's raw water requirements. The benefits of the use of this water supply for the project include:

- Reduced use of River Murray water compared to initial prefeasibility studies which planned to use River Murray water as the main water supply for the mine, with consequent environmental, social and economic benefits.
- Requirement for extraction of groundwater water reduced.
- Support of local water recycling facilities.
- Use of wastewater that is currently discharged to a watercourse during high-flow events.
- Meets the strategic objectives of the Mount Barker District Community Strategic Plan (DCMB, 2004) and associated Septic Tank Effluent Disposal Scheme regarding the reuse of effluent from townships within the council boundary so as to avoid the discharge of effluent to Mount Barker Creek.

It is intended that the pipeline infrastructure installed as part of the reuse scheme will also be beneficially used by others during and upon cessation of operations.

Further detail regarding the water supply for the project is provided in Section 6.8.2.

4. Legislative Context

4.1 South Australian Legislation

In South Australia, the environmental impacts of a mining proposal can be assessed under the *Mining Act 1971* (Mining Act) or, if the project is deemed to be a major development, under the *Development Act 1993*. Under the Mining Act, a mining lease proposal (MLP) is the key assessment document, whereas a public environmental report (PER) or an environmental impact statement (EIS) serve as the assessment documents for the *Development Act 1993* 'major project' option.

PIRSA advised Hillgrove that the Mining Act was the appropriate environmental assessment route for the Kanmantoo Copper Project.

4.1.1 Mining Act

The principal legislation for the regulation of mining in South Australia is the *Mining Act 1971*, which is administered by PIRSA. Under this act, the proponent must obtain a mining lease (ML) in order to proceed with a mining project. This requires the proponent to prepare and submit a MLP (this document) that identifies the risks of the proposal and outlines management measures to minimise these risks. The MLP must demonstrate that there is a net public benefit¹ from the proposal and that social, environmental and economic outcomes are broadly acceptable to the stakeholders (PIRSA, 2007a).

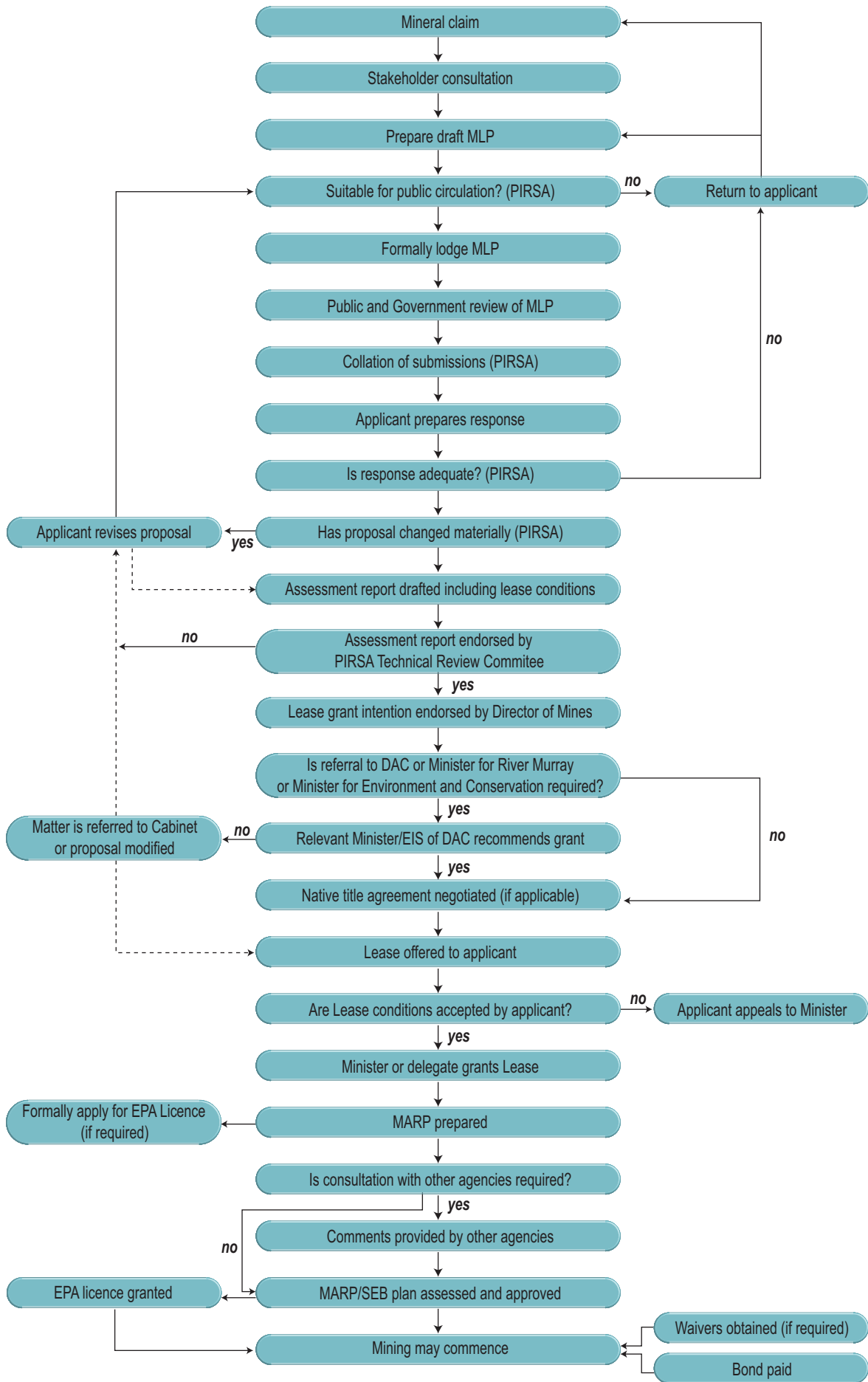
The MLP is submitted to PIRSA, placed on public exhibition and referred to relevant state government agencies for comment (Figure 4.1). Following public exhibition and agency review, PIRSA considers the available information, including submissions on the MLP, in making a decision as to the project's viability and the establishment of appropriate ML conditions (PIRSA, 2007a).

Before the commencement of mining, the proponent must obtain approval for a Mining and Rehabilitation Program (MARP). The MARP includes more detailed and specific information on environmental control measures and establishes outcome-based performance criteria for the project. Once approved, the MARP becomes the key operational document for the mining project and is the document PIRSA uses to regulate the construction and ongoing operations of the project.

PIRSA policy requires that a stamped, numbered copy of the MARP is kept on site at all times and that it is reviewed and updated at least every seven years, although a revision will be required if there is (PIRSA, 2006):

- A change in the operation (size, scope, or mining techniques).
- A significant change in the environmental risks of the project.

¹ This MLP presents an environmental and social impact assessment for the project and includes information and feedback obtained during stakeholder consultation. PIRSA through the public consultation process will determine if this project presents a net public benefit.



Source: PIRSA, 2007f



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Mining Act assessment process

Figure No:
4.1

- Evidence that the current MARP does not adequately address the environmental risks of the project.

Earlier reviews may also be required by PIRSA if the lease renewal is due, if there is a change in the mine owner/operator or if there is a change in stakeholder expectations in regard to the operation (PIRSA, 2006).

Infrastructure items associated with the mine, but not involving mining, require a miscellaneous purposes licence (MPL), rather than an ML, as per Section 52 of the Mining Act or separate assessment under the Development Act. No MPLs will be required for the project. The new site access road and the water pipeline from the Laratinga waste treatment facility will be permitted under the Development Act. The new electricity transmission line (approximately 1.5 km) that will run from the existing substation located at the former process plant site (now occupied by Neutrog and used as a fertiliser factory) to the site, will be permitted and constructed by ElectroNet.

Land classified as exempt from mining activities under Section 9 of the Mining Act, requires a Form 23 waiver of exemption, to be completed by the landowner and the proponent. No waivers are required for the project, as the proposed operation is greater than 400 and 150 m from the nearest resident and nearest industrial/commercial premise, respectively.

Pursuant to Section 35 of the Mining Act, when considering an application for a mining lease in an area within the Murray-Darling Basin, the Minister for Mineral Resources Development must take into account the objectives of the *River Murray Act 2003* and the Objectives for a Healthy River Murray under that act. For projects within the River Murray Protection Area, like the Kanmantoo Copper Project, an application for a ML needs to be referred to the Minister for the River Murray and her views obtained before a decision is made on the application.

4.1.2 Other Key Acts

Natural Resources Management Act

The *Natural Resources Management Act 2004* promotes sustainable and integrated management of the state's natural resources and provides for their protection. This act, which repeals the *Animal and Plant Control (Agricultural Protection and Other Purposes) Act 1986*, the *Soil Conservation and Land Care Act 1989* and the *Water Resources Act 1997*, is administered by the Department of Water, Land and Biodiversity Conservation (DWLBC).

Under this act, certain areas within the state have been designated 'prescribed water resource areas' in recognition that they need ongoing water resources management. The project is within the Eastern Mount Lofty Ranges prescribed water resource area (DWLBC, 2006) for which a water allocation plan (WAP) is currently being developed.

Until the WAP is in place, the DWLBC has placed a Notice of Prohibition over the Eastern Mount Lofty Ranges area, which puts a halt on any new developments. However, as Hillgrove has a financial and legal commitment to the Kanmantoo Copper Project, the company has been recognised by the department as being a 'prospective user' and can therefore apply for temporary authorisation to use surface or groundwater.

Permanent licences will only be granted once the Notice of Prohibition is lifted and the WAP for the area implemented (Overeem, pers.comm. 2007).

River Murray Act

The *River Murray Act 2003* provides for the protection and enhancement of the River Murray and related areas and ecosystems. The main features of the act are (Dyson, 2003):

- A new 'duty of care' – a duty not to harm the river through one's actions. The duty is enforceable through River Murray Protection Orders and associated instruments.
- Various powers of the Minister for the River Murray to undertake activities and carry out works and measures.
- The ability for the Minister for the River Murray to register management agreements with landowners, assisting projects such as wetlands management on private land and other conservation efforts.
- The establishment of a new Joint House Standing Committee of the South Australian Parliament i.e., the Natural Resources Parliamentary Committee. The committee is composed of sitting members of both Houses of Parliament.
- A regulation-making power that will enable the future regulation or prohibition of any identified activity deemed to harm the River.
- The ability of the Minister to impose conditions on activity authorisations, through the operation of the new 'referral' mechanism. The referral mechanism requires:
 - The referral of certain applications for statutory authorisations (for example, licences or permits) made under other acts to the Minister for the River Murray.
 - The referral of certain statutory planning instruments (for example, council development plans as well as other natural resources management instruments such as native vegetation guidelines and district soil plans) to the Minister for the River Murray.

A Schedule to the River Murray Act amends a number of other South Australian acts, including the Mining Act and Development Act, to ensure that the objectives of the River Murray Act are considered during the assessment of ML and MPL applications, and that projects within the River Murray Protection Area are referred to the Minister for the River Murray for assessment.

Environment Protection Act

The *Environment Protection Act 1993* provides for the protection of the environment and is administered by the Environment Protection Authority (EPA). Under this act, mining and mineral processing is a prescribed activity and requires an environmental authorisation in the form of a works approval and/or licence from the EPA to proceed. It is intended that this MLP will provide the necessary information to support applications for environmental authorisations. This act also provides for the establishment of environment protection policies, several of which are relevant to the project:

- Environment Protection (Air Quality) Policy 1994.
- Environment Protection (Industrial Noise) Policy 1994.
- Environment Protection (Machine Noise) Policy 1994.
- Environment Protection (Used Packaging Materials) Policy 2001.
- Environment Protection (Waste Management) Policy 1994.
- Environment Protection (Water Quality) Policy 2003.

Hillgrove may apply for an exemption from the Environment Protection (Water Quality) Policy 2003 to cover the possibility of seepage from the TSF (see Section 6.8.2).

In addition to the above policies, the EPA has published a number of guidelines that have relevance to the project, including:

- Air pollution modelling—presentation of results.
- Air quality impact assessment using design ground level pollutant concentrations.
- Bunding and spill management.
- Compliance and enforcement.
- Disposal of used hydrocarbon-absorbent materials.
- Odour assessment using odour source modelling.
- Pollutant management for water well drilling.
- Soil bioremediation.
- Waste tracking form.
- Waste tyres.

Development Act

The *Development Act 1993* (Development Act) provides for the planning and regulation of developments, the use and management of land and buildings, the design and construction of buildings and the maintenance and conservation of land and buildings. Mining projects that are considered to be of 'major projects' status, i.e., of major environmental, social or economical impact, are assessed under this act.

Under Section 75 of the Development Act, all mining proposals within those areas of the state listed in Schedule 20 of the Development Regulations (which include the Mount Barker District Council and therefore apply to this project) require PIRSA to consider the advice of the Extractive Industries Committee (part of Development Assessment Commission).

The Kanmantoo Copper Project was not given major project status and therefore does not require development assessment under the Development Act. The project will, however, require review by the Extractive Industries Committee (as discussed above). Additionally, the site access road and water pipeline from the Laratinga waste treatment facility, will be assessed under the Development Act.

Buildings, work areas or other amenities that are directly involved in the operation of a mine are exempt from assessment under the Development Act (Section 84 Development Regulations 1993). Authorisation occurs as part of the approval obtained for the project under the Mining Act (Bailiht, pers.comm. 2007).

Native Vegetation Act

The *Native Vegetation Act 1991* (and regulations) is administered by the Native Vegetation Council (NVC) and provides incentives and assistance to landowners in relation to the preservation and enhancement of native vegetation, and regulates the clearance of native vegetation. Operations authorised under the Mining Act are exempt from the act provided that clearance is undertaken in accordance with an approved management plan that PIRSA (as the delegated authority with respect to mining operations) is confident will provide either a significant environmental benefit (SEB) on the site or within the same region of the state, or a payment has been made to the NVC sufficient to achieve a SEB elsewhere in the state (NVC, 2005).

A native vegetation management plan in accordance with the 'Guidelines for a Native Vegetation Significant Environmental Benefit Policy for the Clearance of Native Vegetation Associated with the Minerals and Petroleum Industry' (DWLBC, 2005) has been prepared as part of this MLP and is included as Appendix 14. As required by the guidelines, PIRSA will assess the suitability of this plan in meeting SEB policy requirements (with the NVC being a referral authority in this assessment).

4.1.3 Other Relevant Legislation

Other South Australian legislation relevant to the project includes the following acts (and associated amendments and regulations):

- *Aboriginal Heritage Act 1988.*
- *Controlled Substances Act 1984.*
- *Country Fires Act 1989.*
- *Dangerous Substances Act 1979.*
- *Explosives Act 1936.*
- *Heritage Places Act 1993.*
- *Local Government Act 1934.*
- *Mines and Works Inspection Act 1920.*
- *National Parks and Wildlife Act 1972.*
- *Natural Resources Management Act 2004.*
- *Occupational Health Safety and Welfare Act 1986.*

4.2 Australian Government Legislation

4.2.1 Environment Protection and Biodiversity Conservation Act

The Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) enables the Australian Government to join with the states and territories to provide a national scheme of environment protection and biodiversity conservation.

Under the EPBC Act, actions that are likely to have a significant impact on a matter of National Environmental Significance are assessed. The Australian Government's Department of Environment and Water Resources (DEWR) is responsible for administering the act. Matters considered to be of National Environmental Significance are:

- World Heritage properties.
- National Heritage places.

- Ramsar wetlands of international significance.
- Threatened species and ecological communities.
- Migratory species.
- Nuclear actions.
- Commonwealth marine areas.
- Additional matters of national environmental significance (prescribed actions).

Where there is the potential for an action to have a significant impact to a matter of National Environmental Significance, a referral and assessment process determines the application of the EPBC Act.

The first step in this process is referral of the action to the DEWR, for determination as to whether or not it is likely that the action will have a significant impact on a matter of National Environmental Significance. Any interested party can refer an action to the DEWR. An action is deemed a 'controlled action' if it is likely to have a significant impact, and assessment and approval is required under the EPBC Act.

Hillgrove submitted a referral for the project to the DEWR on 26 February 2007. On 28 February 2007, the DEWR placed the referral on its website with an invitation for public comment for the statutory period of 10 business days. On 30 March 2007 the DEWR deemed that the project was not a controlled action and, as such, assessment and approval under the EPBC Act was not required.

4.2.2 Other Relevant Legislation

Other Commonwealth legislation relevant to the project includes the following acts (and associated amendments and regulations):

- *Aboriginal and Torres Strait Islander Heritage Protection Act 1984.*
- *Australian Heritage Council Act 2003.*
- *Australian Heritage Council (Consequential and Transitional Provisions) Act 2003.*
- *Environment and Heritage Legislation Amendment Act 2003.*
- *Dangerous Goods Amendment Act 2000.*
- *Heritage Act 1975.*

4.3 International Conventions and Agreements

The following international conventions, protocols and agreements (with relevant enabling legislation provided in square brackets) have been considered in the course of the MLP's preparation:

- Wetlands of International Importance Especially as Waterfowl Habitat (Ramsar, 1971) [EPBC Act provisions].
- Protection of World Cultural and Natural Heritage (World Heritage Convention, 1972) [EPBC Act provisions].
- International Migratory Bird Agreements (JAMBA, 1974, and CAMBA, 1986) [EPBC Act provisions].
- Conservation of Migratory Species of Wild Animals (Bonn Convention, 1979) [EPBC Act provisions].

4.4 National Policies and Strategies

The following national policies have been considered in the course of the MLP's preparation:

- Intergovernmental Agreement on the Environment (1990).
- National Strategy for Ecologically Sustainable Development (1992).
- National Strategy for the Conservation of Australia's Biological Diversity (1996).
- National Greenhouse Strategy (1998).
- National Environment Protection Measures.

4.5 Standards and Codes of Practice

The construction and operation of the project will take into consideration all applicable standards and codes of practice, including those listed in Table 4.1 below.

Table 4.1 Standards and codes of practice relevant to the project

Standards	
Environmental management systems	AS140001 (2004)
Risk management	AS4360 (2004)
Compliance management	AS3806 (1998)
Explosives – storage, transport and use.	AS 2187
National Standard for Manual Handling.	NOHSC:1001 (1990)
National Occupational Health and Safety Certification Standard for Users and Operators of Industrial Equipment, 3rd Edition.	NOHSC:1006 (2001)
National Standard for Occupational Noise.	NOHSC:1007 (2000)
National Standard for the Control of Inorganic Lead at Work.	NOHSC:1012 (1994)
National Standard for the Control of Major Hazard Facilities.	NOHSC:1014 (2002)
Safe working in a confined space.	AS/NZS 2865:2001
Recommended practices for eye protection in the industrial environment.	AS/NZS 1336:1997
Selection, use and maintenance of respiratory protective devices.	AS/NZS 1715:1994
Occupational protective helmets – selection, care and use.	AS/NZS 1800:1998
Occupation protective gloves – selection, use and maintenance.	AS/NZS 2161.1:2000
Occupational protective footwear: guide to selection, care and use.	AS/NZS 2210.1:1994
Guide to the selection, care and use of clothing for protection against heat and fire.	AS 2375-1980
Industrial safety belts and harnesses – selection, use and maintenance.	AS/NZ 1891.4:2000
Occupational noise management – hearing protector program.	AS/NZS 1269.3:2005
Classification of hazardous areas – examples of classification – general.	AS/NZS 2430.3.1:2004
Evaluation of human exposure to whole-body vibration – general.	AS 2670.1-2001
Fixed platforms, walkways, stairways and ladders – design, construction and installation.	AS 1657-1992
Earthmoving machinery – seat belts and seat belt anchorages.	AS 2664-1983
Power-actuated hand-held fastening tools – charges.	AS/NZS 1873.3:2003
Power-actuated hand-held fastening tools – fasteners.	AS/NZS 1873.4:2003
In-service safety inspection and testing of electrical equipment.	AS/NZS 3760:2003
Portable fire extinguishes and fire blankets – selection and location.	AS 2444-2001
Structural design actions – general principals.	AS1170-2002
Methods of testing soils for engineering purposes.	AS 1289-2000
Specification and supply of concrete.	AS 1379-1997
Geotechnical site investigations.	AS 1726-1993
Piling design.	AS 2159-1995
Concrete structures code.	AS 3600-2001
Formwork code.	AS 3610-1995
Reinforcement.	AS 4671-2001
Guidelines on earthworks for commercial and residential developments.	AS 3798-2007

Table 4.1 Standards and codes of practice relevant to the project (cont'd)

<p>Standards (cont'd) Portland and blended cements. Steel structures. Steel reinforcing materials. Earth retaining structures. Bridge design. Austroads Rural Road Design – A Guide to the Geometric Design of Rural Roads. Austroads Pavement Design – A Guide to the Structural Design of Road Pavements. Austroads Waterway Design – A Guide to the Hydraulic Design of Bridges.</p>	<p>AS 3972-1997 AS 4100-1998 AS 4671-2001 AS 4678-2002 AS 5100-2004 AP-G1/03 AP-G17/04 AP-23/94</p>
<p>Model Regulations National Model Regulations for the Control of Workplace Hazardous Substances. National Model Regulations for the Control of Scheduled Carcinogenic Substances.</p>	<p>NOHSC:1005 (1994) NOHSC:1011 (1995)</p>
<p>Codes of Practice Building Code of Australia. National Code of Practice for the Control of Workplace Hazardous Substances. National Code of Practice for the Prevention of Occupational Overuse Syndrome. National Code of Practice for the Labelling of Workplace Substances. National Code of Practice for Manual Handling. National Code of Practice for Management and Protection of Hearing at Work. National Code of Practice for the Control of Scheduled Carcinogenic Substances.</p>	<p>BCA 2007 NOHSC:2007 (1994) NOHSC:2013 (1994) NHOSC:2012 (1994) NOHSC:2005 (1990) NOHSC:2009 (2000) NOHSC:2014 (1995)</p>

5. Existing Environment

The MLA area is a brownfields site and is heavily influenced by the components of the previous mining operations in particular the old pit (Plate 5.1 and 5.2), old waste rock dump (Plate 5.3) and old tailings dam (see Figure 1.2). Legacy issues associated with the previous mining operations include acid rock drainage (ARD) from waste rock, tailings and pit walls and the high visual impact of the mine components. These legacy issues are a key part of the existing environment and are discussed below along with other environmental aspects of the MLA area and surrounds.

5.1 Climate

Meteorological data for the MLA area has been obtained from a number of sites (see Figure 1.1 for site locations):

- Kanmantoo, 1.5 km northeast of the MLA area.
- Callington, 4 km southeast of the MLA area.
- Nairne, 10 km northwest of the MLA area.
- Mount Barker, 13 km west of the MLA area.
- Adelaide, 44 km northwest of the MLA area.

The MLA area and surrounds has a typical Mediterranean climate, characterised by low rainfall, cool, wet winters and hot, dry summers. Moderate to high daytime temperatures are a feature of summer. Evaporation exceeds rainfall for five months of the year, and the annual evaporation (at Adelaide) is approximately 1,450 mm (Figures 5.1 and 5.2).

The mean monthly rainfall displays significant seasonality, with higher monthly rainfall totals occurring during the winter months (see Figure 5.1). June, July and August are the wettest months in the Kanmantoo–Callington region, and the only months when the mean monthly rainfall is greater than 100 mm. Annual rainfall in the immediate area of Kanmantoo and Callington averages around 424 mm, which includes occasional intense summer events where more than 100 mm can fall within a 24-hour period. The highest rainfall event recorded for Kanmantoo was 115 mm, which lasted for 60 minutes in December of 1894 (BOM, 2007a). Annual rainfall across the remaining sites (Nairne, Mount Barker and Adelaide) averages around 667 mm. 2006 was a particularly dry year for the MLA area and was the 18th driest year in the 132 years of records (BOM SA, 2007a).

Maximum summer temperatures in Mount Barker (see Figure 5.2) tend to exceed 26°C and winter minimum temperatures are typically around 5°C. January and July are the hottest and coldest months, respectively, with trends being similar in both Mount Barker and Adelaide (although temperatures in Adelaide can be significantly warmer).

Relative humidity levels in Mount Barker and Adelaide are similar, with relative humidity being greater in the mornings (9 am) than in the afternoons (3 pm). Humidity peaks in June (83% at Mount Barker) and is lowest in January (37% at Adelaide) (BOM, 2007a; BOM, 2007b).

Meteorological data collected from a weather station located at the former Kanmantoo mine demonstrates that annual wind direction (recorded between April 2006 and March



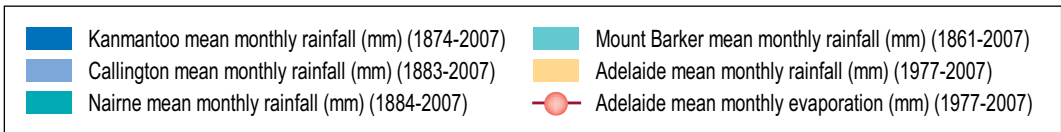
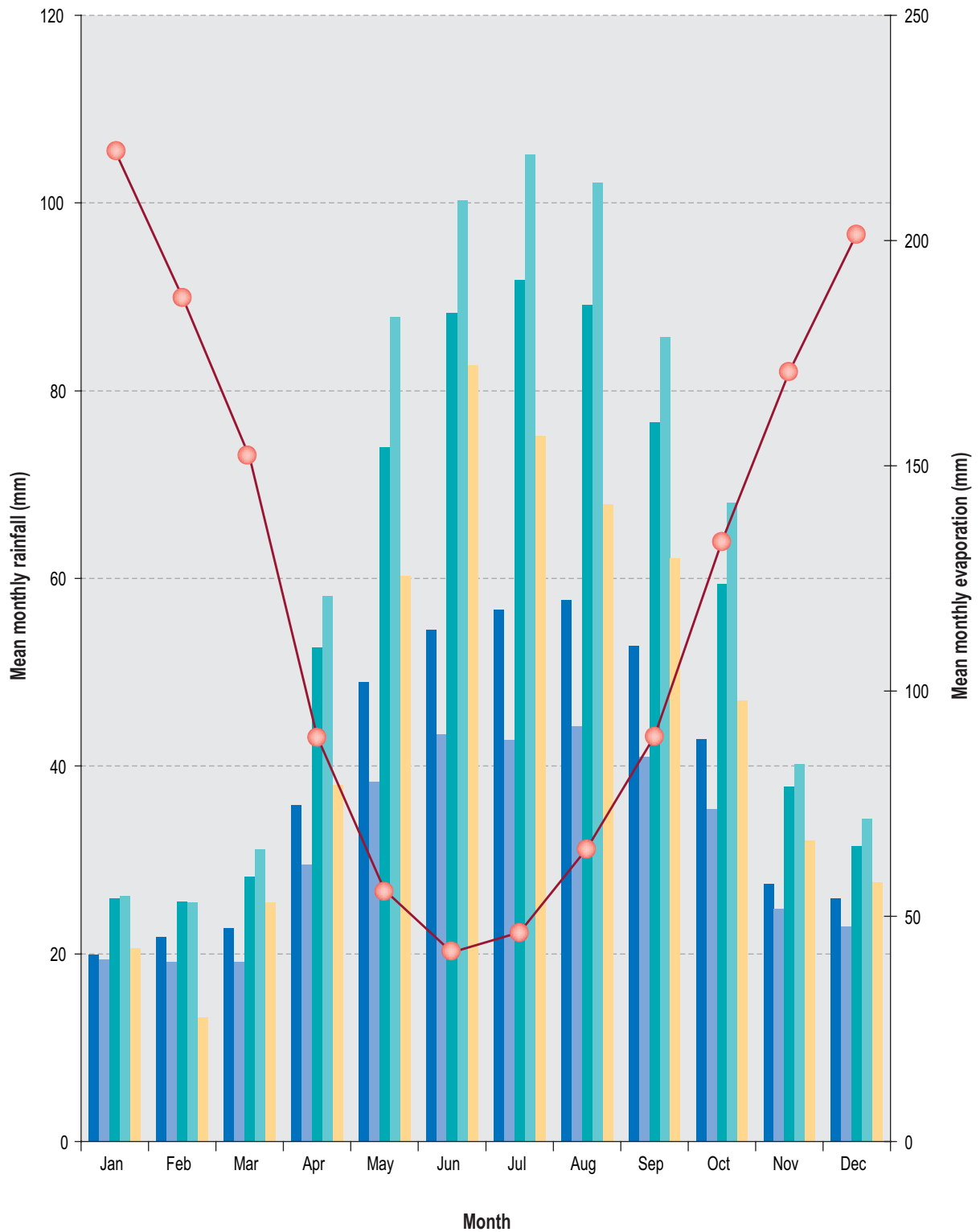
Plate 5.1
Old pit



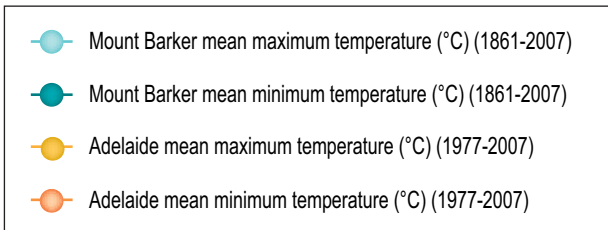
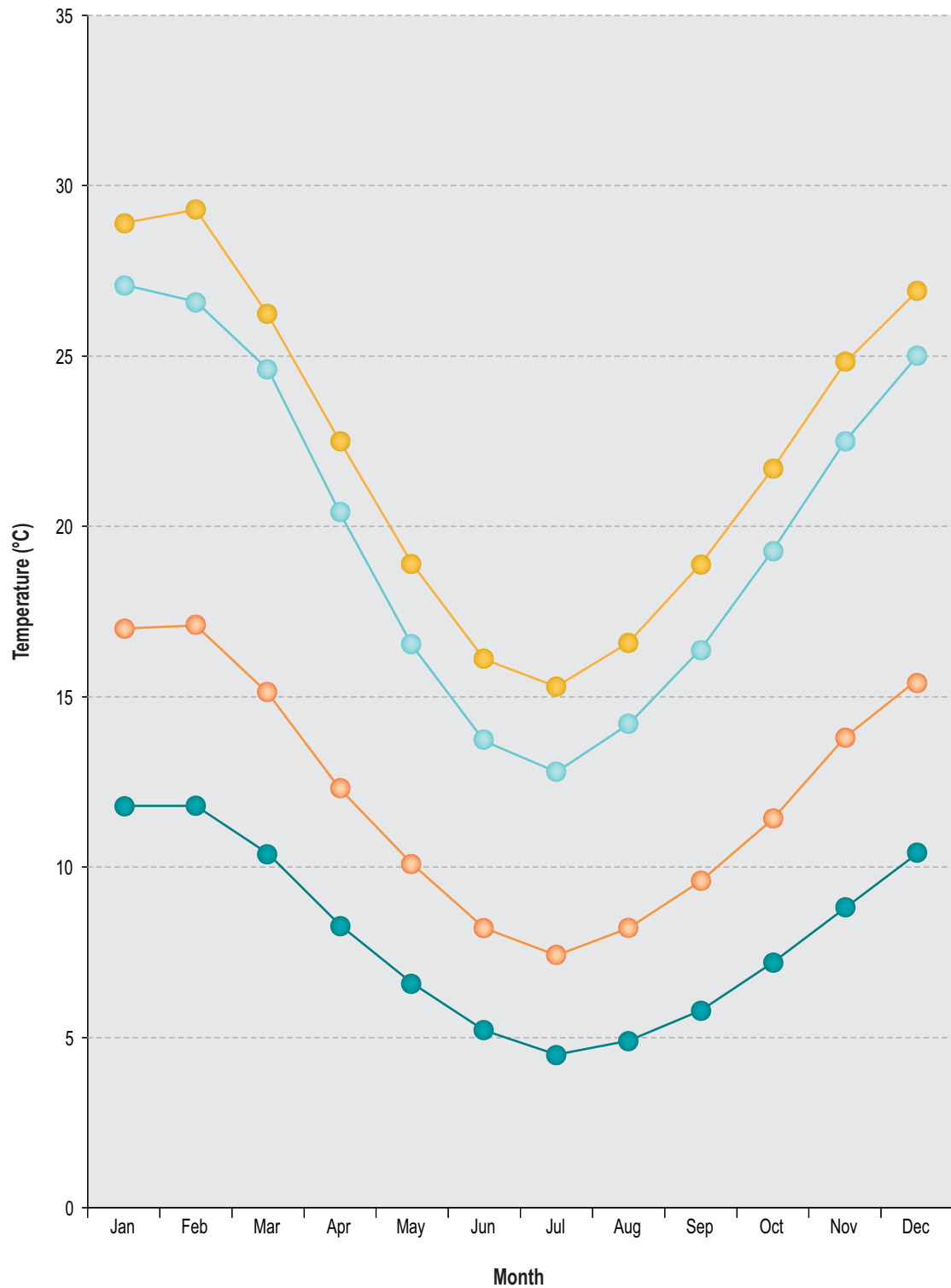
Plate 5.2
Old pit lake



Plate 5.3
Old waste rock dump,
showing poor revegetation



Source: BOM (2007a), BOM (2007b), BOM SA (2007b) BOM SA (2007c), Climate Department, pers. comm.
 Note: Data collected up until April 2007.



Source: BOM (2007a), BOM (2007b).
 Note: Data collected up until April 2007.



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**Mean daily temperature by month
 for Mount Barker and Adelaide**

Figure No:
5.2

2007) is predominately from the south and west, although some variation occurs between the seasons (Figure 5.3). The prevailing winds in the summer months are generally from the south while winds in the winter months occur largely from the west, with some northerly and northwesterly components.

5.2 Ambient Air Quality, Odour and Noise Levels

5.2.1 Air Quality

This section is based on an air quality assessment undertaken by Tonkin Consulting (Appendix 1A).

Background dust levels were measured by deposition gauges at four locations within the MLA area and surrounds (Figure 5.4) over eight sampling periods, from April 2006 to May 2007. The dust monitoring results (Figure 5.5) indicate that the background dust fall is generally in the range of 13 to 65 mg/m²/day, which is typical of rural conditions. Site 3 displayed high levels of dust deposition during sampling periods 1 and 2, and this is believed to be due to the occurrence of exploration drilling operations in the area. Variation in dust deposition levels at Site 2, which is located on the Paringa homestead, were due to farm activities (including the destocking of sheep from the property after Hillgrove acquired it) and nearby exploration drilling operations.

5.2.2 Odour

This section is based on an odour assessment undertaken by Tonkin Consulting (Appendix 1B).

The Neutrog fertiliser factory, located east of MacFarlane Hill in the old processing plant site (see Figure 1.2), is the main source of odour within the area. Nearby residents to the east and northeast of the factory are occasionally affected by odour.

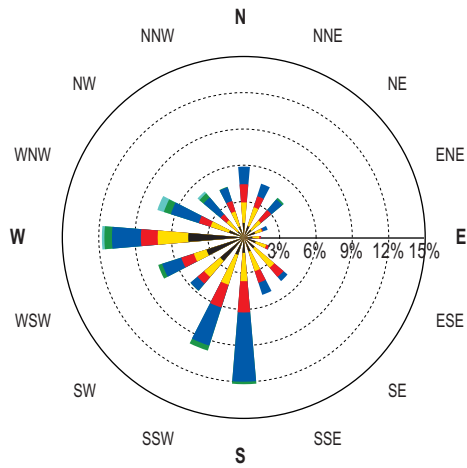
5.2.3 Noise Levels

This section is based on a noise assessment (of the existing environment) undertaken by Vipac Engineers and Scientists (Appendix 4Y of Roche, 2006).

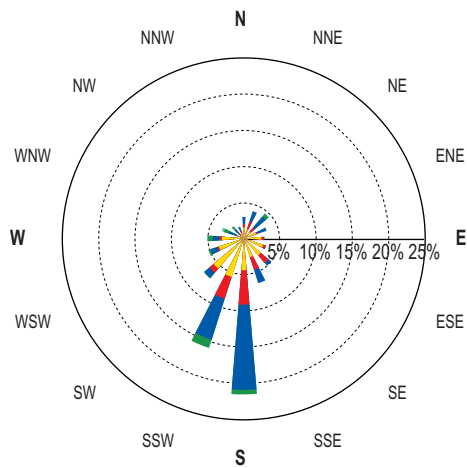
Four receiver-monitoring locations within the MLA area and surrounds were selected (Figure 5.6), and the background noise level (L_{A90})¹ at these locations was measured over the period 12 to 18 April 2006. The instrumentation was programmed to continuously sample noise levels and store data in 30-minute intervals.

The noise monitoring results (Table 5.1) indicate that existing background noise levels in the MLA area and surrounds are typical of a rural area (loggers B, C and D) and country town (Logger A), with moderate activity during the day and low activity at night. Most of the noise present is caused by natural sounds (birds and wind), trains, aircrafts, traffic on the South Eastern Freeway and the Neutrog fertiliser facility.

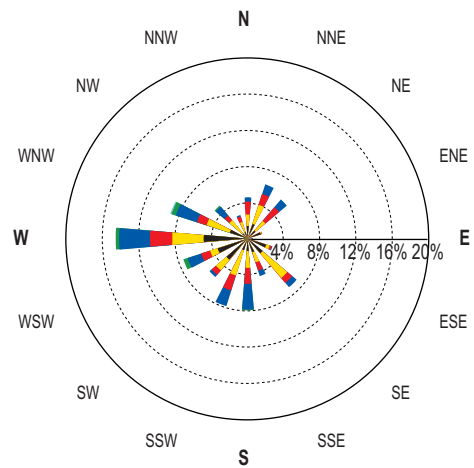
¹ The noise level statistically exceeded 90% of the time.



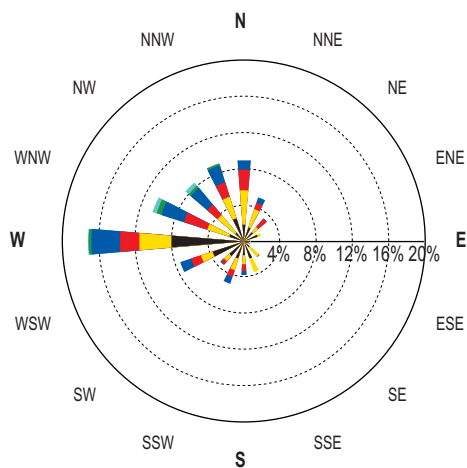
Annual
Calms = 5.58%



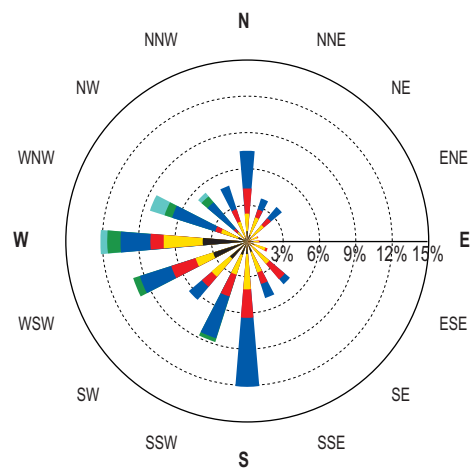
Summer
Calms = 4.8%



Autumn
Calms = 6.84%



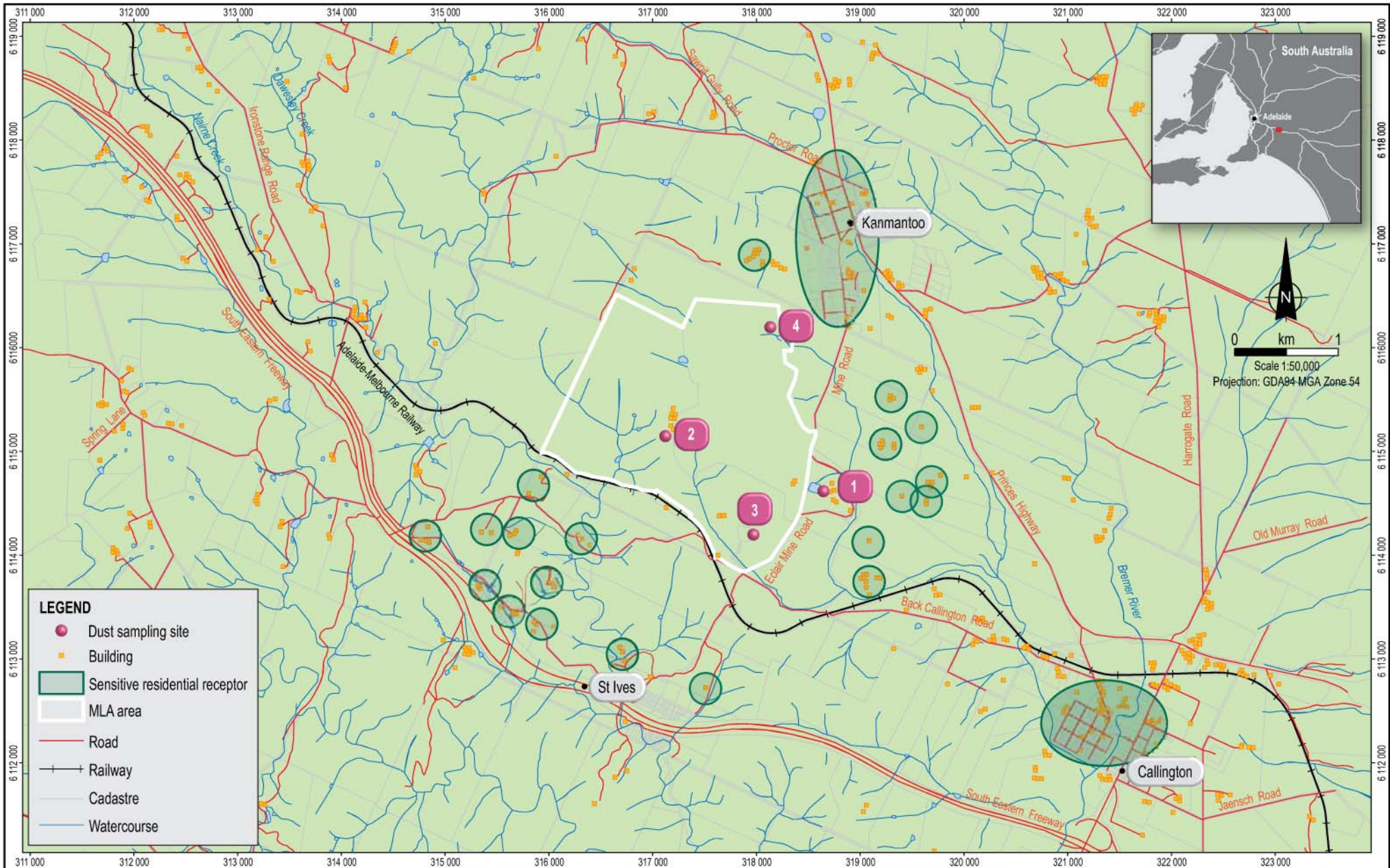
Winter
Calms = 7.98%



Spring
Calms = 3.43%

Source: Appendix 1A

	Job No: 5000	Hillgrove Copper Pty Ltd	HILLGROVE RESOURCES	Annual and seasonal windroses at MacFarlane Hill, April 2006 - March 2007	Figure No: 5.3
	File No: 5000_02_F05.03_HB	Kanmantoo Copper Project			



Source:
Place names, cadastre, roads, rail and drainage from DEH (optimum scale 1:50,000)
Buildings from GEODATA TOPO 250K (optimum scale 1:250,000)
Dust sampling sites from Tonkin Engineering

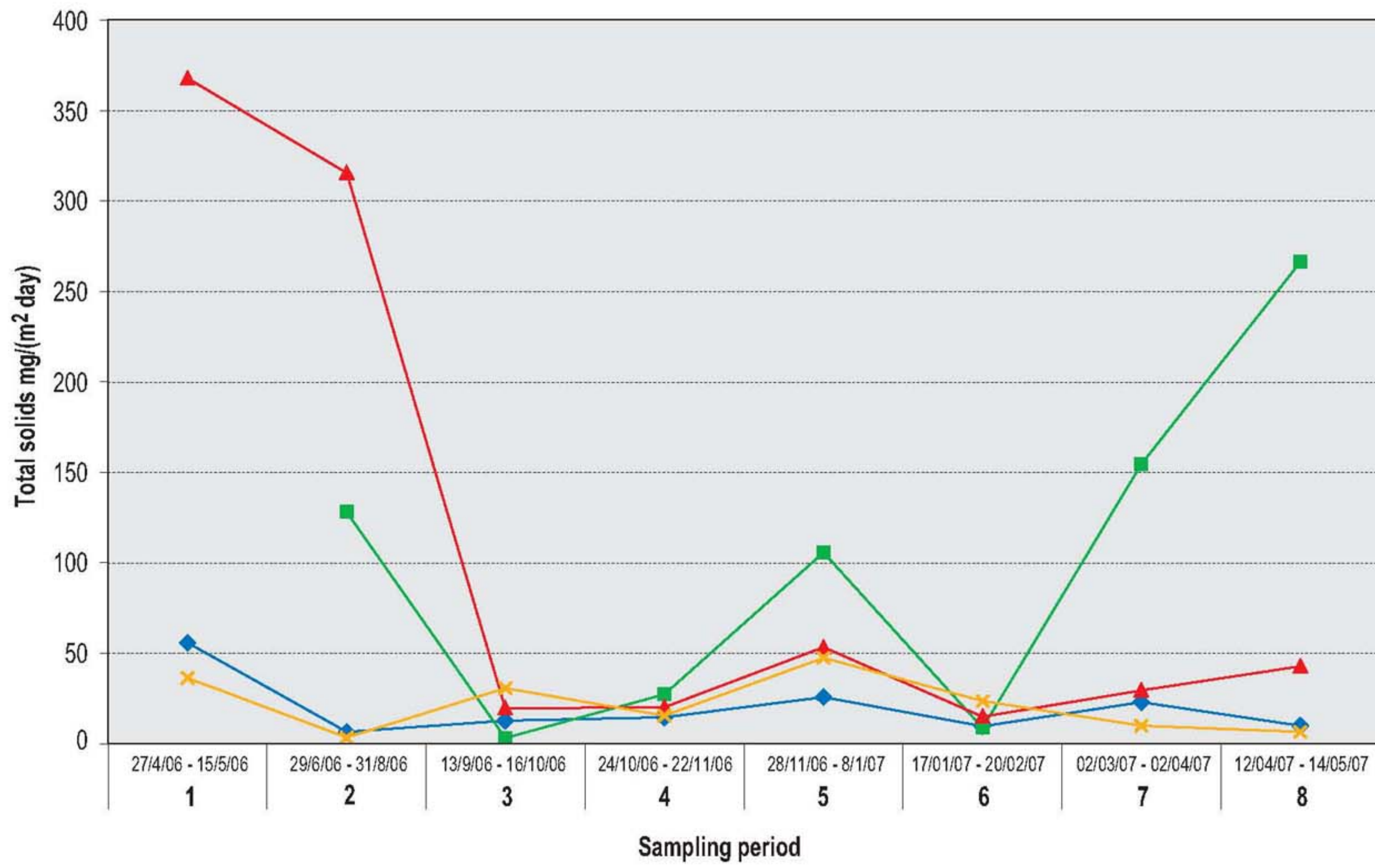

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 Job No: 5000_02_F05.04_GIS_AI

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Location of dust sampling sites
 and sensitive residential receptors

Figure No:
5.4



◆ Site 1: Neutrog
 ■ Site 2: Paringa
 ▲ Site 3: McFarlane Hill
 ✕ Site 4: Old Tailings Dam

Source: Appendix 1A, Adams, pers. comm.



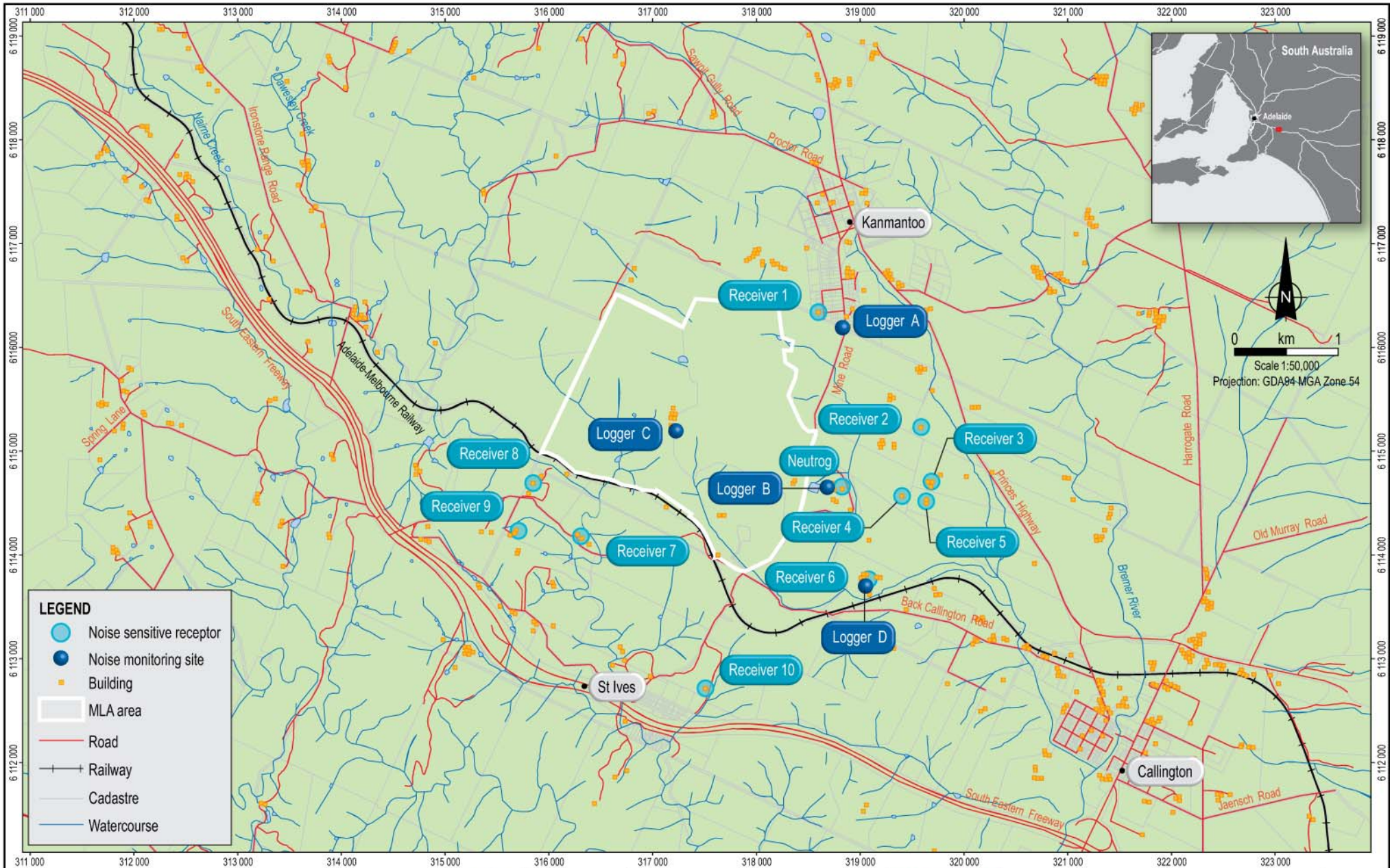
Job No:
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 File No:
 5000_02_F05.05_HB

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Dust monitoring results

Figure No:
5.5



LEGEND

- Noise sensitive receptor
- Noise monitoring site
- Building
- MLA area
- Road
- +— Railway
- Cadastre
- Watercourse

Sources:
 Place names, cadastre, roads, rail and drainage from DEH (optimum scale 1:50,000)
 Buildings from GEODATA TOPO 250K (optimum scale 1:250,000)
 Noise sensitive receptors from Sonus.


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HILLGROVE
RESOURCES

**Noise monitoring locations
 and sensitive receptors**

Figure No:
5.6

Table 5.1 Ambient noise environment, 12-18 April 2006

Monitoring Location	Average Background (L_{A90}) Noise Level (dB(A))	
	Day*	Night*
Logger A	37	26
Logger B	41	29
Logger C	37	30
Logger D	28	28

*Day = 07:00 to 22:00 and Night = 22:00 to 07:00.

5.3 Topography, Landscape and Visual Amenity

5.3.1 Topography

Topography of MLA Area

The MLA area is located on the eastern slopes of the Mount Lofty Ranges, within the catchment of the Bremer River (Figure 5.7) (and also within the tributary zone of the River Murray, see Figure 2.3). The MLA area is dominated by northwest to southeast trending ridges, with surface elevations ranging from 150 to 260 m Australian Height Datum (AHD), forming several small sub-catchments and ephemeral creeks. The slopes of these ridges, although steep and punctuated by several gullies, maintain a gently rolling surface.

The implication of the local topography on surface hydrology and local drainage systems in the MLA area is discussed in Section 5.7.

Topography of Surrounding Area

The MLA area's surrounding topography comprises:

- North: A series of closely spaced ridgelines that run east to west and are punctuated by low-lying valleys and areas of remnant vegetation.
- East: Two dominant parallel ridges, punctuated by low-lying valleys that run along the entire length of the local and sub-regional area (including Kanmantoo and Callington).
- South: A series of ridges and valleys that run in an east to west direction.
- West: Distinct ridges that run in a north to south direction, forming promontories and rolling hills that extend over the area. Valleys and creeks are also common in this area.

5.3.2 Landscape and Visual Amenity

This section is based on a landscape character and visual amenity assessment undertaken by Wax Design Space (in association with Brett Grimm) (Appendix 2).

The landscape is generally characterised by undulating ridges with steep slopes punctuated by low-lying valleys and creeks. The long history of farming, grazing and previous mining operations in the region has resulted in the clearing of large areas of native vegetation for crops, pasture and planted vegetation.



As a result, remnant native vegetation is generally restricted to areas that have not been used for agricultural activities.

The MLA area comprises four main landscape units:

- Petwood South (Ironstone Range Road): The landscape south of Petwood contains local ridges and vegetation that has grown along the northern edge of the mine. A transmission line and rail corridor are also present (see Viewpoint 1 in Figure 5.8).
- Callington North (Princess Highway): The landscape north of Callington lacks vegetation to the foreground when viewing it from the Old Princess Highway (between Callington and Kanmantoo), although it contains vegetation that is associated with ridgelines (MacFarlane Hill) adjacent to Kanmantoo. The landscape also includes several dwellings, a rail corridor and fence lines (see Viewpoint 2 in Figure 5.8).
- Dawesley South (Ironstone Range Road): The landscape south of Dawesley is dominated by the undulating ridges associated with the northwestern sub-regional area. Fence lines and transmission lines are common in this area (see Viewpoint 3 in Figure 5.8).
- St Ives North (Back Callington Road): The landscape north of St Ives contains the old waste rock dump (to the west), while Adelaide Hills and the Mount Lofty Ranges dominate the distant landscape. Scattered dwellings are also present (see Viewpoint 4 in Figure 5.8).

The visual amenity of the MLA area is dominated by remnants of previous mining operations, including an old open pit, old waste rock dump, old tailings dam and associated mine infrastructure. These facilities can be viewed from the northwest, west, southwest and southeast; however, due to existing topography and landscape features (MacFarlane Hill), the degree of exposure varies.

The landscape south of Petwood provides limited screening of existing mine infrastructure, particularly the old waste rock dump, which is visible despite the presence of MacFarlane Hill (Plate 5.4). MacFarlane Hill does, however, screen distant views of the mine site south of Callington.

From Callington North, the entire old waste rock dump and old open pit is screened by MacFarlane Hill, although due to the lack of vegetation when travelling along the old Princes Highway, mine infrastructure is visible in the distance (Plate 5.5).

The vegetation and topography south of Dawesley provides moderate screening of existing mine infrastructure, with only part of the old waste rock dump visible (Plate 5.6).

North of St Ives, the old waste rock dump is quite visible; however, the elevated distant landscape of Adelaide Hills and the Mount Lofty Ranges assists in removing the silhouette of the old waste rock dump (Plate 5.7).

The MLA area is also visible from the north–south ridge to the east of the Bremer River.

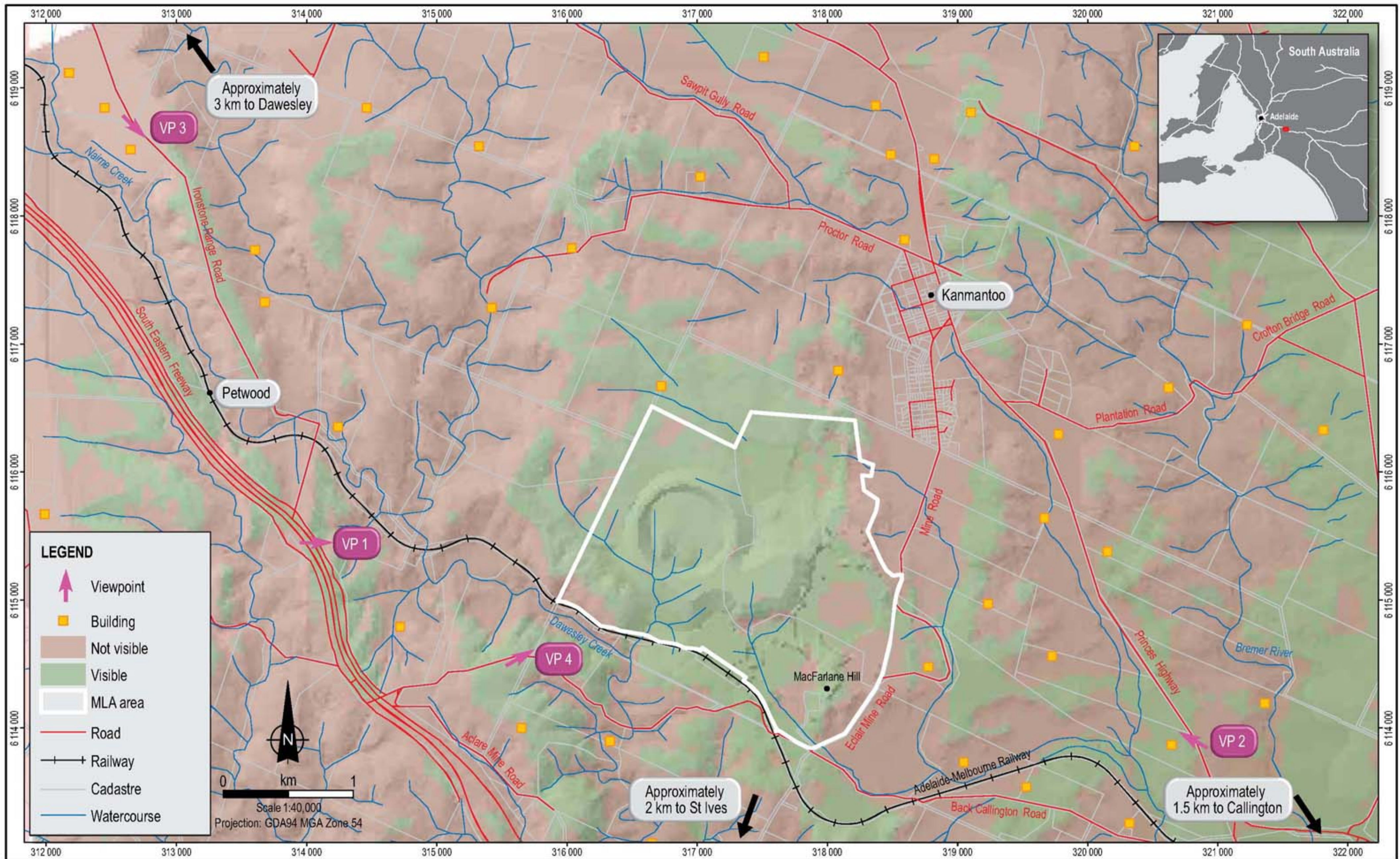




Plate 5.4
Viewpoint 1 -
Petwood South

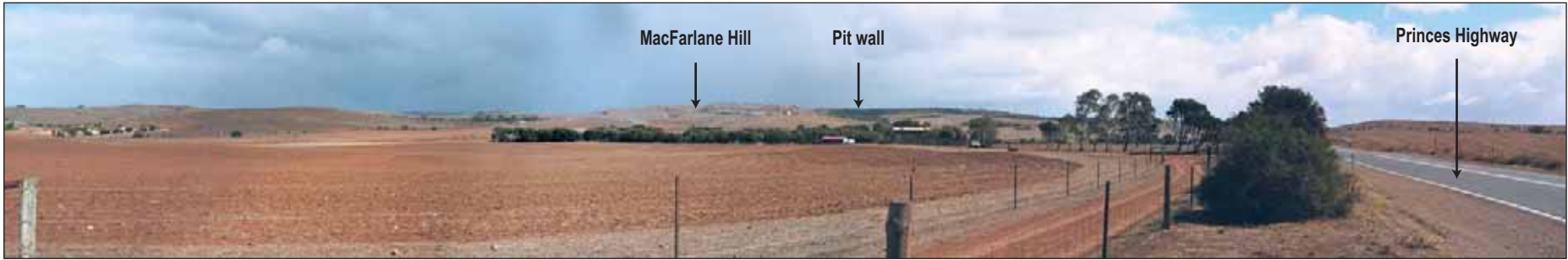


Plate 5.5
Viewpoint 2 -
Callington North



Plate 5.6
Viewpoint 3 -
Dawesely South



Plate 5.7
Viewpoint 4 -
St Ives North

5.4 Land Uses

5.4.1 Historical Land Use

The project is located on a brownfields site, which has been used intermittently for mining activities. The first major mining activity occurred during the mid nineteenth century, and from 1971 to 1976 the Kanmantoo Mine was in operation (see Sections 1.1, 5.13).

Grazing has been the primary land use in the region and has occurred for many years. Over the past 150 years, much of the MLA area has been extensively cleared for agriculture and most parts not actively cleared have still been grazed. As a result, there is little remnant native vegetation in the MLA area (see Section 5.9).

5.4.2 Current Land Use

MLA Area Land Uses

Areas of disturbance from previous mining operations comprise approximately 103 ha (23.5%) of the MLA area. The majority of these areas have not been actively used since the Kanmantoo Mine closed, with the exception of recent exploration activities undertaken by Hillgrove and a small-scale heap leach operation adjacent to the old copper oxide stockpile (see Figure 1.2). The heap leach operation was established in 2003 and is operated by South Australian Mining Resources (SAMR). The operation involves the extraction of copper from the old copper oxide stockpile using the heap leach method and is scheduled to be completed prior to Hillgrove commencing mining in the area, should this project proceed. SAMR's MARP conditions will continue to be observed until the completion of SAMR's operations. Remnant leached ore from SAMR's operation will be taken to the waste rock storage area and encapsulated, with other PAF material, in NAF material.

About three-quarters (325 ha, 74%) of the MLA area is either cleared (221 ha, 50.5%) or affected by previous mining activity (103 ha, 23.5%). Agricultural land is currently used for moderate to high-intensity sheep grazing. The remaining land (113 ha, 26%) of the MLA area contains remnant vegetation, with some of this also being grazed.

Surrounding Land Uses

The Neutrog fertiliser factory (Neutrog Australia Pty Ltd) utilises the processing plant facility of the 1970's mining operation, and is located directly adjacent to the MLA area on industrial zoned land. The main industries within Mount Barker local government area (LGA) (Figure 5.9) (which includes the MLA area) are the manufacturing, production and processing of farm products, including livestock, horticulture and field crops. Other industries within the Mount Barker LGA include the wine, tourism, retail, manufacturing and seafood processing industries.

Agriculture, including dryland cropping, is the primary land use in the surrounding area. The majority of the farms are now hobby farm size (between 1 and 60 ha) and only a few working farms remain.



Note: For the purposes of the socio-economic assessment, the study area is defined as the area within approximately 20 km (or 15 mins drive) from the centre of the project area. Although Murray Bridge is located just outside the defined study area it is likely to be impacted to some extent by the project and is still considered part of the study area.

Source:
Place names, roads, rail and drainage from GEODATA TOPO 250K (optimum scale 1:250,000)


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Socio-economic study area
5.9

Figure No: 5.9

Land within the Mount Barker LGA is predominately zoned as rural, with some land being zoned as industrial. Within Kanmantoo, the land is all zoned residential, and approximately 28% (20.5 ha) of the residential land is not developed. Most land in Callington zoned as residential is already developed, with about 55 and 65 undeveloped residential allotments being available in Callington and Kanmantoo, respectively. Residential developments extend to the northeast of the MLA area, with a new residential development in Kanmantoo, along Mine Road.

Several national estate sites exist within the surrounding area, including one indigenous site (Kanmantoo painting site) and seven historical sites (Bremer Mine explosives hut, Callington township, Bremer mine, Erskine bridge, flour mill (former), Callington police station (former) and a public school) (see for further detail Sections 5.12 and 5.13). *Crown Land Act 1929* reserves and heritage sites are also located within the surrounding area (Figure 5.10).

5.5 Geology and Soils

5.5.1 Geology

Background

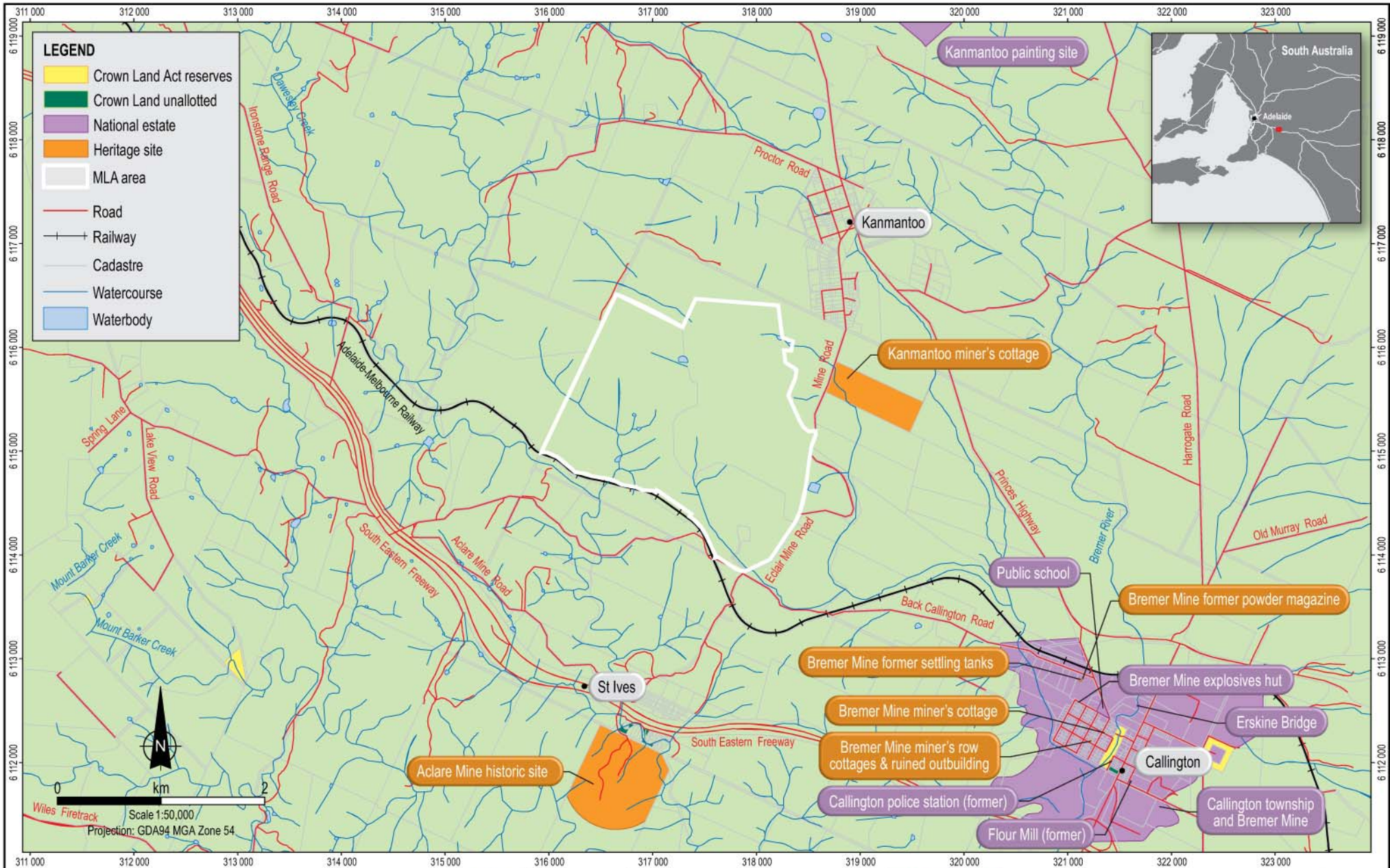
The Kanmantoo copper-gold deposit is hosted within the metamorphosed Kanmantoo group sediments (Figure 5.11). Kanmantoo group sediments are known to extend between the Mount Lofty Ranges and Kangaroo Island and are some 365 km in length, 35 km in width, and are up to 18 km thick (Jago et al, 1994). The Kanmantoo group is derived from the sedimentation of the Kanmantoo Trough, a rift basin formed during the latter phases of the early to mid (542 to 515 Ma) Cambrian crustal extension on the palaeo-Pacific margin of Gondwana (Belpario et al, 1998; Gravelstock 1995 in Burt, 2003). The Kanmantoo Trough forms a major component of the Adelaide Geosyncline (Burt, 2003) (Figure 5.12).

Kanmantoo Group and Associated Subgroups

Current stratigraphic subdivisions of the Kanmantoo group are based on Jago et al. (2003), who proposed two subgroups: the Keynes subgroup and the Bollapurudda subgroup. The Keynes subgroup is a collection of fine to medium grained 'muddy' sandstones with minor interbedded siltstone, feldspathic sandstones and deeper water siltstones and carbonate sediments (Toteff, 1999; Burt, 2003). The overlying Bollapurudda subgroup consists of conglomerates, massive greywacke beds, calcareous metasiltstones of the Talisker formation, interbedded muddy sands and siltstones of the Tapanappa formation and cross-bedded sandstones (Burt, 2003). The Bollapurudda subgroup also hosts iron sulphide deposits within the Talisker formation and all significant base metal deposits within the Tapanappa formation (Toteff, 1999; Daily and Milnes, 1973; Burt, 2003).

Regional Mineralisation

Mineralisation within the region associated with the Tapanappa formation includes copper-gold and lead-zinc-silver. Mineralisation is generally associated with, and spatially related to, specific lithologies, such as garnet quartzite, banded iron formations, quartz-biotite-garnet ± garnet schist and quartz-biotite-andalusite ± garnet chlorite schist (Abbot et al 1995 in Burt, 2003). Mineralisation styles within the Tapanappa can



Source:
Place names, cadastre, roads, rail, drainage, crown land,
heritage sites and national estate from DEH (optimum scale 1:50,000)

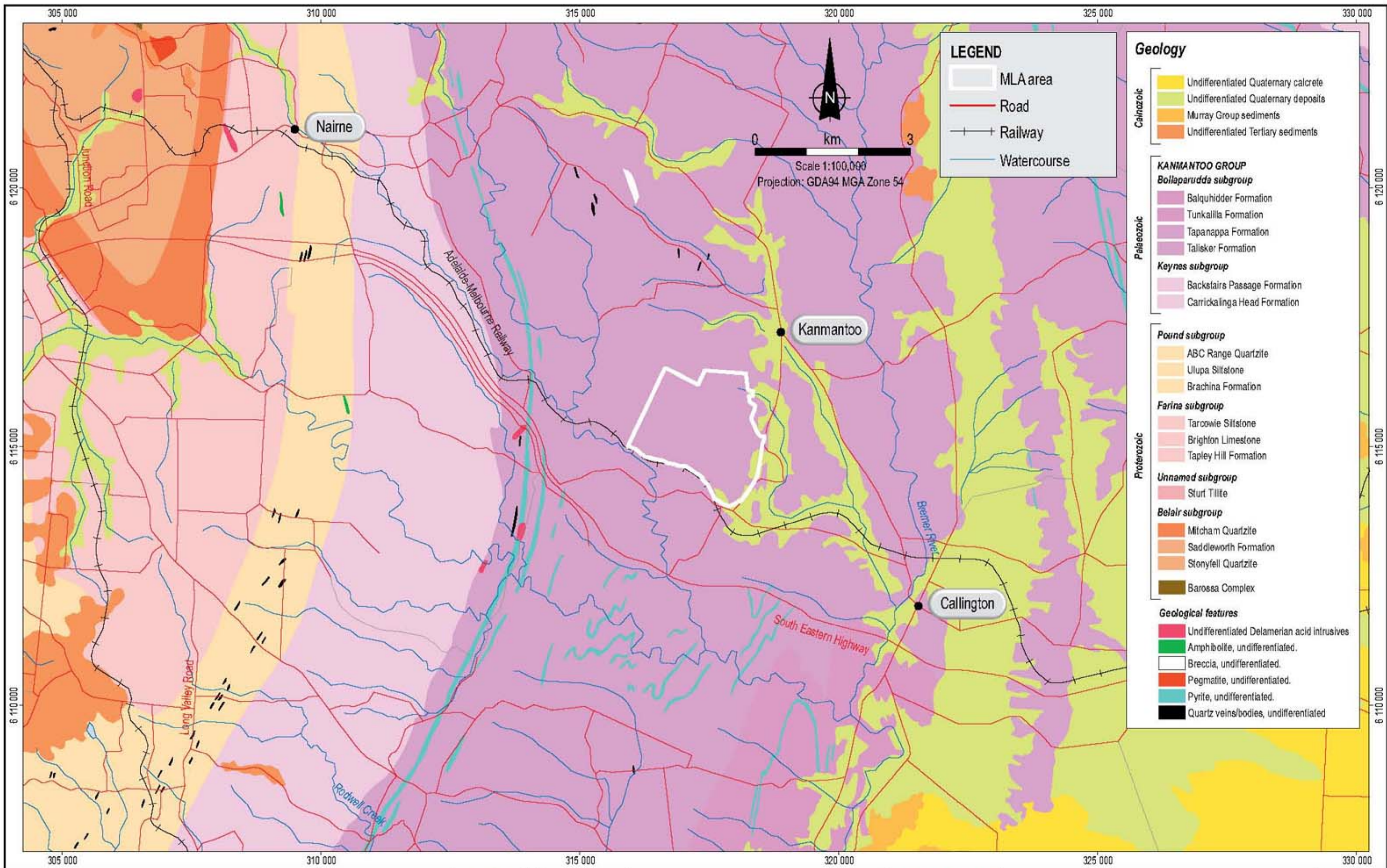

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Regional sites of non-Indigenous
 cultural significance

Figure No:
5.10



Source:
Place names, roads, rail and drainage from GEODATA TOPO 250K (optimum scale 1:250,000)
Geology from PIRSA

enesar
people and place

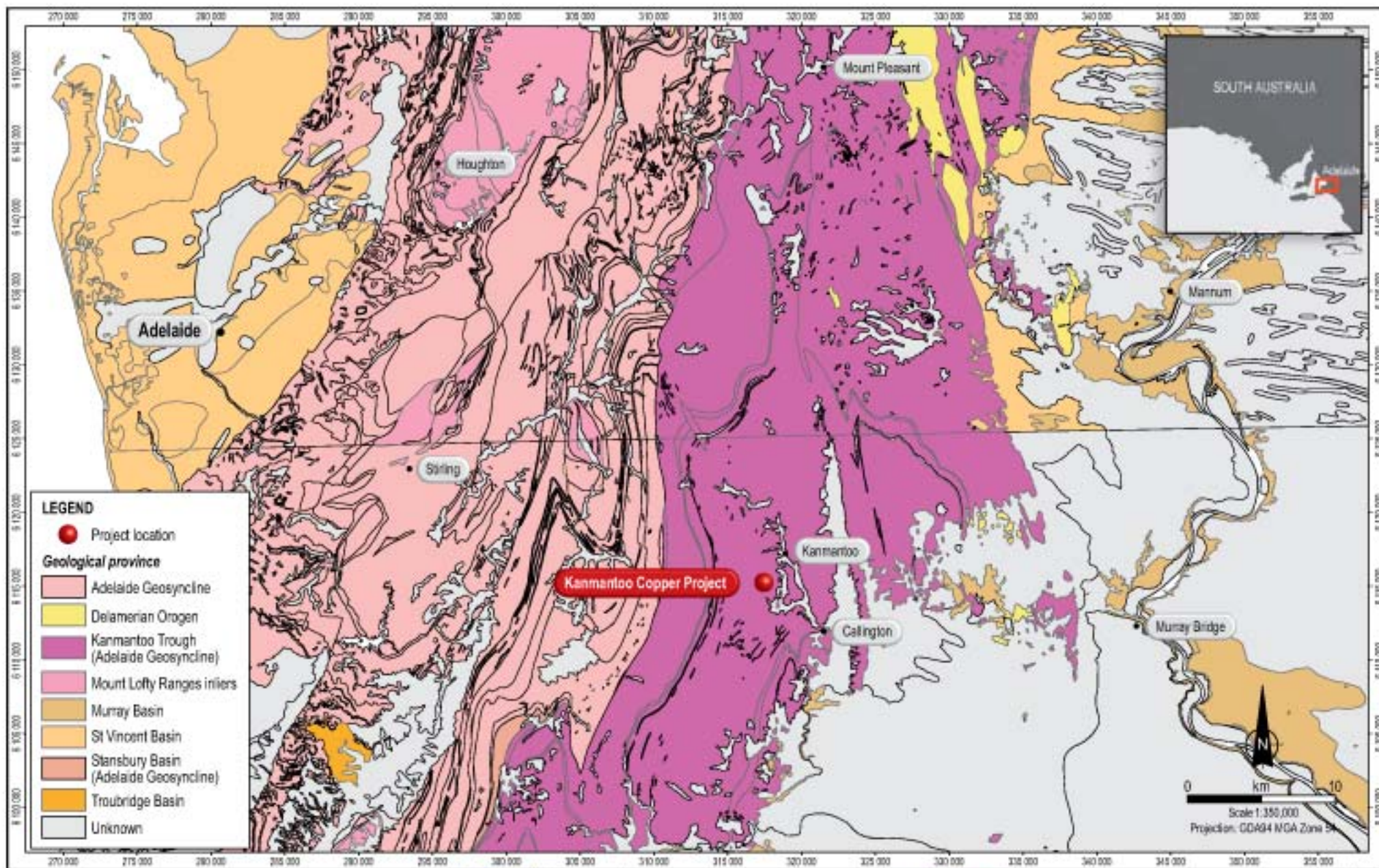
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Geology of MLA area and surrounds

Figure No:
5.11



Source:
Place names from GEODATA TOPO 250K (optimum scale 1:250,000)
Geology provinces from PIRSA

Doc: 015857
MOC
HydroResources Consulting
Lic No: 0908 82 P65.12 GIS AI

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Regional geological provinces

Figure No:
5.12

generally be attributed to syngenetic hydrothermal lead-zinc-silver mineralisation and epigenetic, structurally controlled, copper-gold mineralisation (Toteff, 1999; Burt, 2003).

Kanmantoo Copper-Gold Deposit

The Kanmantoo copper-gold deposit is the largest known orebody within the Tapanappa formation (Burt, 2003). The copper and gold mineralisation at Kanmantoo is hosted within a 5-km² zone of massive andalusite-quartz-biotite-garnet ± staurolite schists (Toteff, 1999; Burt, 2003). Mineralisation is characterised by chalcopyrite ± minor pyrite, pyrrhotite and magnetite (Freeman, pers. comm. in Roche, 2006).

Within the ore zones of the Kanmantoo copper-gold deposit, copper minerals are hosted within chlorite lode schists, commonly composed of quartz-chlorite-garnet ± pyrrhotite and chalcopyrite (Toteff, 1999). The main mineralisation at Kanmantoo occurs as chalcopyrite disseminations and veinlets in a steeply plunging pipe-like structure (Toteff, 1999). Minor amounts of staurolite, pyrite, magnetite, sphalerite, bismuthinite and galena are also present (Seccombe et al 1985 in Toteff, 1999). While many interpretations exist as to the origin of the Kanmantoo mineralisation, the Kanmantoo deposit is commonly attributed to structurally modified syngenetic mineralisation, with numerous epigenetic hydrothermal remobilisation events (Toteff, 1999; Burt, 2003).

5.5.2 Soils

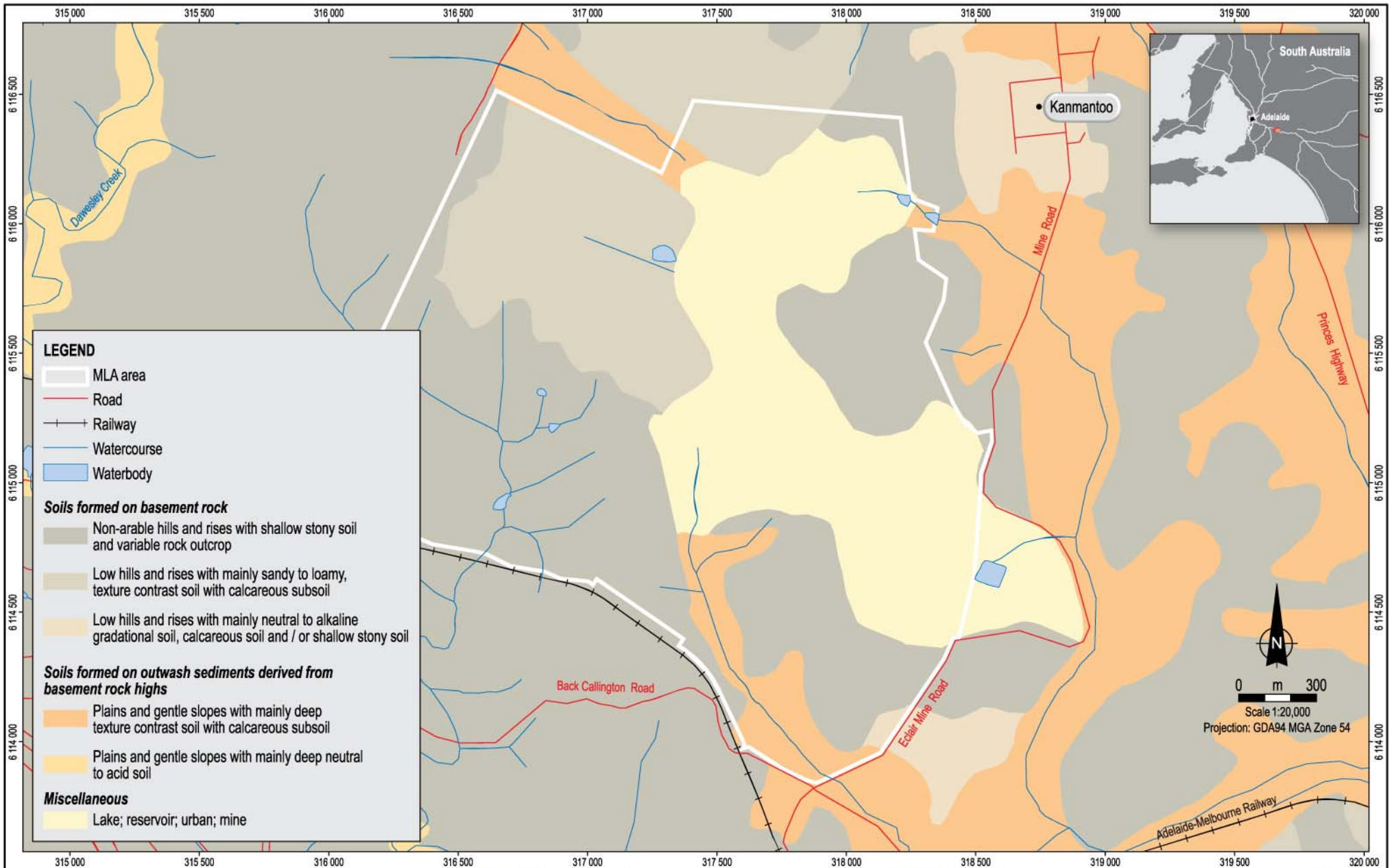
Soils within the MLA area and surrounds are broadly characterised into two main divisions: soils formed on basement rocks and soils formed on outwash sediments derived from basement rock highs (Figure 5.13). Soils are characterised by elevated concentrations of metals such as copper, due to the underlying rock type and proximity to mineralisation (Burt and Gum, 2000a).

The MLA area has predominantly shallow, stony soils with rocky outcrops present in the east, south and west. Sands and loams with underlying calcareous subsoils occupy the northwestern edge of the MLA area, while deep texture-contrast soils with calcareous subsoils extend south from the MLA area along ephemeral creek lines (see Figure 5.13). As indicated by the miscellaneous area on Figure 5.13, a significant portion of the MLA area (centre and east) does not have a soil classification due to the modifications caused by historic mining activities.

These broad classifications have been refined by the geotechnical site assessment carried out by Coffey Mining (2007), where excavation of over 150 test pits across the MLA area provided site-specific soil and distribution information. Test pits identified specific soil profiles based on three broad geographical subdivisions within the MLA area: valleys and watercourses, undulating hills and pastures, and steep sided hills and ridges.

Valleys and Watercourses

Valleys and ephemeral watercourses traverse the south to southeastern boundaries of the area and are characterised by a distinctive horizon of alluvium. A thin layer of topsoil (0.05 to 0.50 m deep) overlies the alluvium, described as a slightly cemented fine-to medium-grained grey to grey-brown silty sand. Alluvial deposits are 0.25 to 1.00 m thick, and are described as fine-to medium-grained sandy clays. Underlying the alluvium, residual sandy clays (around 0.40 m thick) that overlay more competent weathered



Source:
Place names, roads, rail and drainage from DEH
Soil and land types from DWLBC


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Soil distribution within the MLA area

Figure No: 5.13

bedrock were observed. Typical soil profiles in these regions extend up to 3.50 m.

Undulating Hills and Pastures

Undulating hills and pastures prevail in the north of the MLA area. These regions have a unique colluvial layer of fine to medium grained sandy clay derived from both residual and alluvial materials. Colluvial sediments typically extend 0.35 m in depth and overlay an additional 0.40 m of in situ weathered sandy clays. Underlying the clay horizons, highly weathered bedrock sequences are encountered with original rock texture and structure. These sequences are comprised of both clayey, gravelly, fine to medium sand and sandy fine to coarse gravel and extend to typical depths of 0.50 m. The maximum soil profile depth was 2.60 m.

Steep-sided Hills and Ridges

On the steep-sided hills and ridges, skeletal topsoils (minimum 0.10 m deep) described as slightly cemented, silty, and fine-to medium-grained sand were present. No alluvial or residual clay profiles were identified in these regions, with typical transition between topsoil and underlying weathered bedrock at 0.15 m. Highly weathered bedrock sequences were a mixture of gravelly, clayey sands and highly weathered sandy gravel that typically extended from 0.10 to 0.50 m in depth. The average soil profile depth was 1.20 m, the shallowest in the MLA area.

5.6 Geohazards

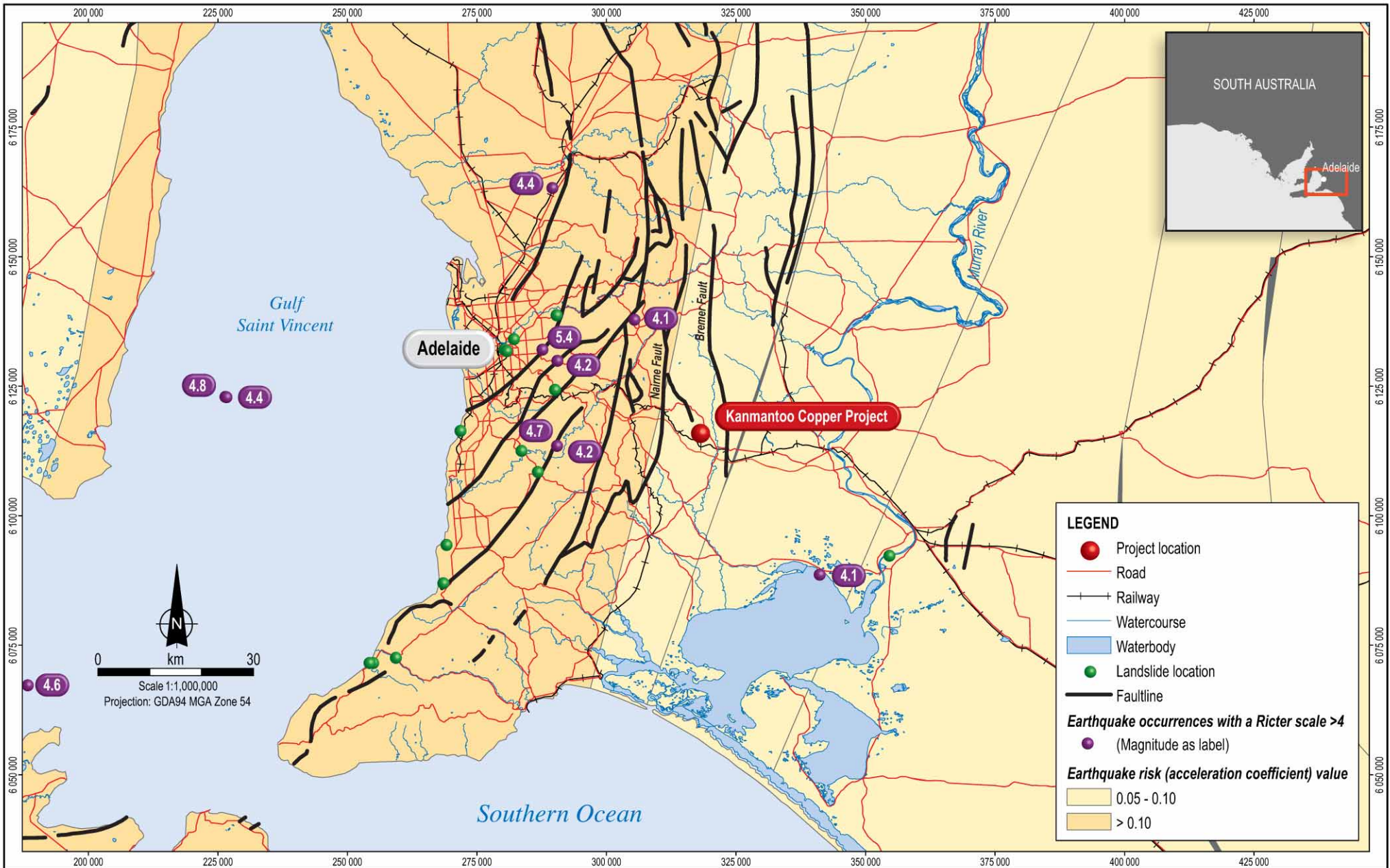
5.6.1 Landslides

No landslides have been recorded within, or immediately adjacent to, the MLA area (GA, 2000a) (Figure 5.14). The closest landslide recorded by Geoscience Australia occurred 27.5 km west of the MLA area, on the Bridal Path in Crafers on 20 July 1999. This mudslide displaced several tonnes of soil from a roadside embankment after heavy rainfall (GA, 2000a). Other recorded landslides in the eastern Mount Lofty Ranges have been closely associated with road and highway embankments, and have typically been triggered after significant rainfall events. Such sites include Dashwood Gully, Kangarilla and between Carey Gully and Balhannah on the lower side of Greenhill Road (GA, 2000a).

5.6.2 Historic Earthquake Events

Seismic activity in the surrounding region (15 km radius) has been limited to micro-earthquakes (less than 2.0 Richter magnitude) and very minor earthquakes (2.0 to 2.9 Richter magnitude) not generally felt by humans (GA, 2000b). The closest recorded earthquake occurred approximately 3 km from the MLA area in St Ives (GA, 2000b) on 3 May 1992, with a Richter magnitude of 1.2. Very minor seismic events with a Richter magnitude 2 to 2.9 have also been recorded adjacent to Nairne and Mount Barker, approximately 7 km and 11 km from the MLA area, respectively (GA, 2000b).

Significant earthquakes, with a Richter magnitude over 4, are identified in Figure 5.14. The closest of these seismic events, the 1883 Mount Bold earthquake, had its epicentre some 25.6 km from the MLA area. This earthquake recorded a Richter magnitude of 4.7, a light earthquake not producing any significant damage (GA, 2000b). The Beachport 1897, 6.5 Richter magnitude earthquake is South Australia's most significant seismic



Source:
 Place names, roads, rail and drainage from GEODATA TOPO 250K (optimum scale 1:250,000)
 Geohazards from PIRSA


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Local geohazards -
 earthquake risk and landslide locations

Figure No: 5.14

event in recorded history (GA, 2000b). Beachport lies approximately 280 km southeast of Kanmantoo.

5.6.3 Earthquake Risk

Earthquake acceleration coefficients are derived for the structural design of buildings and infrastructure and determine the amount of weight that can be applied horizontally during an earthquake. The higher the value of this coefficient, the greater the risk of an earthquake occurring. Within the Kanmantoo region, the acceleration coefficient range is between 0.05 and 0.10 g (GA, 2000c) (see Figure 5.14). These values are derived from the Australian Standard (AS 1170.4) and are based on a 10% chance exceedance in 50 years (SA, 1993).

Comparison acceleration coefficient values for other South Australian and Australian localities include Adelaide 0.10 g, Brisbane 0.06 g, Melbourne 0.08 g and Perth 0.09 g. Meckering in Western Australia is the site of Australia's largest coefficient value, 0.22 g. (SA, 1993).

5.6.4 Faults

Kanmantoo lies to the east of the north-south-trending Nairne fault and west of the Bremer fault (see Figure 5.14). Multiple escarpments exist within the Mount Lofty Ranges, with the most recent movement along these faults believed to be during the Tertiary (65 to 1.8 Ma) (Drexel and Preiss, 1995). All recent seismic activity (1856-2007) in South Australia is widely distributed, and therefore cannot be directly correlated with known fault lines (PIRSA, 2002).

5.6.5 Hazardous Minerals

On a regional scale, asbestos minerals have not been identified within Kanmantoo Group sediments. South Australian asbestos deposits are primarily hosted within the carbonate rocks of the Burra and Hawker groups (PIRSA, 2007d). Known asbestos deposits lie approximately 120 and 75 km north of the MLA area in Robertstown and Truro, respectively.

A number of small arsenic deposits have been identified and exploited within the Kanmantoo host, the Tapanappa Formation. The closest of these is situated about 4 km southeast of Kanmantoo near the old Bremer mine (PIRSA, 2007d). Arsenic assemblages within the Tapanappa are typically associated with silver-lead-zinc mineralisation rather than copper-gold mineralisation (PIRSA, 2007d). The Kanmantoo deposit ore and waste rock sequences contain on average 1.47 and 0.52 ppm of arsenic, respectively (Ferguson, Pers. comm.). Average background arsenic concentrations within soil range from 1 to 40 ppm with intermediate values often around 5 ppm (WHO, 2001).

Radioactive minerals are not found in significant quantities in Cambrian Kanmantoo Group sediments (PIRSA, 2007e). Major uranium deposits in South Australia are restricted to Proterozoic rock units. The two major uranium deposits in South Australia, the Proterozoic-hosted Olympic Dam deposit and the Tertiary palaeochannels Beverly deposit, are located over 500 km northeast to northwest of Kanmantoo (PIRSA, 2007e). Radioactive minerals will not be mined during the project; the ore concentrate contains very low levels of uranium (2 ppm).

5.7 Surface Water

This section describes the existing surface waters in the MLA area and surrounds, with a focus on:

- Catchment systems, surface drainage patterns, waterways or other wetland habitat (natural or artificial, ephemeral or permanent) that may be impacted by the project.
- Information of specific interest:
 - Significance (e.g., wetlands, Ramsar-listing).
 - Current uses.
 - Flows, discharge rates.
 - Water quality.

Local drainage systems in the MLA area are ephemeral, flowing only after large rainfall events. Overall 2006 was a particularly dry year (see Section 5.1) and there was little opportunity to collect surface water quality data in the immediate MLA area. The following description is therefore based primarily on information contained in:

- Stream quality assessment report (Appendix 4B of Roche, 2006).
- Surface water yield assessment report (Aquaterra, 2007a)
- Kanmantoo Copper Project pre-feasibility study (Roche, 2006).

Bremer River and Lake Alexandrina water quality data (EPA, 2006b) has been included to provide an overview of the regional surface water quality, while hydrological data is from the DWLBC Surface Surrounds Water Archive (DWLBC, 2004).

5.7.1 General Description of MLA Area

The MLA area lies within the catchment of the Bremer River (see Figure 5.7), which is a sub-catchment of the Murray River. Most of the MLA area is drained by a number of small, unnamed tributaries that report to Dawesley Creek, a tributary of Mount Barker Creek, which flows into the Bremer River near Callington (see Figure 5.7). Drainage from the south of the MLA area flows parallel with Back Callington Road to the Bremer River. The Bremer River then flows south for about 40 km through Hartley and Langhorne Creek, eventually discharging into Lake Alexandrina, which is part of the Ramsar-listed Coorong, Lake Alexandrina and Lake Albert Wetland (see Figures 5.7 and 2.3).

Lake Alexandrina and Lake Albert form a terminal lake system covering about 85,000 ha. The Coorong is a coastal system comprising two main lagoons that are 2 to 3 km wide (see Figure 5.7), with a total length of 140 km (RMCWMB, 2003). Lake Alexandrina is the largest reservoir of freshwater in South Australia and is important from ecological, recreational, agricultural and economic viewpoints. Agricultural industries and towns along the lakeside extract water for a variety of purposes (EPA, 2006a). Further information about the flora and fauna is given in Sections 5.9.2 and 5.10.2.

5.7.2 Hydrology

The rivers and catchments of South Australia are governed by its largely semi-arid climate, resulting in some of the most variable rainfall and surface water flows (runoff) in the world. Annual rainfall in the area averages 424 mm, most of which falls in the winter months (see Section 5.1).

Three selected gauging stations in the broader MLA area are located on Dawesley Creek at Dawesley (A4260558), Mount Barker Creek downstream of Mount Barker (A4260557) and the Bremer River near Hartley (GS426533) (Figure 5.15 and Plates 5.8, 5.9 and 5.10). The historical daily stream discharge record for the Bremer River at GS426533 (DWLBC, 2004) (Figure 5.16) shows distinct annual high and low flow periods, with the high flow events occurring during the winter/spring months, especially July to September, and corresponding with seasonal rainfall. Discharge statistics for each of the gauging stations are shown in Table 5.2.

Table 5.2 Average daily stream discharge statistics over historical record

Site	Catchment area km ²	Minimum (L/s)	Mean (L/s)	Maximum (L/s)
Dawesley Creek (A4260558)	43	52	102	226
Mount Barker Creek (A4260557)	88	89	203	456
Bremer River (GS426533)	473	284	512	933

In a study conducted by Aquaterra, (Aquaterra, 2007a,b), annual average flow rate of the MLA area (based on a catchment area of 4.4 km²) was estimated to be 4.7 L/s.

5.7.3 Current Uses and Environmental Values

The MLA area lies within the Eastern Mount Lofty Ranges (EMLR) water resource management scheme and a water allocation plan (WAP) is currently being developed for the region (see Section 4.1.2).

Protected environmental uses for South Australian inland surface waters (and underground waters) are (EPA, 2003a):

- Maintenance of aquatic systems.
- Recreation and aesthetics.
- Potable water use.
- Agriculture (irrigation and livestock drinking water).
- Industrial use.

Environmental values for the Bremer River specifically include ecosystems, drinking water, livestock and irrigation (EPA, 2003b).

5.7.4 Water Quality

The major water quality concerns in the Mount Lofty Ranges watershed are generally the result of a number of small influences (diffuse pollution) combining to produce a major effect on water quality. The major pollutants include faeces, parasites (*Cryptosporidium* and *Giardia*), nutrients, sediment and pesticides. In the Bremer River catchment specifically, elevated turbidity, heavy metal, and nutrient levels are the most likely water quality problems (EPA, 2006b). Previous water quality studies in the Bremer catchment include:

- Measurement of general parameters and metals in stream water and sediment (Burt and Gum, 2000a and b).
- Characterisation of sediment samples (Appendix 4B of Roche, 2006).

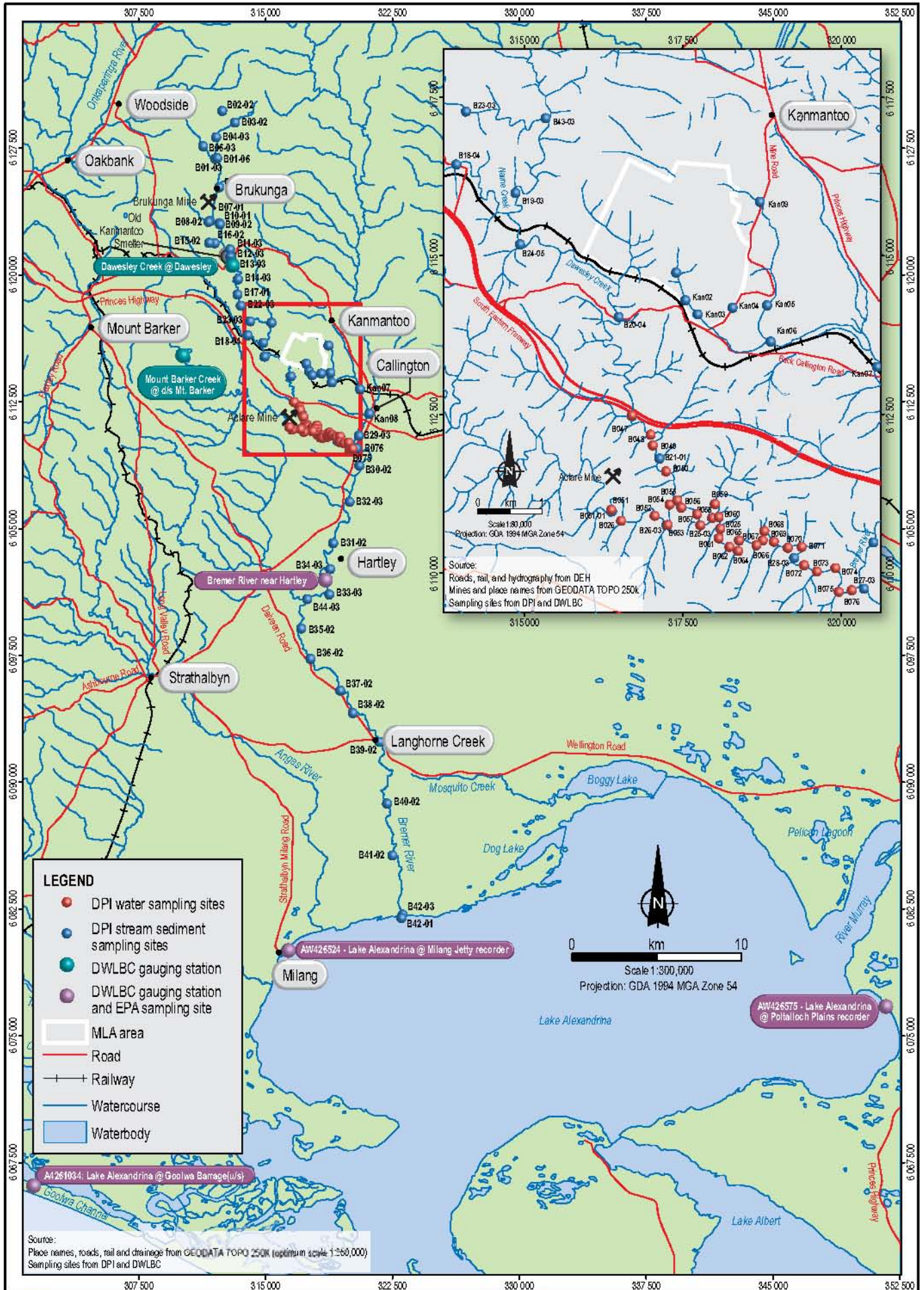


Plate 5.8
Dawesley Creek
stream gauging station site



Plate 5.9
Mount Barker Creek
stream gauging station site

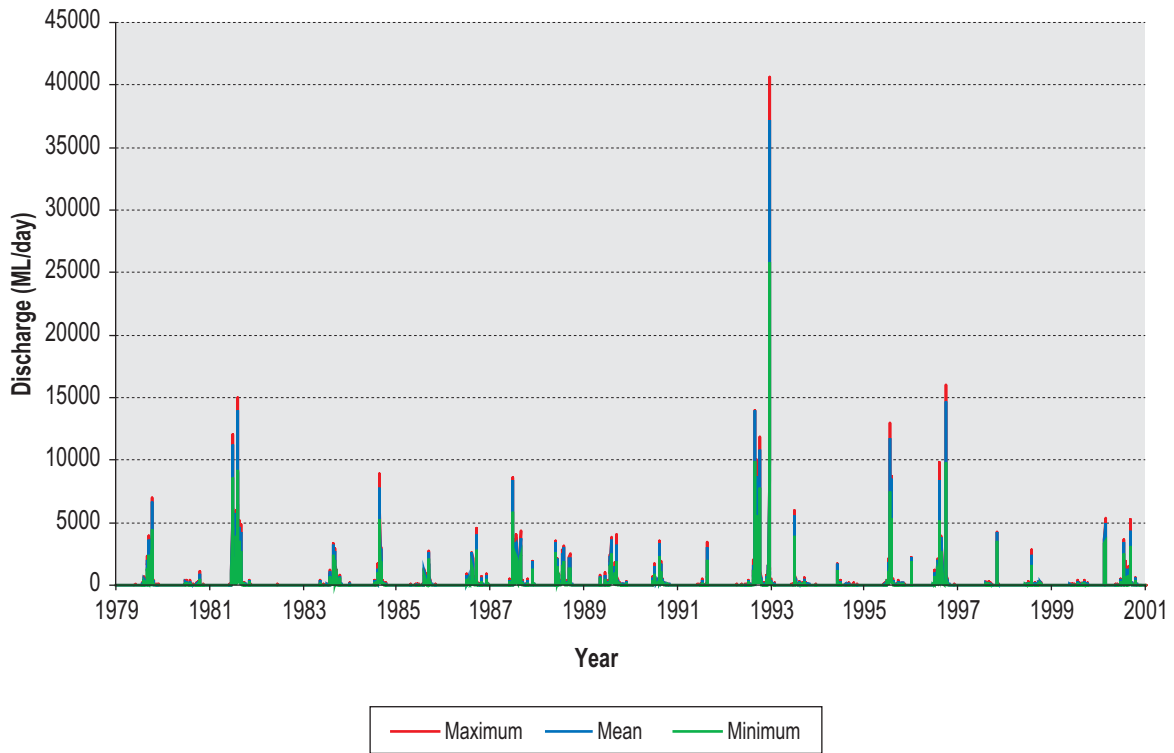


Plate 5.10
Bremer River
stream gauging station site

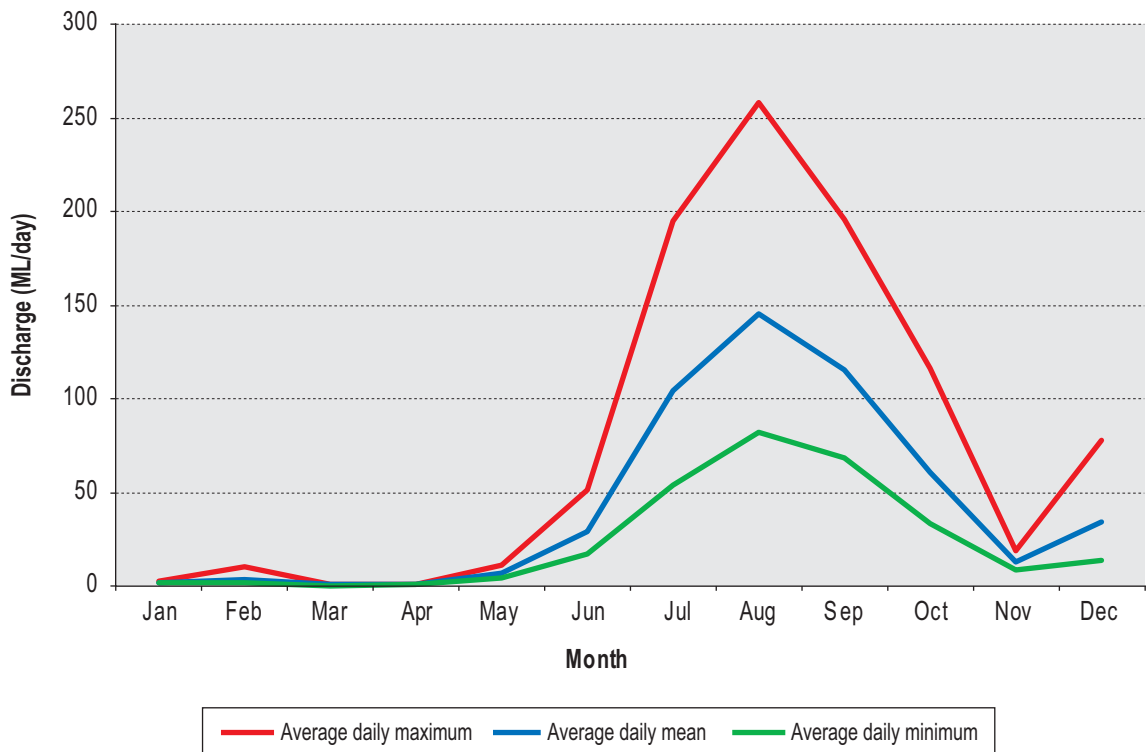


Source: DWLBC (2004).

Bremer River daily stream discharge historical record at GS426533



Bremer River average daily stream discharge for each calendar month at GS426533 (1979-2001)



Source: DWLBC (2004).



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**Bremer River stream gauging
station flow record**

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- Surface water quality monitoring data (in the broader MLA area) (EPA, 2006b):
 - Bremer River.
 - Lake Alexandrina.

A statistical summary of the data is presented in Appendix 3A, with all data being presented in Appendix 3B.

Water and Sediment Quality Guidelines

Schedule 2 of the Environment Protection (Water Quality) Policy 2003 (EPA, 2003a) lists the water quality criteria for environmental parameters, which are based on ANZECC (1992), ANZECC/ARMCANZ (2000), NHMRC/ARMCANZ (1996) and NHMRC (1990). This assessment refers to these guidelines and in particular the Australian and New Zealand guidelines for fresh and marine water quality (ANZECC/ARMCANZ 2000).

Although a number of environmental values have been identified for the Bremer River system (see Section 5.7.3), the value that generally requires the highest water quality, and hence forms the basis for determining water quality objectives, is maintenance of aquatic ecosystems. Guidelines relevant to this environmental value, assuming a slightly to moderately disturbed system and protection of 95% of species, have therefore been used herein.

Guidelines used for sediment quality with respect to toxicant levels are the Australian interim sediment quality guidelines (ANZECC/ARMCANZ, 2000). The guidelines contain two values, ISQG-low and ISQG-high, which delineate three biological effects ranges:

- Concentrations below the ISQG-low represent a range where adverse biological effects on benthic biota will rarely be observed.
- Concentrations between the ISQG-low and ISQG-high represent a range where adverse biological effects on benthic biota will occasionally be observed.
- Concentrations above the ISQG-high represent a range where adverse biological effects on benthic biota frequently occur.

General Water Quality

In a study of the potential environmental contaminants in the Bremer catchment (Burt and Gum, 2000a and b), the site of the Brukunga Mine, located upstream of the Kanmantoo Copper Mine (see Figure 5.15), is highlighted as a source of acid rock drainage (ARD) primarily from the old tailings dam. Discoloured water was observed reaching as far as Lake Alexandrina during periodic flooding of the creek.

Other potential heavy metal contamination sources were identified, including (see Figure 5.15):

- 'Bird in Hand' wastewater treatment plant, which treats effluent from the town of Woodside and surrounds. The plant is located at the headwaters of the drainage system.
- An effluent pit draining the town of Brukunga's sewage and wastewater that is situated on the banks of Dawesley Creek.

- Runoff from Aclare mine tailings, containing high levels of arsenic, lead and antimony, that washes into Dawesley Creek during high rainfall events.
- The old Kanmantoo smelter, which is situated on the banks of Dawesley Creek at Dawesley, where blocks of slag material leaching copper oxides are scattered in the creek and along the banks (Burt and Gum, 2000a).

Figure 5.15 also shows the locations of water and sediment sampling sites from Burt and Gum (2000a and b) and the EPA (EPA, 2006b), and the results are discussed below. For statistical purposes, all data less than the detection limit has been assigned a value half of the detection limit.

In the Kanmantoo MLA area, a study undertaken by Parsons Brinkerhoff (PB 2006a) identified the presence of acidic water in the old pit and in the old tailings dam (pH 2.8 and 2.6, respectively), in addition to high electrical conductivity (14,000 and 9,000 $\mu\text{S}/\text{cm}$, respectively) and a chemical composition typical of mine-related ARD.

Dawesley Creek and Mount Barker Creek

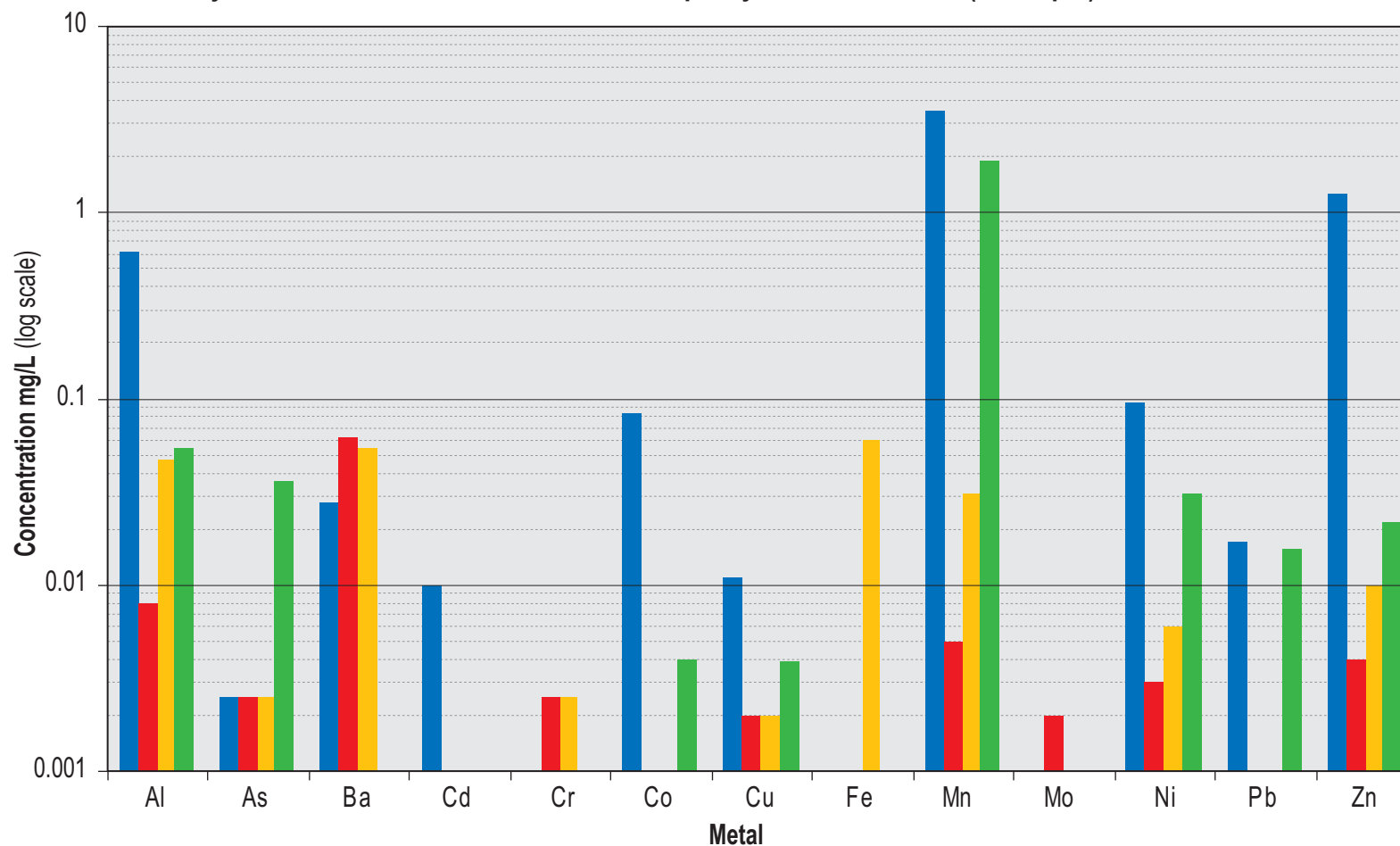
Drainage from the MLA area reports eventually to the Bremer River, either via Dawesley Creek and Mount Barker Creek or via an unnamed ephemeral stream (see Section 5.7.1). Statistical summaries of water quality general parameters and metal concentrations, along with the ANZECC/ARMCANZ (2000) and state guidelines (EPA, 2003a), are shown in Tables 1 and 2, Appendix 3A. Median filtered metal concentrations are represented graphically in Figure 5.17. Summaries were generated using the following sampling sites (see Figure 5.15):

- Dawesley Creek (upstream of confluence with Mount Barker Creek): B047, B048, B049, B050, B055.
- Mount Barker Creek (upstream of confluence with Dawesley Creek): B026, B051, B052, B053, B054.
- Mount Barker Creek (downstream of confluence with Dawesley Creek): B025, B056, B057, B058, B059, B060, B061, B062, B063, B064, B065, B066, B067, B068, B069, B070, B071, B072, B073, B074, B075, B076.

Dawesley Creek upstream of the Dawesley Creek/Mount Barker Creek confluence was more acidic (median pH 5.4), and below the recommended ANZECC/ARMCANZ (2000) and EPA (2003a) guidelines, than the Mount Barker Creek sites both upstream (median pH 7.3) and downstream (median pH 7.6) of the confluence (Table 1, Appendix 3A). The sulfate concentration at these sites ranged from 630 to 800 mg/L, which is in exceedance of the guidelines for state water quality criteria for potable water and livestock (EPA, 2003a), and substantially higher than Mount Barker Creek upstream of the confluence with Dawesley Creek (64 to 92 mg/L), and is consistent with the occurrence of ARD as referred to above under 'General Water Quality'.

The results show a substantial decrease in metal concentrations (Table 2, Appendix 3A) below the junction of Dawesley Creek and Mount Barker Creek, which is suggestive of the precipitation of metals as a result of the pH gradient in the two creek systems (Burt and Gum, 2000a) in addition to dilution. In general, median filtered metal concentrations

Dawesley Creek and Mount Barker Creek water quality – median filtered (<0.45 µm) metal contaminations



Source: Burt and Gum (2000b).

Note:
Measurements not determined or below detection limits have not been included.



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**Dawesley Creek and
Mount Barker Creek water quality**

Figure No:
5.17

are higher than the ANZECC/ARMCANZ (2000) guidelines in the Dawesley Creek upstream of the confluence with Mount Barker Creek (see Figure 5.17).

Burt and Gum (2000a) speculate that high concentrations of some metals, including aluminium, cadmium, cobalt, copper, manganese, nickel and zinc, in Dawesley Creek are indicative of ARD occurring at the Brukunga mine site (EPA, DEH, 2000), situated upstream of the Kanmantoo mine site, as well as a minor contribution from the Aclare mine tailings (see preceding discussion). Filtered metal concentrations in exceedance of the ANZECC/ARMCANZ (2000) guidelines for aquatic ecosystem protection are shown in italics in Table 2, Appendix 3A, while total metal concentrations in exceedance of the state water quality criteria are indicated in bold. The metal-containing material from the Aclare mine would only be transported into the creek during high rainfall events, with metals possibly being mobilised by the slightly acidic waters of Dawesley Creek (Burt and Gum, 2000a).

Bremer River

The Bremer River receives discharge from both Dawesley and Mount Barker creeks. Summary statistics for general water quality parameters and metals for the Bremer River near Hartley, some 8 km downstream of the Dawesley Creek/Bremer River confluence (see Figure 5.15), are shown in Table 3 and Table 4, respectively, of Appendix 3A.

Median total metal concentrations are below the state water quality criteria (EPA, 2003a) with the exception of cadmium and copper, which are slightly elevated.

The median concentrations of oxidised nitrogen and total nitrogen exceed ANZECC/ARMCANZ (2000) guidelines but not the state water quality guidelines (EPA, 2003a) (Table 3, Appendix 3A). The highest concentrations of nutrients generally occur in the winter months and are likely to be due to runoff from grazing land (mainly fertilisers and animal wastes) and septic tank overflows, as well as excessive irrigation in the catchment (EPA, 2006b).

Lake Alexandrina

Lake Alexandrina, The Coorong and Lake Albert lie approximately 40 km south of the MLA area. A statistical summary of general parameters for three sampling sites in Lake Alexandrina (Poltalloch Plains, Goolwa (upstream of the barrage) and Milang see Figure 5.15) is shown in Table 5, Appendix 3A, along with ANZECC/ARMCANZ (2000) guidelines for both freshwater lakes and marine ecosystems and state guidelines.

Lake Alexandrina is shallow, well-mixed by prevailing winds, and relatively turbid and saline. The River Murray has the greatest effect on water quality and is the largest contributor to sediment, nutrient and salt loads. The Angas, Bremer, Currency and Finniss rivers also discharge into the lake but their influence away from the point of discharge is thought to be minor (EPA, 2006b).

Median total nitrogen at all sites and total phosphorus at two out of three sites were greater than the ANZECC/ARMCANZ (2000) guidelines (Table 5, Appendix 3A) but less than those in the state water quality guidelines (EPA, 2003a). The irrigated farming in the Lower Murray region is likely to add a substantial nutrient load to the lake, with fertilisers and animal wastes being washed off farms during storms or due to effluent outfalls (EPA, 2006b). Nutrient inputs promote blooms of non-toxic algae and micro-crustaceans.

Blooms of toxic blue-green algae (cyanobacteria) occur regularly in the lake for substantial periods and the water is often unusable during this time. Blooms are linked to the availability of nutrients, particularly nitrogen and phosphorus, and warm weather (EPA, 2006b).

5.7.5 Stream Sediment Quality

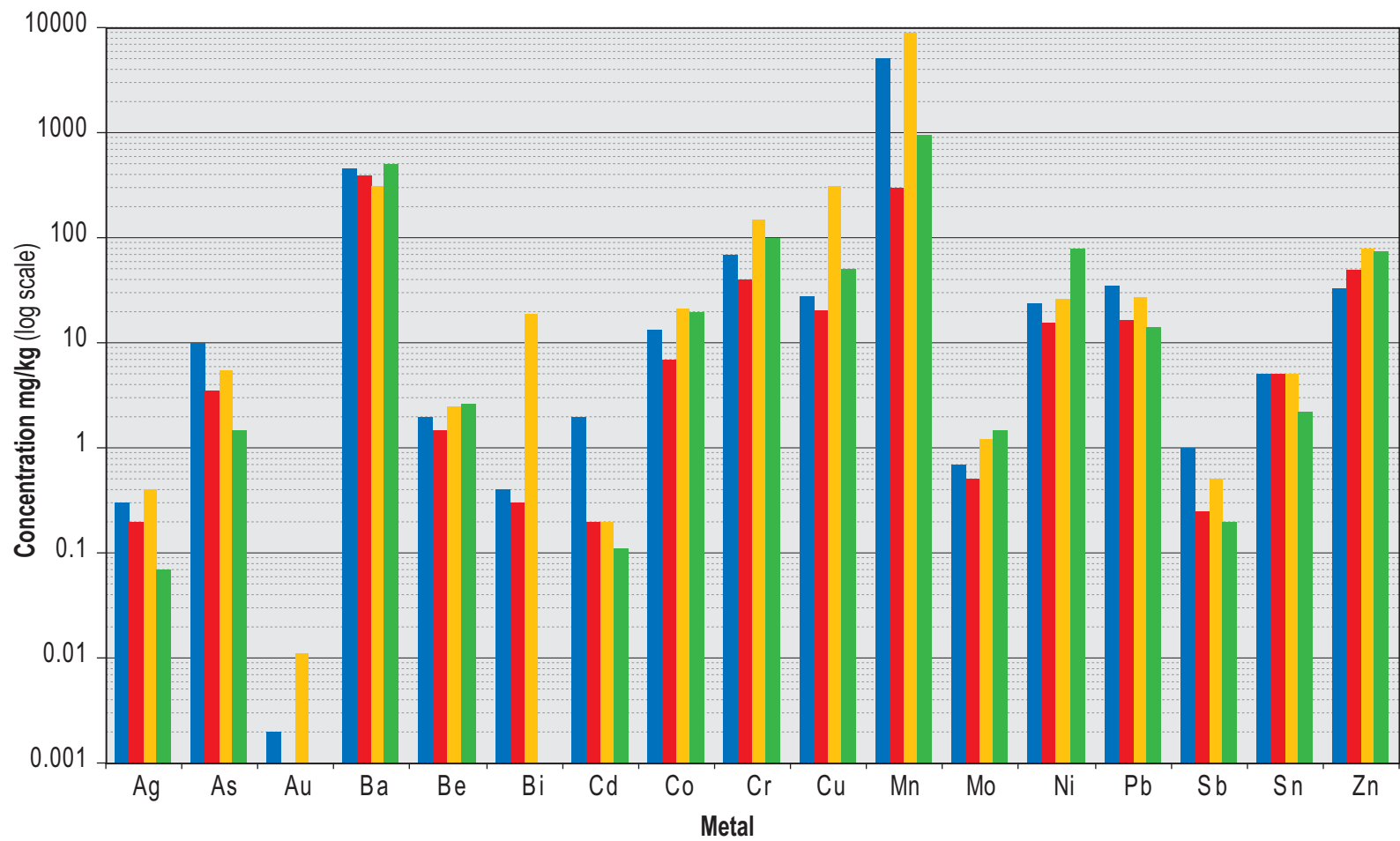
The MLA area and surrounds contains mineralisation and hence the soil, rock and stream sediments contain high concentrations of some metals (Burt and Gum, 2000a).

Extensive sediment sampling was conducted in 2000, with sampling sites located approximately 200 m apart along the Dawesley and Mount Barker creeks (Burt and Gum, 2000a) (see Figure 5.15). A statistical summary of pH, electrical conductivity and metal concentrations in total sediment sampled from Dawesley/Mount Barker creeks, Langhorne Creek and the Kanmantoo mine, together with Interim Sediment Quality Guidelines (ISQG), is shown in Table 6, Appendix 3A.

Most median metal concentrations in sediments collected from the Bremer catchment within the Kanmantoo mine area, including silver, arsenic, cadmium, cobalt, chromium, copper, manganese, lead, tin and zinc exceeded average crustal abundances (Figure 5.18). Most of these metals, however, were below the ISQG-high guidelines (where these are available), with the exception of copper concentrations that ranged from 140 to 13,500 mg/kg (where the latter value is 50 times the ISQG-high value).

Burt and Gum (2000a) concluded that most of the heavy metal contamination in the Bremer catchment is largely confined to the top 20 cm of the soil and sediment profile. The area with the highest concentrations of heavy metals, and which showed the greatest exceedance of ISQG-high guidelines, was situated at the Dawesley/Mount Barker confluence, with cadmium ranging from <0.1 to 54 mg/kg (ISQG-high = 10), lead ranging from 2 to 42,400 mg/L (ISQG-high = 220) and zinc ranging from 16 to 5850 mg/L (ISQG-High = 410). Burt and Gum (2000a) hypothesised that, at this point, the more acidic waters of Dawesley Creek mix with the more alkaline waters of Mount Barker Creek, resulting in precipitation of dissolved metals and consequently increased bed sediment metal concentrations. Concentrations of cadmium, arsenic, copper, lead, molybdenum, tin, and zinc were elevated in stream sediment where the tailings of the abandoned Aclare Mine enter Dawesley Creek (Burt and Gum, 2000b) (see Figure 5.15).

Results for stream sediment samples in the Kanmantoo MLA area that were reported in May 2000 (Burt and Gum, 2000a) and April 2006 (Appendix 4B of Roche, 2006) from creeks that drain the old waste dump, old tailings dam and old mine workings are presented in Table 7, Appendix 3A. In general, metal concentrations in sediments in the MLA area were either below ISQG-low guidelines (arsenic, cadmium, mercury and zinc)



Source: Burt and Gum (2000a).



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**Bremer River catchment sediment –
median metal concentrations**

Figure No:
5.18

or between the ISQG-low and ISQG-high guidelines (chromium and lead), with the exception of several copper and nickel values¹ that exceeded the ISQG-high guidelines.

5.8 Groundwater

This section describes the existing groundwater regime in the MLA area and surrounds, with a focus on:

- Relevant groundwater resources in areas likely to be affected by the construction and operation of the mine and processing plant.
- Information of specific interest:
 - Significance.
 - Current uses.
 - Water quality.
 - Flows.

This description is based primarily on information provided in REM (2007a), which describes a water resources investigation that addresses both groundwater quality and a conceptual hydrogeological model. Other relevant reports include a groundwater assessment (Appendix 4C of Roche, 2006) which focuses on groundwater in the vicinity of the old pit and old tailings dam, and the characterisation of background groundwater within a 5-km radius of the old pit (PB, 2006b; REM, 2007b).

5.8.1 General Description

Groundwater in the EMLR water resource management area (see Section 5.7.3) is sourced from two different types of aquifers. Fractured rock aquifers consist of stored groundwater that moves through joints and fractures in the basement rocks. Sedimentary aquifers occur in the valleys and beneath the Murray Plains where groundwater flows through pore spaces within the sediments. The fractured rock aquifers include Adelaidean sediments, the Normanville Group and the Kanmantoo Group, and the sedimentary aquifers include the Permian sands and the Murray Group limestones (see Section 5.5.1) (DWLBC, 2003).

Groundwater in the Kanmantoo area and surrounds is of varying quality and yields. The MLA area is underlain by the Kanmantoo Group fractured rock aquifer that is generally tight and impermeable with few open systems of fractures and joints, yielding only low-flow (<1 L/s) stock supplies typically with salinity ranging from 8,000 to 15,000 mg/L TDS (Roche, 2006; DWLBC, 2003). In general, the quality and yield of groundwater deteriorates eastward across the Adelaide Hills at this latitude, which is thought to be related to both decreasing rainfall resulting in reduced flushing and recharge potential, and the changing lithology (Appendix 4C of Roche, 2006).

¹ Major discrepancies between the results from 2000 and 2006 may be due to different methods of sediment digestion. Burt and Gum (2000b) used an HF/multi-acid digest while PB (App 4B, Roche, 2006) used an aqua regia digest.

Based on the occurrence of ARD at the former Kanmantoo operations, there is likely to be an area of groundwater close to the Kanmantoo mine that has been affected by acidic and metal-rich infiltration (Appendix 4C of Roche, 2006). The old pit, however, has been behaving as a groundwater sink since at least 2004, with groundwater flowing towards, rather than away from the pit (see Sections 5.8.4 and 5.8.5).

5.8.2 Groundwater Uses

Protected environmental uses for South Australian underground waters are the same as for inland surface waters (maintenance of aquatic systems, recreation and aesthetics, potable water, agriculture and industrial use) (see Section 5.7).

Within a more regional context, the National Water Commission has formed a National Water Initiative (NWI) containing a number of performance indicators for a groundwater management unit in the Southern EMLR, within which the MLA area lies. One of the performance indicators is a water resource cap (NWC, 2005) which includes the following groundwater usage types:

- Irrigation.
- Urban supply.
- Commercial/industrial.
- Mining/oil and gas.

When released, the WAP for the EMLR water resources area will also define groundwater uses and allocations (see Sections 4.1.2 and 5.7.3).

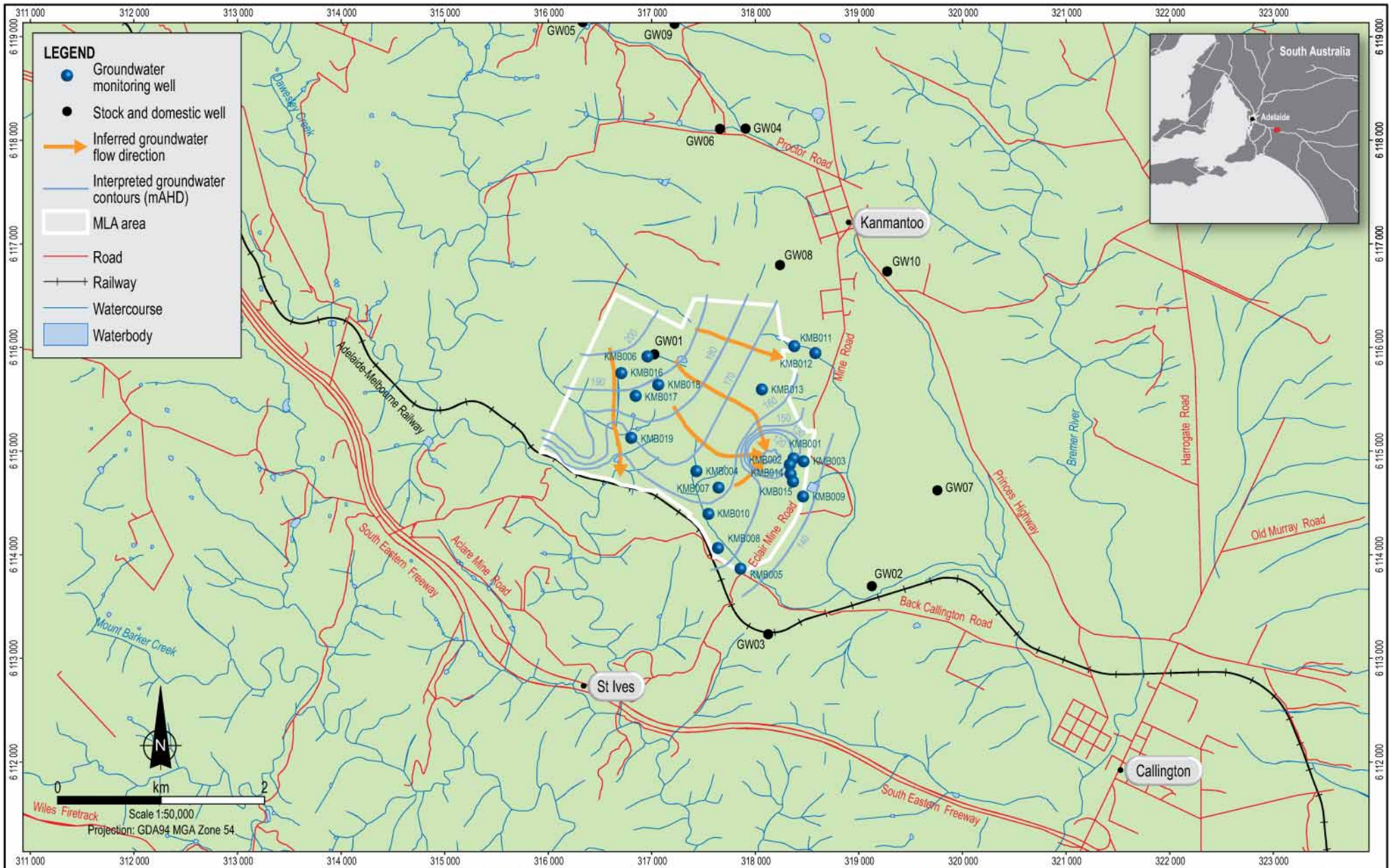
Currently the main groundwater uses in the EMLR are for stock and domestic purposes, sourced from relatively shallow groundwater wells equipped with windmills or low capacity submersible pumps (REM, 2007a).

5.8.3 Water Quality

Existing stock and domestic wells, as well as new monitoring wells installed by Hillgrove, have been sampled and analysed for water quality since April 2006.

Ten stock and domestic wells (GW01 to GW10) (Figure 5.19) within a 5-km radius of the old open pit were sampled in April to June 2006 and analysed for pH, temperature, electrical conductivity, major ions, cyanide and metals to assess background groundwater quality (Appendix 4C of Roche, 2006). Four groundwater monitoring wells (KMB001 to KMB004) (see Figure 5.19)—three to the east of the old pit (within several hundred metres of the pit perimeter) and one immediately south of the old waste rock dump (also within several hundred metres of the pit perimeter)—were installed in November 2006 (REM, 2007a; REM, 2006). Most of these wells were re-sampled in May 2007 and analysed for the same parameters (REM, 2007b).

A further six groundwater monitoring wells (KMB005 to KMB010) were drilled in March 2007 within the MLA area boundary (see Figure 5.19), and sampled in April. KMB001 to KMB004 were also re-sampled. Installation of a further five groundwater monitoring wells (KMB011 to KMB015) was completed in May and June 2007 (Appendix 4). Four groundwater monitoring wells (KMB016 to KMB019) were installed by Hillgrove in the area of the proposed integrated waste landform to improve the understanding of the local hydrogeology and to provide baseline conditions beneath the proposed landforms.



- LEGEND**
- Groundwater monitoring well
 - Stock and domestic well
 - Inferred groundwater flow direction
 - Interpreted groundwater contours (mAHd)
 - MLA area
 - Road
 - Railway
 - Watercourse
 - Waterbody



Source:
 Cadastre, roads, rail and drainage from DEH (optimum scale 1:25,000)
 GW monitoring wells and groundwater flows from REM
 Stock and domestic wells from 2002 PIRSA Groundwater Database


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Groundwater flows and monitoring sites

Figure No: 5.19

Parameters typically measured include major ions, cyanide and metals for samples taken at each of the watertable levels, as well as at a depth where the highest yield was identified. Selected results are shown in Table 5.3, with additional data presented in Appendix 4 and other reports (Appendix 4C of Roche, 2006; REM, 2006; PB, 2006b).

Surrounding Area Groundwater Quality

The groundwater sampling program, covering an area within a 5-km radius from the old pit (PB, 2006b), indicated pH values from 6.8 to 8.4, which is within SA EPA potable guidelines (6.5 to 8.5). Electrical conductivity varied from fresh in one well (GW08 – EC < 700 μ S/cm) to a brackish 9,460 μ S/cm in windmill GW06 (see Figure 5.19). Major ion concentrations were generally in the following order (mg/L):

Na > Mg > Ca > K
Cl > HCO₃ > SO₄ >> NO₃.

Most metals were below the detection limit or the SA EPA potable water guidelines (PB, 2006b) with the exception of:

- One arsenic concentration (GW06, 0.008 mg/L compared with the guideline value of 0.007 mg/L).
- One manganese concentration (GW07, 0.7 mg/L compared with 0.5 mg/L).
- One nickel concentration (GW01, 0.027 mg/L compared with 0.02 mg/L).
- Several selenium concentrations (GW02 to GW07, 0.011 to 0.043 mg/L compared with 0.01 mg/L).

Due to the potential for localised occurrences of groundwater discharging to streams, results have also been compared to aquatic ecosystem protection guidelines. Exceedances identified include (PB, 2006b):

- One chromium concentration (GW01, 0.034 mg/L exceeding the guideline value of 0.01 mg/L).
- Several copper concentrations (GW01, GW03, GW04, GW08, GW09, 0.011 to 0.240 mg/L compared with 0.01 mg/L).
- One iron concentration (GW05, 2.9 mg/L compared with 1 mg/L).
- Three zinc concentrations (GW01 to GW03, 0.22 to 0.78 mg/L compared with 0.05 mg/L).

These concentrations are expected to be naturally occurring and related to regionally high metal content of the rocks of the district, rather than anthropogenic activities (PB, 2006b). The results from the May 2007 sampling and analysis program are consistent with the 2006 results and support the findings listed above (REM, 2007b).

Table 5.3 Groundwater quality - metal concentrations

Site	Al mg/L	As mg/L	Be mg/L	Ba mg/L	Cd mg/L	Cr mg/L	Co mg/L	Cu mg/L	Fe mg/L	Mn mg/L	Hg mg/L	Ni mg/L	Pb mg/L	Se mg/L	V mg/L	Zn mg/L
State water quality criteria ^{B1}																
Freshwater aquatic	0.1 ^{B2}	0.05	0.004	–	0.002	^{B3}	–	0.01	1	–	0.0001	0.15	0.005	0.005	–	0.05
Potable water	–	0.007	–	0.7	0.002	^{B3}	–	2	–	0.5	0.001	0.02	0.01	0.01	–	0.05
Irrigation	1	–	0.1	–	0.01	1	0.05	0.2	1	2	0.002	0.2	0.2	0.02	0.1	2
Livestock	5	–	0.1	–	0.01	1	–	0.5	–	–	0.002	1	0.1	0.02	0.1	20
KMB001 (Nov 06)	15	0.041	–	–	0.051	<0.001	9.4	14	120	21	0.0003	3	0.06	0.24	–	8.1
KMB001 (Apr 07)	–	0.004	0.056	0.036	0.126	0.001	14.7	14.8	–	25.8	0.0001	4.94	0.449	–	<0.01	16.4
KMB002 (Nov 06)	91	0.006	–	–	0.024	<0.001	3.6	10	1.2	17	<0.0005	2.5	0.23	0.039	–	1.3
KMB002 (Apr 07)	–	0.003	0.051	0.016	4.16	0.004	4.4	118	–	20.5	<0.0001	1.91	0.045	–	<0.01	1.8
KMB003 (Nov 06)	<0.005	0.009	–	–	<0.0002	<0.001	0.096	0.09	1.7	0.71	<0.0001	0.023	<0.001	0.063	–	0.013
KMB003 (Apr 07)	–	0.01	<0.001	0.039	0.0003	<0.001	0.011	0.01	–	0.219	<0.0001	0.2	<0.001	–	<0.01	0.009
KMB004 (Nov 06)	<0.005	0.008	–	–	0.0057	<0.001	0.29	0.14	3.8	1.8	<0.0001	0.27	<0.001	0.074	–	0.066
KMB004 (Apr 07)	–	–	0.001	0.039	0.0058	<0.001	0.101	0.039	–	1.01	<0.0001	0.158	0.002	–	<0.01	0.053
KMB005 (54 m bgl)	–	0.008	0.004	0.021	<0.0001	<0.001	0.022	0.002	–	0.179	<0.0001	0.049	<0.001	–	<0.01	0.033
KMB006 (watertable)	–	0.005	0.003	0.042	0.0014	<0.001	0.014	0.186	–	0.21	<0.0001	0.049	<0.001	–	<0.01	0.014
KMB006 (54 m bgl)	–	0.005	0.004	0.044	0.0014	<0.001	0.008	0.02	–	0.208	<0.0001	0.02	<0.001	–	<0.01	0.021
KMB007 (watertable)	–	<0.001	<0.001	0.033	<0.0001	<0.001	0.005	0.002	–	0.654	<0.0001	0.012	<0.001	–	<0.01	0.011
KMB007 (54 m bgl)	–	0.005	0.003	0.044	<0.0001	<0.001	0.013	<0.001	–	0.312	<0.0001	0.036	<0.001	–	<0.01	0.018
KMB008 (watertable)	–	0.002	0.003	0.042	0.0003	<0.001	0.007	0.001	–	0.119	<0.0001	0.011	<0.001	–	<0.01	0.022

^{B1} EPA (2003). Environmental Protection (Water Quality) Policy (Schedule 2).

^{B2} Applies to soluble form, filterable through a 0.1 µm filter.

^{B3} Cr(VI). Insufficient data exists to establish a trigger value for Cr(III).

bgl = below ground level

	Exceedance of freshwater guidelines.
	Exceedance of potable guidelines.
	Exceedance of irrigation guidelines.
	Exceedance of livestock guidelines.

NB: In general, trigger values increase from freshwater aquatic through to livestock guidelines (with the exception of As).

MLA Area Groundwater Quality

Findings. Analytical results from the two wells closest to the old pit (KMB001 and KMB002) revealed acidic conditions ranging from pH 3.9 to 5.2, while pH in monitoring wells located further from the old pit ranged from pH 6.7 to 8.0 (KMB003, KMB004, KMB005, KMB006 and KMB007) (see Figure 5.19) (Appendix 4C of Roche, 2006). Additional monitoring bores installed in May 2007 had pH values ranging from 6.3 to 8.3 (KMB011 to KMB019), these results being consistent with previous data.

The ionic composition of groundwater sampled near the old open pit (KMB003, KMB014 and KMB015), old tailings dam seepage pond (KMB011 and KMB012) and old waste rock dump (KMB004) have been impacted compared to background wells (KMB016 to KMB019), but to a lesser extent than KMB001 and KMB002 (Appendix 4).

Groundwater analytical results for samples taken from monitoring wells KMB001 and KMB002 in April 2007 generally confirmed the elevated heavy metal concentrations identified in November 2006, including (see Table 5.3):

- Cadmium, cobalt, copper, nickel and selenium, which exceed the water quality policy criteria (EPA, 2003a) for livestock watering (and in most cases, also exceed criteria for freshwater aquatic ecosystems, potable water and irrigation).
- Iron, manganese, lead and zinc, which exceed the water quality policy criteria (EPA, 2003a) for irrigation (and hence also exceed criteria for potable water).
- Beryllium, arsenic, and mercury, which exceed the potable and freshwater aquatic criteria.

Aluminium exceeded the criterion for livestock watering in the November 2006 samples.

Heavy metal concentrations and acidic field pH observed in groundwater sampled from monitoring wells KMB001 and KMB002 was similar to values measured from the pit, suggesting that historical mining activities and potential leakage from the shallow tailings dam located near KMB002 have impacted groundwater quality in this area.

The concentrations of heavy metals further away from the pit (KMB003) decrease significantly, with only arsenic and nickel reported to exceed the SA Environment Protection (Water Quality) Policy (EPA, 2003a) criteria for potable use (see Table 5.3).

Monitoring wells installed in May 2007 (KMB014 to KMB015) in a south to southeast transect from the old pit indicate that groundwater has been impacted further down the hydraulic gradient than observed directly east of the pit. Exceedances of Schedule 1 of the (EPA, 2003a) water quality policy criteria include:

- Aluminium, which exceeds the water quality policy criteria for freshwater aquatic ecosystems (KMB015).
- Cobalt, iron, manganese, nickel and zinc, which exceed either potable water or irrigation guidelines (KMB014 and KMB015).
- Cadmium and copper, which exceed the guidelines for livestock, and which also exceed guidelines for freshwater aquatic, potable and irrigation use (KMB015).

Monitoring well KMB011, located approximately 150 m down hydraulic gradient of the tailings dam seepage pond (see Figure 5.19), shows:

- Aluminium and copper concentrations above freshwater aquatic guidelines.
- Cadmium and zinc concentrations exceeding potable water use guidelines.
- Cobalt, iron and manganese exceeding the irrigation guidelines, with iron and manganese being extremely elevated (149 mg/L and 171 mg/L, respectively).
- The nickel concentration is in exceedance of the water quality policy criterion (EPA, 2003a) for livestock use.

Metal concentrations in monitoring well KMB012, which is located 200 m down gradient of the seepage pond, are not elevated or are below the detection limits.

Groundwater monitoring well KMB006, located up hydraulic gradient of the site to assess background groundwater quality of the aquifer, contained concentrations of copper (0.186 mg/L) that substantially exceeded the fresh water criterion (0.01 mg/L) and nickel (0.049 mg/L) exceeding the potable use criterion (0.02 mg/L) (EPA, 2003a). Parsons Brinckerhoff (2006b) undertook an assessment of background groundwater quality data and found that copper concentrations in groundwater in the region ranged between below the detection limit (0.005 mg/L) to 0.24 mg/L. Regional bores up hydraulic gradient of the old Kanmantoo Mine site reported copper concentrations ranging from below the detection limit (0.005 mg/L) to 0.042 mg/L.

Background monitoring wells KMB007 and KMB008 sampled at the watertable reported all heavy metal concentrations either below the detection limit or below relevant criteria, with the exception of manganese in KMB007 (0.654 mg/L), which was above the (EPA, 2003a) potable use criterion (0.5 mg/L).

Groundwater sampled from water supply wells KMB005, KMB006, KMB007 and KMB008 at the highest yielding water depth identified concentrations of arsenic and nickel marginally exceeding potable use criteria (EPA, 2003a) in KMB005 and KMB007, and copper marginally above the fresh water criterion at KMB006 (see Table 5.3).

Groundwater samples from background monitoring wells (KMB016 to KMB019) installed within the MLA area boundary contain elevated concentrations of arsenic, cadmium, copper, nickel, manganese, selenium and zinc with respect to water quality policy criteria (EPA, 2003a). These concentrations most likely reflect naturally occurring concentrations in the parent rock in the MLA area.

Discussion. The groundwater geochemistry (particularly elevated sulphate) in wells located closest to the old pit (REM, 2007a), suggests that natural pyritic material in the aquifer formation may be undergoing oxidation, thereby creating acidic conditions (with this conclusion being supported by low pH field observations) and resulting in the mobilisation of heavy metals in the groundwater system. This is further supported by the positive redox potential (indicative of oxidising conditions) observed in groundwater sampled from these monitoring wells (KMB001 and KMB002). The dominance of calcium and magnesium at these sites compared to other locations sampled across the mine site are most likely due to the parent rock formation in this area.

These natural oxidation processes of the Kanmantoo schist are potentially contributing to elevated concentrations of heavy metals in the groundwater system in this area. However, groundwater flow conditions suggest that, at present, impacted groundwater near the old pit is hydraulically contained, with groundwater flowing towards the pit (see Section 5.8.4).

Consistent with the November 2006 sampling event, groundwater sampled in April 2007 from monitoring well KMB004 installed near the creek line and adjacent to the old waste rock dump reported a number of elevated heavy metals exceeding the relevant criteria (EPA, 2003a), thereby indicating that groundwater may have been impacted in this area from the historical placement of this material. The additional groundwater monitoring well (KMB007) installed approximately 260 m down hydraulic gradient of KMB004 showed elevated concentrations exceeding the criteria (EPA, 2003a), with the exception of nickel, with respect to potable use. This suggests that impacted groundwater identified in KMB004 does not extend as far as KMB007, which is located 260 m down gradient.

This assessment is further supported by the ionic composition of old pit water and groundwater illustrated in Figure 11 in REM (2007a), which shows that considerable mixing of water derived from the pit and groundwater has occurred close to the pit, with a lesser degree of mixing being evident further away at KMB003. The ionic composition of groundwater sampled from KMB003 and KMB004 compared to background wells (KMB006 and KMB007) suggest that the former wells have been impacted by both the old pit and the old waste rock dump, but to a lesser extent than groundwater sampled from KMB001 and KMB002.

Analytical data from background wells indicate that minor concentrations of heavy metals are naturally present in the groundwater system at concentrations that reflect the mineralisation of the parent rock at that location. As described above, in many cases this is above EPA guideline criteria, and represents natural background levels for this area.

5.8.4 Groundwater Flow

Regional groundwater flow direction, interpreted from groundwater level data, is in a generally east direction across the MLA area and in a south to southeasterly direction in the southern portion of the site (consistent with undulating topography) (Appendix 4; REM, 2007a) (see Figure 5.19). Groundwater level data from boreholes KMB001 to KMB004 located close to the old pit suggest that the pit acts as a groundwater sink (and has done since at least 2004), with groundwater flow occurring in a radial direction toward the pit, where evaporative losses from the water body are likely to be much higher than groundwater inflows (REM, 2007a). Anecdotal information suggests that the pit did not require significant dewatering due to the tight nature of the Kanmantoo schist formation in this area. Groundwater inflows during mining are predicted to range between 5 and 19 L/s, typically increasing with time as the pit becomes deeper (Appendix 4).

5.8.5 Conceptual Hydrogeological Model

Conceptual hydrogeological (groundwater) models are used to describe (often complex) groundwater flow systems in their simplest terms. Development of a conceptual model for the MLA area has helped understand the hydrogeology of the area further, delineate data and knowledge gaps, and provide a basis for developing numerical computational

models used for impact prediction (as discussed in Section 9.3). Figure 5.20 shows a cross-section of the project region, along the regional flow path through the old pit, that highlights key aspects of the conceptual hydrogeological model.

The hydrogeology of the site is discussed in detail in Appendix 4 and REM, 2007a and summarised below (see Figure 5.20).

The groundwater system beneath the Kanmantoo site area comprises a fractured rock aquifer, as described above in Section 5.7.1, with groundwater largely occurring within discrete fracture zones within mineralised and unmineralised fresh bedrock units of the Kanmantoo Group. The overlying shallower weathered bedrock profiles tend to confine the aquifer. Shallow Quaternary sediments associated with drainage lines, if saturated, may form perched aquifers that support remnant vegetation.

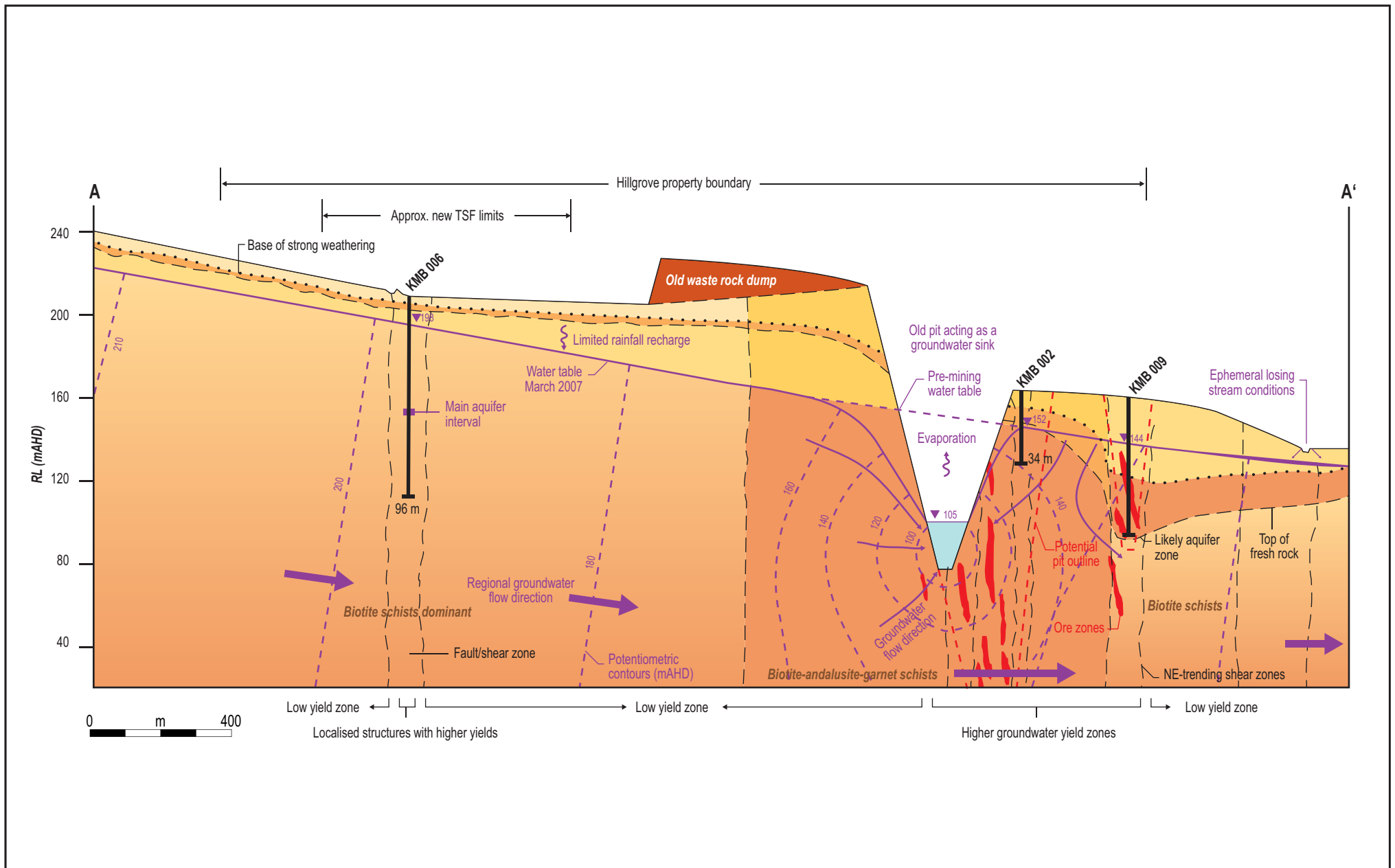
Groundwater in the MLA area is replenished largely by rainfall and probably occurs at an average rate of around 30 mm/yr based on previous regional studies (Appendix 4). Some recharge to groundwater may also occur along watercourses during rainfall runoff events. Groundwater discharge from beneath the MLA area occurs via groundwater flow toward lower lying parts of the Bremer catchment and via evaporation from the old pit.



At the very local scale, groundwater flow directions may be influenced by the expected regions of differing hydraulic conductivity within the discrete fractured aquifer and the less permeable surrounding bedrock (rock matrix). Groundwater flow may be strongly compartmentalised into discrete 'strip aquifers' in at least three locations across the site (near KMB005, KMB006 and KMB010) (see Figure 5.19), and may also be a subdued reflection of site topography. The inferred groundwater contour plan for the site (see Figure 5.19) shows:

- Pre-mining groundwater probably flowed toward the Bremer River valley in the southeast, and Nairne/Dawesley Creek in the south.
- The old pit now intercepts the southeasterly groundwater flow field beneath the site (i.e., the old pit is now acting as a local-scale groundwater sink).

Analytical modelling of pumping tests conducted at the Kanmantoo site suggests the aquifer behaves in a leaky confined and bounded manner. The pumping test data indicates the presence of a recharge boundary, which may be consistent with groundwater leakage from an overlying aquitard or from the fractured rock matrix. Whatever the source of leakage, it appears that groundwater system response to pumping and old pit development may be consistent with that of a uniform porous media, at the sub-regional scale, even though local-scale response might demonstrate a degree of variability in terms of hydraulic conductivity within the fractured rock aquifer.

Groundwater discharge to the old pit has probably imposed itself on the local groundwater system in a manner consistent with what might be expected from a large diameter well. Despite the heterogeneous nature of the fractured rock aquifer at the local scale (as discussed above), it is reasonable to assume that a cone of depression will have developed around the old pit, the extent of which is related to the bulk hydraulic properties of the aquifer and the gradient established between the mine pond and the water table.



	Job No: 5000	Hillgrove Copper Pty Ltd		Conceptual hydrogeological section	Figure No: 5.20
	File No: 5000_02_F05.20_FT	Kanmantoo Copper Project			

Watercourses within and immediately next to the MLA area are ephemeral, only flowing during and after rainfall events that generate runoff. Typically, when flowing the streams will act as losing streams, i.e., they lose water to soils and rocks that underlie the stream beds, and baseflow (groundwater recharge) is not expected to contribute to sustained stream flow following rainfall runoff events, except in the case where local flow systems occur.

5.9 Flora

5.9.1 Background

The characterisation of the composition, structure and diversity of flora species in the MLA area is based on a vegetation survey undertaken by Ecological Associates Pty Ltd in April 2007 and described in detail in Appendix 5. This assessment builds on previous flora assessments of the area by Ecological Associates (2007), Playfair (2004), Simon and Seagar (2006), Simon (2006) and Ecological Associates (2006) (cited in Appendix 5).

In February 2007, records of flora previously observed in the region surrounding the MLA area were extracted from the Biological Survey of South Australia database maintained by the South Australian Department of Environment and Heritage (SADEH) with records for an area of 6 km radius from the boundary of the MLA area reviewed to assess flora potentially present.

Survey methods for the MLA area were in accordance with the *Guide to a Native Vegetation Survey using the Biological Survey of South Australia* methodology (Heard and Channon, 1997 cited in Appendix 5). During February and March 2007, the MLA area was surveyed by vehicle and on foot. Native vegetation remnants were located and the vegetation communities comprising them were identified and mapped. A list of all plant species was compiled for each vegetation community (except two that comprised a very minor component (1.15% and 0.18%) of the vegetation).

One quadrat (30 by 30 m) within each of the following major vegetation associations was surveyed to prepare detailed quadrat descriptions for (Figure 5.21):

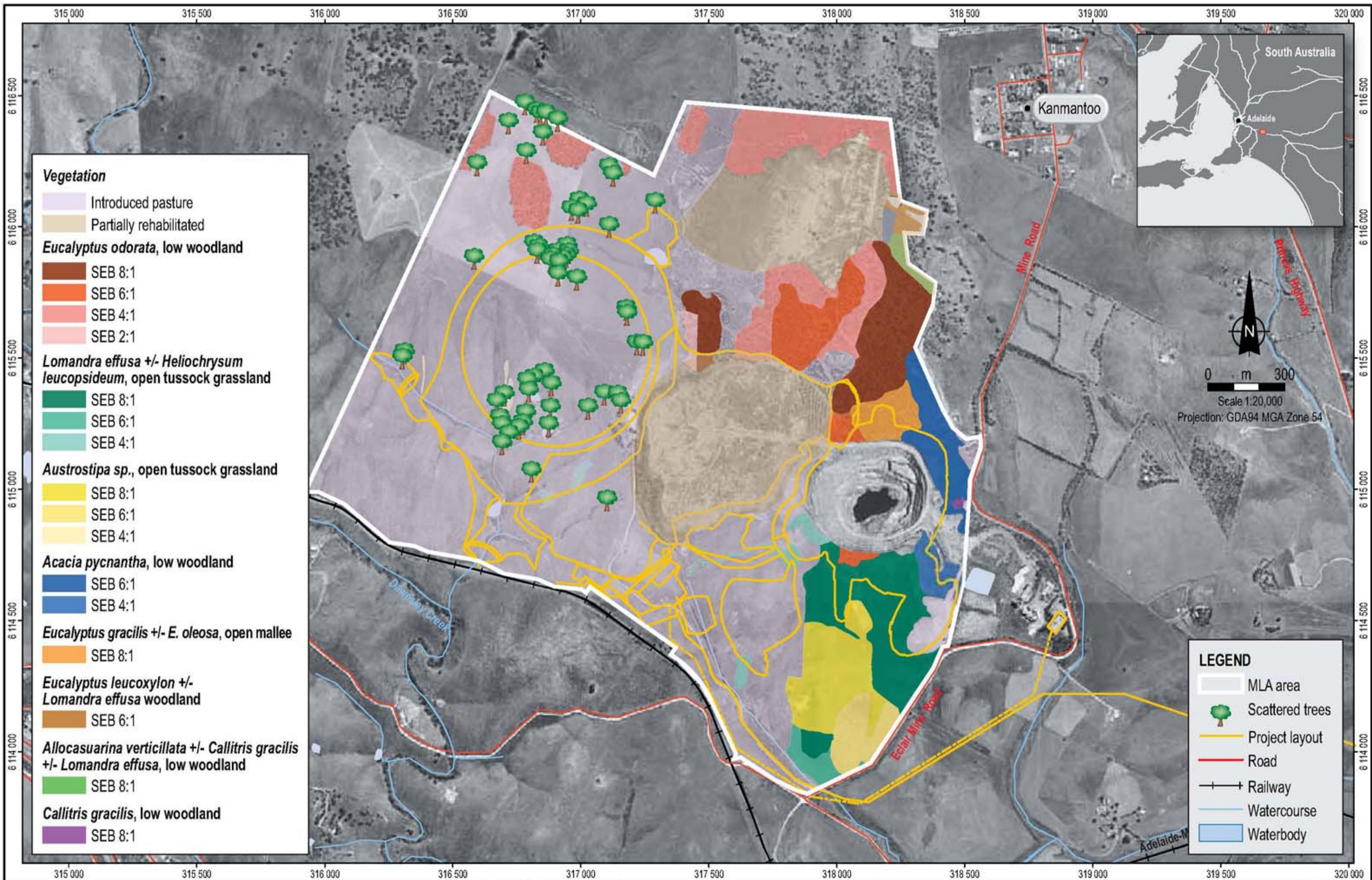
- *Austrostipa* sp. open tussock grassland.
- *Lomandra effusa* ±² *Heliochrysum leucopsideum* open tussock grassland.
- *Eucalyptus odorata* low woodland.
- *Eucalyptus gracilis* ± *Eucalyptus oleosa* open mallee.

Minor vegetation types in the MLA area (e.g., *Callitris gracilis* low woodland and *Acacia pycnantha* low woodland) were surveyed by species inventory only.

Detailed quadrat surveys included assessment of:

- Physical description of the site, i.e., landform and surface lithology.

² Symbol used by SADEH when undertaking vegetation mapping and classification indicating that species may or may not be present together.



Source:
 Place names, roads, drainage and cadastre from DEH, SA (optimum scale 1:50,000)
 Mine Layout from Hillgrove Resources
 Vegetation survey from Ecological Associates

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RESOURCES

Figure No:
5.21

MLA area vegetation

- Degree of disturbance.
- Presence or absence of vertebrates.
- Soil texture.
- Vegetation description, i.e., species, structure, life form, canopy cover and life stage.

Vegetation condition was mapped in accordance with *Guidelines for Native Vegetation Significant Environmental Benefit Under the Native Vegetation Act 1991 and Regulations 2003 for the Mineral and Petroleum Resources Industry* (DWLBC, 2005). These guidelines require that vegetation condition be reported as a significant environmental benefit (SEB) ratio, which is calculated following consideration of measures such as vegetation diversity, structure, presence and abundance of introduced species and impact from grazing. A summary of vegetation condition and its corresponding SEB ratio is provided in Table 5.4.

Table 5.4 SEB vegetation condition ratios

Vegetation Condition	Indicators for Condition	SEB Ratio
Weed-dominated with only scattered areas or patches of native vegetation	Vegetation structure no longer intact (e.g., removal of one or more vegetation strata).	2:1
	Scope for regeneration, but not to a state approaching good condition without intensive management.	
	Dominated by very aggressive weeds.	
	Partial or extensive clearing (greater than 50% of area).	
	Evidence of heavy grazing (tracks, browse lines, species changes, no evidence of solid surface crust).	
Native vegetation with considerable disturbance	Vegetation structure substantially altered (e.g., one or more vegetation strata depleted).	4:1
	Retains basic vegetation structure or the ability to regenerate it.	
	Very obvious signs of long-term or severe disturbance.	
	Weed dominated with some very aggressive weeds.	
	Partial clearing (10 to 50% of area).	
	Evidence of moderate grazing (tracks, browse lines, soil surface crust extensively broken).	
Native vegetation with some disturbance	Vegetation structure altered.	6:1
	Most seed sources available to regenerate original structure.	
	Obvious signs of disturbance.	
	Minor clearing (less than 10 % of area).	
	Considerable weed infestation with some aggressive weeds.	
	Evidence of some grazing (tracks, soil surface crust patchy).	
Native vegetation with little disturbance	Vegetation structure intact (e.g., all structure intact).	8:1
	Disturbance minor, only affecting individual species.	
	Only non-aggressive weeds present.	
	Some litter build-up.	
Intact vegetation	All strata intact and botanical composition close to original.	10:1
	Little or no signs of disturbance.	
	Little or no weed infestation.	
	Soil surface crust intact.	
	Substantial litter cover.	

Source: Table 1 of DWLBC (2005).

Where present, vegetation of conservation significance in the MLA area has been classified as significant at the:

- National level, i.e., listed under the EPBC Act.
- State level, i.e., listed under the NPW Act.
- Regional level, i.e., listed under the Biodiversity Plan for the South Australian Murray-Darling Basin.

Scattered trees were assessed in accordance with *Scattered Tree Habitat Value Ready Reckoner* (Cutten and Hodder 2002 cited in Appendix 5). A photograph of each tree and a record of its location, species, height, trunk diameter at breast height, proportion of canopy die back, canopy diameter, proportion of canopy mistletoe, number of individual mistletoe infections and number of small, medium and large hollows was taken. Suitability of the scattered trees as habitat for threatened fauna was also scored and mapped. The SEB ratio for all scattered trees was calculated using the spreadsheet provided by the Department of Water, Land and Biodiversity Conservation (DWLBC) (Cutten and Hodder, 2002 cited in Appendix 5).

The scattered vegetation along the proposed private access road between the mine site and the Princes Highway was inspected in July 2007. Species lists were prepared and vegetation was classified as native or non-native, with native vegetation further classified according to the dominant species present.

5.9.2 Existing Conditions

Summary

Remnant vegetation comprises around 26% (113 ha) of the 436 ha MLA area. The remaining area comprises approximately 103 ha of land disturbed by previous mining operations (23.5%) and 221 ha of cleared pastures used for high-intensity sheep grazing (50.5%).

The two largest remnant vegetation communities present are *Eucalyptus odorata* low woodland and *Lomandra effusa* ± *Heliochrysum leucopsidium* open tussock grassland, which occupy 54.1 and 23.3 ha respectively. These vegetation communities are of declared conservation significance at the national, state and regional level. Each of these vegetation communities have only recently been listed as nationally significant (i.e., listed under the EPBC Act). The timing of listing was after referral to, and assessment of, the project by the Australian Government Department of Environment and Water Resources. This assessment determined that the project was 'not a controlled action' (see Section 4.2.1).

Six additional vegetation communities are represented across the MLA area. Vegetation condition is of varying quality, having been strongly affected by disturbance due to previous mining and agricultural activity such as grazing and pasture.

No nationally significant species were found during the current survey or have been identified during previous surveys in the MLA area. Four species listed as rare at the regional level were recorded in the current survey. Although few species of conservation significance were recorded in the current survey, an additional two species of

conservation significance at the state level, *Diuris behrii* (Behr’s cowslip orchid) and *Ptilotus erubescens* (hairy-tails), and 19 species of regional significance have been recorded within the area during previous surveys.

Scattered trees are located across the MLA area, with 56 located within the proposed project footprint. All of the 56 scattered trees within the proposed project footprint were assessed and scored one point (the lowest score) for suitability for threatened fauna species and were located a considerable distance from vegetation of high quality.

Vegetation along the proposed private access road is predominantly pasture and introduced species such as sharp-rush (*Juncus acutus*), wild oats (*Avena* sp.) and artichoke thistle (*Cynara cardunculus* ssp. *flavescens*).

A total of 47 introduced species including grasses, herbs, shrubs and woody weeds have been documented for the MLA area during all surveys.

Vegetation Communities

The MLA area occurs within the region covered by the Biodiversity Plan for the South Australian Murray-Darling Basin and within the Eastern Mount Lofty Ranges Regional Ecological Area (REA). The clearance of native vegetation within the REA has been extensive, with only 6% of original vegetation cover remaining (Kahrimanis et al., 2001 cited in Appendix 5).

Eight vegetation communities were identified within the MLA area. These are summarised in Table 5.5 and described in detail below. A complete list of the plant species identified for each community and quadrat survey data is provided in Appendix 5.

Table 5.5 SEB ratio, area, and conservation significance of surveyed vegetation communities in the MLA area

Vegetation Community	SEB Ratio	Area (ha)	Conservation Significance		
			National	State	Regional
<i>Eucalyptus odorata</i> low woodland (54.1 ha)	8:1	14.9	✓	✓	✓
	6:1	9.7			
	4:1	28.5			
	2:1	1.0			
<i>Lomandra effusa</i> ± <i>Heliochrysum leucopsidium</i> open tussock grassland (23.3 ha)	8:1	17.8	✓	✓	✓
	6:1	2.1			
	4:1	3.5			
<i>Austrostipa</i> sp. open tussock grassland (17.0 ha)	8:1	11.6			✓
	6:1	4.7			
	4:1	0.7			
<i>Acacia pycnantha</i> low woodland (11.2 ha)	6:1	7.7			
	4:1	3.5			
<i>Eucalyptus gracilis</i> ± <i>E. oleosa</i> open mallee	8:1	4.0			
<i>Allocasuarina verticillata</i> ± <i>Callitris gracilis</i> ± <i>Lomandra effusa</i> low woodland	6:1	1.8			

Table 5.5 SEB ratio, area, and conservation significance of surveyed vegetation communities in the MLA area (cont'd)

Vegetation Community	SEB Ratio	Area (ha)	Conservation Significance		
			National	State	Regional
<i>Eucalyptus leucoxylon</i> ssp. <i>leucoxylon</i> ± <i>Lomandra effusa</i> open woodland	6:1	1.3			✓
<i>Callitris gracilis</i> low woodland	8:1	0.2			✓
Total area of native vegetation		113	(26% of MLA area)		
Disturbance from previous mining operations		103	(23.5% of MLA area)		
Pasture		221	(50.5% of MLA area)		
Total MLA area		436			

***Eucalyptus odorata* low woodland.** This is the most extensive vegetation community within the MLA area, occupying 54.1 ha. This vegetation community is significant at the national level, listed as a critically endangered ecological community (as peppermint box (*E. odorata*) grassy woodland) under the EPBC Act (DEWR, 2007a), at a state level, listed as Priority 3 for conservation under the NPW Act, and at the regional level, listed as threatened within the South Australian Murray-Darling Basin (Ecological Associates, 2007).

The *E. odorata* woodland within the study area is one of the largest remnants in the eastern slopes of the southern Mount Lofty Ranges. It represents approximately one third of the high quality vegetation of this type and about 10% of the entire occurrence (292.5 ha) in this region.

The best examples of this vegetation onsite occur to the north (12 ha) and northwest (2.8 ha) of the old pit (see Figure 5.21). These areas have all vegetation strata intact, low cover of weeds, evidence of recent regeneration of overstorey trees and some old, hollow-bearing trees. Other examples of this vegetation in the MLA area are of varying quality, and reflect past clearing, weed infestation, exposure to grazing and disturbance from previous mining operations.

***Lomandra effusa* ± *Heliochrysum leucopsideum* open tussock grassland.** This vegetation community occupies 23.3 ha of the MLA area. It is significant at the national level, listed as a critically endangered ecological community (as iron-grass natural temperate grassland) under the EPBC Act (DEWR, 2007a), at the state level, listed as Priority 1 for conservation in South Australia under the NPW Act, and at the regional level, listed as threatened within the South Australia Murray-Darling Basin (Ecological Associates, 2007 as cited in Appendix 5).

The community occurs predominantly to the south of the old pit on the crest and slopes of MacFarlane Hill (16.7 ha). The best examples feature an intact structure of dense *L. effusa* interspersed with native grasses and few weeds. Emergent trees, typically *Allocasuarina verticillata*, are present in some areas.

Although MacFarlane Hill has been grazed by stock, approximately 19.9 ha of this remnant is of high quality and represents a small proportion (approximately 1.5%) of the high quality remnants of the vegetation community in the eastern slopes of the southern Mount Lofty Ranges. The 23.3 ha of this vegetation community in the MLA area

represent about 1.8% of all *L. effusa* tussock grassland (approximately 1,309 ha) in the region.

***Austrostipa* sp. open tussock grassland.** Remnant patches of this vegetation community occupy 17 ha within the MLA area. *Austrostipa* sp. open tussock grassland is significant at the regional level, listed as threatened within the South Australia Murray-Darling Basin.

***Acacia pycnantha* low woodland.** To the immediate east and northeast of the old pit lies 11.2 ha of this vegetation community. Anecdotal reports and the absence of overstorey eucalyptus species suggest that this community has been subject to past disturbance or clearance and has regenerated naturally. To the northeast of the old pit this vegetation community is dominated by an overstorey of low *A. pycnantha*, has an intact understorey dominated by native grasses, particularly *Austrostipa* sp., and low shrubs and has a low cover of weeds. Further to the south, at the base of the eastern side of MacFarlane Hill, the vegetation has been more recently disturbed and partially cleared.

Other Vegetation Communities

Vegetation communities present in the MLA area, but in relatively low abundances, include:

- *E. gracilis* ± *E. oleosa* open mallee.
- *Allocasuarina verticillata* ± *Callitris gracilis* ± *Lomandra effusa* low woodland.
- *E. leucoxydon* ssp. *leucoxydon* ± *Lomandra effusa* open woodland (significant at the regional level, listed as threatened within the South Australia Murray-Darling Basin).
- *Callitris gracilis* low woodland (significant at the regional level, listed as threatened within the South Australia Murray-Darling Basin).

Appendix 5 provides a detailed description of these vegetation communities.

Riparian Vegetation

Riparian vegetation is present along some creek and drainage lines in the MLA area. However, this is highly disturbed, dominated by weeds such as spike-rush (*Juncus acutus*), and comprises less than 10% native species.

Access Road Vegetation

Patches along the proposed route for the road have been revegetated with native species, and small areas of significantly degraded *L. effusa* tussock grassland are present at isolated intervals. However, the majority of vegetation is pasture and introduced species such as sharp-rush (*Juncus acutus*), wild oats (*Avena* sp.) and artichoke thistle (*Cynara cardunculus* ssp. *flavescens*).

Plant Species of Conservation Significance

No plant species of national conservation significance were recorded in the MLA area, and none are considered likely to be present. The highest level of conservation significance for plant species recorded during the survey was regional, although two

species of conservation significance at the state level (i.e., listed under the NPW Act) have been recorded within the MLA area during previous surveys:

- ***Diuris behrii* (Behr's cowslip orchid)**. Listed as vulnerable. The known locations of *Diuris behrii* were recorded by Ecological Associates (2006 cited in Appendix 5) and by the Kanmantoo–Callington Landcare Group (KCLG) in their significant vegetation study during 2006. Some of the known *Diuris behrii* sites fall within the proposed project footprint.
- ***Ptilotus erubescens* (hairy-tails)**. Listed as rare. The single location was obtained from the Biological Survey of South Australia database. An additional 53 records are also listed at the same location, indicating that the BDBSA record location may represent an amalgamation of records for a wider area lowering the spatial confidence of the BDBSA for this species.

Nineteen species of regional significance, including four species listed as rare in the Murray botanical region, have been previously recorded in the MLA area (Table 5.6).

Table 5.6 Surveyed species of regional conservation significance in the Murray botanical region

Species	Common Name	Regional Conservation Significance
<i>E. leucoxylon ssp. leucoxylon</i>	South Australian blue gum	Rare*
<i>Elymus scaber var. scaber</i>	Native wheat-grass	Rare
<i>Aristida contorta</i>	Curly wire-grass	Rare
<i>Aristida behriana</i>	Brush wire-grass	Rare

* Rare: having a low overall frequency, confined to a restricted range or scattered sparsely over a wider area.

The shrub *Acacia iteaphylla*, listed under the NPW Act as rare in South Australia, was also recorded within the MLA area. However, this species was growing outside of its natural range and can be considered introduced. The species is commonly planted for revegetation projects.

A complete list of plant species, both native and introduced, recorded for the MLA area by this and previous surveys is provided in Appendix 5.

Vegetation Communities of Conservation Significance

As described above, five threatened communities occur within the MLA area:

- *Eucalyptus odorata* low woodland.
- *Lomandra effusa* ± *Heliochrysum leucopsideum* open tussock grassland.
- *Austrostipa* sp. open tussock grassland.
- *Eucalyptus leucoxylon ssp. leucoxylon* ± *Lomandra effusa* open woodland.
- *Callitris gracilis* low woodland.

Scattered Trees

Of the 56 scattered trees present within the proposed project footprint, with the exception of one *Allocasuarina verticillata* species, all are *Eucalyptus odorata*. Twenty-four trees had hollows; however, all scattered trees scored one point (the lowest score) for suitability for habitat for threatened fauna species and are located a considerable

distance from vegetation of high quality. Data for all 56 scattered trees assessed is provided in Appendix 5.

Introduced Species

Twenty four introduced plant species were recorded in the MLA area, approximately half the total number of introduced species (47) documented for the MLA area by all known surveys. Introduced plant species include:

- **Grasses.** Wild oats (*Avena barbata*) is the most abundant grass species and is very common throughout the agricultural regions of South Australia. Within the MLA area, it was most abundant in the *Austrostipa* sp. open tussock grassland and *Lomandra effusa* ± *Heliochrysum leucopsidium* open tussock grassland.
- **Herbs.** Herb species include bridal creeper (*Asparagus asparagoides*), South African weed orchid (*Disa bracteata*), artichoke thistle (*Cynara cardunculus* ssp. *flavescens*) and small amounts of Salvation Jane (*Echium plantagineum*).
- **Shrubs.** Shrub species include red-head cotton-bush (*Asclepias curassavica*), Flinders Ranges wattle (*Acacia iteaphylla*), western coastal wattle (*Acacia cyclops*) and Boneseed (*Chrysanthemoides monilifera* ssp. *monilifera*).
- **Woody weeds.** Woody weeds recorded within the MLA area include olive (*Olea europaea* ssp. *europaea*), Aleppo pine (*Pinus halepensis*) and African boxthorn (*Lycium ferocissimum*).

5.10 Fauna

5.10.1 Background

The characterisation of fauna species and habitat types in the MLA area is based on baseline fauna surveys undertaken by Ecological Associates Pty Ltd in February 2007 and described in detail in Appendix 6. This assessment builds on previous desktop fauna assessments of the area in 2006 (PB, 2006b). Records of fauna previously observed in the region were extracted from the Biological Survey of South Australia database in February 2007, with records for an area of 6-km radius from the boundary of the MLA area reviewed to assess the fauna likely to be present.

The fauna survey followed standard South Australia Department for Environment and Heritage biological survey methods (National Parks and Wildlife South Australia, 2000 cited in Appendix 6) and was carried out under:

- The Wildlife Ethics Committee Approval of a Project Involving Animals – Application Number 7/2007.
- Permit to Undertake Scientific Research – Permit Number W25407 1.
- Licence to Use Animals for Teaching, Research or Experimental Purposes – Licence Number 202.

Survey sites were established in the three major distinct habitat types identified in the MLA area (*Eucalyptus odorata* low woodland, *Lomandra effusa* open tussock grassland and *Austrostipa* sp. open tussock grassland). Fauna present across the general

landscape was also assessed. The survey involved trapping, bird searches, active searches for vertebrate fauna in litter, debris, hollows and bark, spotlighting and bat recordings. A summary of the fauna survey methods and survey effort at each site is given in Table 5.7.

Table 5.7 Fauna survey method and effort at each site

Type of Survey	Survey Method	Survey Effort
Mammal and reptile	Pitfall trap line	Six pitfalls 10 m apart for 4 days Fifteen traps 10 m apart for 4 days. Two traps for 4 days.
	Elliot trap line	
	Sherman cage trap	
Mammal (bat)	Anabat ¹	Two detectors and 2 recorders for 4 nights.
Additional mammal (including bird) and reptile search	Physical search for vertebrate fauna in litter, debris, hollows and bark.	Two persons for 3 days. Two hours per day for 3 days.
	Visual observation during roaming survey.	
	Visual observation during spotlighting.	Two persons for 2.5 hours for 1 night.

¹ Anabat surveying allows for the identification of species of bat based on their echolocation signal.

5.10.2 Existing Conditions

Summary

Baseline fauna surveys of the MLA area found 32 bird, 9 reptile and 15 mammal (11 native and four introduced) species. The overall diversity of fauna is low in comparison to records of fauna previously observed in the region, with abundances of fauna also low in comparison to abundances observed during surveys in similar areas. The low diversity and abundances are likely to partly reflect the low rainfall experienced in the region in the 12 months prior to the survey and the timing of the survey. A fauna survey conducted in late winter or spring following suitable rainfall would be likely to report additional species.

A variety of remnant native vegetation communities of varying quality and significance are found across the eastern half of the site (see Figure 5.21 and Section 5.9.2). The greatest diversity and abundance of fauna was found in the *E. odorata* woodland in the north of the MLA area, with this vegetation providing relatively complex habitat components such as hollows, understorey vegetation, logs and deep debris. Species diversity and abundances were lower in the *L. effusa* tussock grassland in the south of the MLA area. However, this habitat type supports specialist grassland species that are unlikely to be found in other vegetation types in the MLA area.

Three major fauna habitats have been identified (Appendix 6):

- *Eucalyptus odorata* woodland (Plate 5.11).
- *Lomandra effusa* grassland (Plate 5.12).
- *Austrostipa* spp. grassland (Plate 5.13).

Detailed descriptions of the structure and composition of these habitats is provided in Section 5.9.2.

No threatened fauna species of national conservation significance (i.e., listed under the EPBC Act) were present, or considered likely to be present, within the MLA area.



Plate 5.11
Fauna survey trap line in *Eucalyptus odorata*
woodland habitat



Plate 5.12
Fauna survey site in *Lomandra effusa*
grassland habitat



Plate 5.13
Fauna survey trap line in *Austrostipa*
grassland habitat

One species listed as migratory under the EPBC Act, the rainbow bee-eater (*Merops ornatus*), is present within the MLA area.

It is considered unlikely that any other EPBC Act-listed species are present in the MLA area (PB, 2006b).

Additional species of state conservation significance (i.e., listed as vulnerable, endangered or rare under the South Australian NPW Act) that are present, or potentially present, within the MLA area are the diamond firetail (*Stagonopleura guttata*), listed as vulnerable, and the peregrine falcon (*Falco peregrinus*), listed as rare. The brushtail possum (*Trichosurus vulpecula*) has been nominated for listing under the NPW Act and was also recorded in the MLA area.

Birds

A total of 32 bird species were recorded within the MLA area during the field surveys. Of the known locally abundant species (as listed in the Biological Survey of South Australia database, cited in Appendix 6), about 45% were recorded during the survey, with predominantly insectivorous and nectivorous species appearing to be under-represented due to their nomadic nature during late summer and autumn (Paton et al., 2004, cited in Appendix 6). The lack of wetland species recorded in the MLA area is likely to be due to the poor water quality (i.e., low pH) and lack of mudflats and aquatic plants in the waterbodies associated with previous mining activities (PB, 2006b). Dry swamps and ephemeral creeks in the area may provide suitable habitat for water birds during winter and spring during times of higher rainfall, and South Australian DEH database records indicate that 13 species of water birds have been recorded in the region.

The nearest Ramsar-listed wetland is The Coorong, and Lakes Alexandrina and Albert Wetland, located approximately 40 km south of the MLA area (see Figure 2.3). This wetland site covers about 1,405 km² and consists of an open beach, together with the mouth of the River Murray and associated lakes and estuaries, and provides habitat for a large number of migratory wetland bird species listed under the EPBC Act. The Bremer River, located approximately 3 km east of the proposed MLA area, flows south through Callington, Hartley and Langhorne Creek, eventually discharging into Lake Alexandrina. Migratory species that may be present in this wetland and protected under the EPBC Act include:

- Latham's snipe, Japanese snipe (*Gallinago hardwickii*).
- Painted snipe (*Rostratula benghalensis*).
- White egret (*Ardea alba*).
- Cattle egret (*Ardea ibis*).
- White-bellied sea-eagle (*Haliaeetus leucogaster*).

It is considered highly unlikely that the MLA area provides suitable habitat for these species (PB, 2006b).

The highest diversity of bird species (69%) was recorded in the *E. odorata* woodland, with this most likely being due to the relatively large area of the woodland in comparison to the other habitat types surveyed and the relatively high diversity of habitat niches within this woodland.

Common bird species in the MLA area include the Australian magpie (*Gymnorhina tibicen*), little raven (*Corvus mellori*), singing honeyeater (*Lichenostomus virescens*) and the Adelaide rosella (*Platycercus elegans* Race *Adelaide*). One species of bird, the Australian owl-nightjar (*Aegotheles cristatus*), was a new record for the area. Only two introduced bird species were observed: the common starling (*Sturnus vulgaris*) and European goldfinch (*Carduelis carduelis*).

Reptiles and Amphibians

Of the nine species of reptiles recorded during the survey, only two had been previously recorded in the area, the eastern striped skink (*Ctenotus robustus*) and the Southern rock dtella (*Gehyra* sp. '2n=44'³). For a habitat fragment of this size in the southern Mount Lofty Ranges, the species count of reptiles in this survey was moderate (Sacchi, 2003, cited in Appendix 6). The most common reptile species were the tawny dragon (*Ctenophorus decessii*), which was associated with rocks, rock falls and rock faces throughout the MLA area, and the sleepy lizard (*Tiliqua rugosa*), which was recorded in relatively high densities in the grassland habitats. Both the thick-tailed gecko (*Nephrurus mii*) and the southern rock dtella (*Gehyra* sp. '2n=44') were widespread.

Five species previously recorded and common to the area were not found: the marbled gecko (*Christinus marmoratus*), three-toed skink (*Hemiergis decresiensis*), eastern bearded dragon (*Pogona barbata*), eastern brown snake (*Pseudonaja textilis*), Boulenger's skink (*Morethia boulengeri*). The carpet python (*Morelia spilota*), listed as rare under the NPW Act, was not found and is probably locally extinct. A number of regionally common skinks (e.g., garden skink (*Lampropholis guichenoti*) and Bougainville's skink (*Lerista bougainvillii*)) were not recorded.

No reptiles of listed conservation significance were found during the survey.

No amphibian species were detected during the survey. Given the relatively warm and dry conditions, this is not unexpected.

Mammals

Eleven native mammal species including bats, rodents and macropods have been identified in the MLA area, with bat species the most diverse mammalian fauna recorded. Two species of kangaroo were observed; the western grey kangaroo (*Macropus fuliginosus*) was common while the euro (*Macropus robustus*) was only observed in small numbers. The presence of the brushtail possum (*Trichosurus vulpecula*) in the MLA area is discussed in detail later in this section.

No threatened mammal species of conservation significance were recorded during the surveys. All 11 native mammal species recorded in the MLA area are new records for the region, with this suggesting that the South Australian DEH database records cannot be considered a complete and representative list.

³ This is a new species based on analysis of chromosome number and is morphologically very similar to another species. 2n=44 refers to the number of chromosomes of this species and provides for identification as the species is yet to be formally named.

Anabat detectors recorded seven bat species over the four nights surveyed. It is possible that another species, the little forest bat (*Vespadelus vulturnus*), was recorded; however, the analysis was not definitive. All species observed are common and widespread in the region and roost in tree hollows or under bark (Reardon and Bourne, 2006, cited in Appendix 6). Species composition in the area was typical for the Mount Lofty Ranges, but overall the number of calls recorded per night was low for the region (Reardon pers. comm., 2007, cited in Appendix 6). The highest diversity of bat species, and largest number of each species recorded, were associated with the *E. odorata* woodland. Species known to forage above tree canopies or in the open (*Tadarida australis*, *Chalinolobus gouldii*, and *Nyctophilus geoffroyi*) were recorded above the *L. effusa* and *Austrostipa* grasslands. Three species that forage in, around, or on tree foliage, or above the shrub layer (*Chalinolobus morio*, *Vespadelus darlingtoni* and *V. regulus*) were only associated with the *E. odorata* woodlands.

The distribution and abundance of introduced mammal species in the MLA area is discussed later in this section.

Aquatic fauna

All streams within the MLA area are ephemeral and flow intermittently (see Section 5.4). As such, they do not support permanent populations of aquatic fauna. These ephemeral streams do, however, report to the Bremer River via Dawesley and Mount Barker creeks (see Section 5.7.1).

The ecological health of the Bremer River at Hartley (downstream of the junctions of the Dawesley and Mount Barker Creeks and Bremer River) has been categorised as moderate, based on the number and diversity of macroinvertebrate species present in various habitat types in the river using the Australian River Assessment System (AUSRIVAS) (EPA, 2006a). Over 120 aquatic invertebrates have been recorded at this location between 1994 and 2004, including species of insects, crustaceans, snails, worms and mites. Most species are commonly found in South Australian inland waters (EPA, 2006a).

The Mount Lofty Ranges is known to support at least 25 native freshwater fish species, including species of galaxids, lampreys and gudgeon (SANFA, 2007). Introduced fish such as trout and carp are also present.

Fauna Species of Conservation Significance

Fauna species of national (EPBC Act) or state (NPW Act) listed conservation significance present in the MLA area are discussed below. Further detail regarding these species is provided in Appendix 6.

Birds. The **rainbow bee-eater** (*Merops ornatus*), a marine-listed species under the EPBC Act, was recorded across the MLA area. Rainbow bee-eaters may be significant at the local level as they are likely to breed in sandy banks and use woodland habitat within the MLA area. However, the presence of this species is unlikely to be significant at the regional, state or national level due to its wide distribution and transient nature.

The **diamond firetail** (*Stagonopleura guttata*), listed as vulnerable under the NPW Act, has declined over most of its historical range across southeastern and eastern Australia

in both extent and density (Garnett and Crawley, 2000, cited in Appendix 6). The *E. odorata* woodland in the MLA area is likely to provide significant habitat for this species and the population in the MLA area is likely to be significant at the local and regional level.

The **peregrine falcon** (*Falco peregrinus*) is listed as rare under the NPW Act. The species has a worldwide distribution, although it has declined significantly in most countries other than Australia where the population is substantial, widespread and viable (Olsen and Olsen, 1988, cited in Appendix 6). In South Australia, the resident population is small, with the total population estimated at less than 3000 mature individuals (NPW Council and SA DEH, 2003, cited in Appendix 6). A study in Victoria (Emison et al., 1997, cited in Appendix 6) suggests that nesting pairs of this species are tolerant to disturbance associated with mines and quarries. As such, the pair of peregrine falcons recorded nesting on the face of the old pit in the MLA area are expected to relocate their nest site within the pit or to a new locality.

Reptiles and amphibians. No reptile or amphibian species listed under the EPBC Act or the NPW Act were recorded, or are considered likely to be present, within the MLA area.

Mammals. No mammal species of listed conservation significance under either the EPBC Act or NPW Act were recorded, or are considered likely to be present, within the MLA area. However, the **brushtail possum** (*Trichosurus vulpecula*), which has been nominated for listing as rare under the NPW Act, was present. This species has the widest distribution of any Australian mammal, being found across southern, eastern, and northern Australia. In the Murray-Darling Basin, the loss of food trees, hollow trees and hollow branches is reducing the area of habitat available to this species and concomitantly increasing the competition between species that require similar habitat resources (Kahrmanis et al., 2001, cited in Appendix 6). This loss of habitat, in combination with high predation pressures, may be underlying the continuing decline of this species in South Australia. The relatively large and floristically diverse *E. odorata* woodland habitat in the MLA area is considered important to this species at the local and regional level.

Aquatic fauna. Two species of native fish listed under the EPBC Act, the Murray hardyhead (*Craterocephalus fluviatilis*) and the Murray cod (*Maccullochella peelii peelii*), have historically been recorded in the Bremer River. Other species present may be of conservation significance at the regional and state level, although there is no formal document that addresses the conservation status of native fish at this level (Turner, 2001).

Introduced Species

Four introduced vertebrate species (other than sheep and cattle) have been identified in the MLA area and surrounding region: the European rabbit (*Oryctolagus cuniculus*), European (brown) hare (*Lepus capensis*), house mouse (*Mus domesticus*) and red fox (*Vulpes vulpes*). The house mouse was recorded throughout the MLA area and is particularly associated with the *L. effusa* grassland.

Observations suggest foxes are relatively common, while European hares appear to be present in low numbers. A number of apparently active, large rabbit warrens were found in the *Austrostipa* grassland; however, no rabbits were observed.

5.11 Socio-economic

This section summarises a socio-economic assessment report that has been prepared by Enesar Consulting Pty Ltd (Appendix 7). The existing socio-economic environment has been based on an analysis of statistical data, literature sources and interviews with stakeholders (including local government, social service providers and members of the community).

Demographic indicators for local towns are based on Australian Bureau of Statistics (ABS) 2001 Census data (ABS, 2006).

5.11.1 Study Area

For the purposes of the socio-economic assessment, the study area is defined as the area within approximately 20 km (or 15 minute drive) from the centre of the MLA area. Although numerous towns are located within this area, the following 16 towns were visited (see Figure 5.9):

- Callington.
- Kanmantoo.
- Hahndorf.
- Woodside.
- Nairne.
- Mount Barker.
- Murray Bridge⁴.
- Strathalbyn.
- Dawesley.
- Monarto.
- Monarto South.
- Harrogate.
- Brukunga.
- Rockleigh.
- Pallamanna.
- Tepko.

The study area is divided into two categories:

- The local area: towns (Callington and Kanmantoo) and individual residences located within 5 km of the MLA area.
- The peripheral area: all other towns and individual residences contained within the study area, as well as Adelaide.

The study area takes into consideration distances people are prepared to travel for goods and services and is designed to include all communities with potential to be directly impacted by the project. Areas located along the main transport route (from where vehicles enter the South Eastern Freeway to Port Adelaide) were not considered part of the study area as this is an existing major traffic route. The study area is located

⁴ Although Murray Bridge is located just outside the defined study area (approximately 5 km), it is likely to be impacted to some extent by the project and was therefore included in the socio-economic assessment.

within the Mount Barker District Council and the Murray Bridge Rural City Council local government areas (LGAs) as defined by the ABS.

Towns and individual residences excluded from the study area were those:

- Located outside the 20-km radius.
- Serviced by a different service centre.
- Located closer to Adelaide (and therefore the effects are absorbed by the close proximity of the town to the capital city).
- From which residents of the town were unlikely to travel to the MLA area.

5.11.2 Population

Between 2000 and 2004, the population of the study area increased by 6.0% (from 55,453 to 58,796). Over the same period, population growth rates in South Australia and Australia were lower at 1.8% and 4.6%, respectively. This growth rate of the study area is mainly due to the rapid population increase in the town of Mount Barker, which rose by approximately 12% between 2000 and 2004 (Figure 5.22).

In 2001, the population of Callington and Kanmantoo (the local area) was 337 and less than 200, respectively. Although 2006 census data is currently unavailable, populations in these towns are believed to have risen considerably in the last 3 years and is now believed to be 500 and 400 people, respectively. This represents a 50% and 100% increase in 5 years.

The population of the towns of Mount Barker and Murray Bridge in 2005 was 26,186 and 18,000 respectively. Based on new land release and recently approved rezoning, the District Council of Mount Barker estimates a population increase in the town of Mount Barker of 7,314 by 2013. The Rural City of Murray Bridge Council predicts an increase in the town of Murray Bridge of 12,000 by 2030. This represents a 3.7% and 2.6% annual growth rate in the towns of Mount Barker and Murray Bridge respectively.

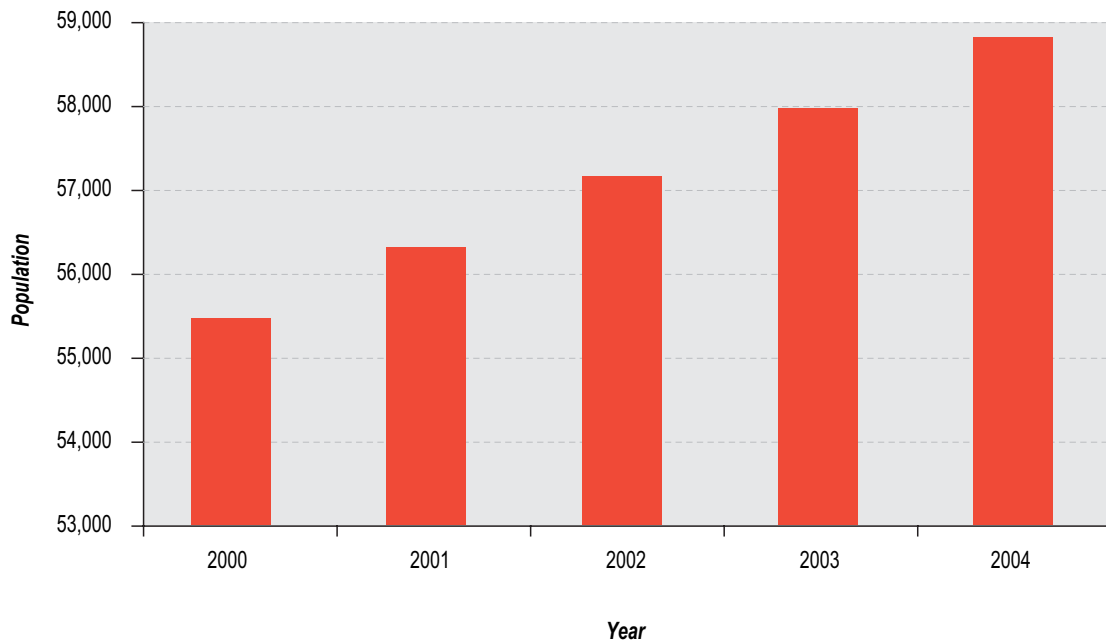
Growth rates in Mount Barker are higher than the average national growth rate of 3.5%. This is likely to be the result of the availability of cheaper housing compared to Adelaide (see Section 5.11.7).

The median age of the Mount Barker and Murray Bridge LGAs populations is 34 and 36 years, respectively. This is similar to the rest of the state (37 years) and Australia (35 years). Median age shows greater variability through the local townships, with Callington having the youngest population (30 years), and Hahndorf the oldest (43 years) (Table 5.8).

5.11.3 Ethnicity and Religion

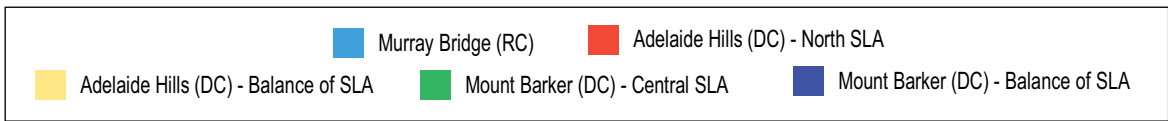
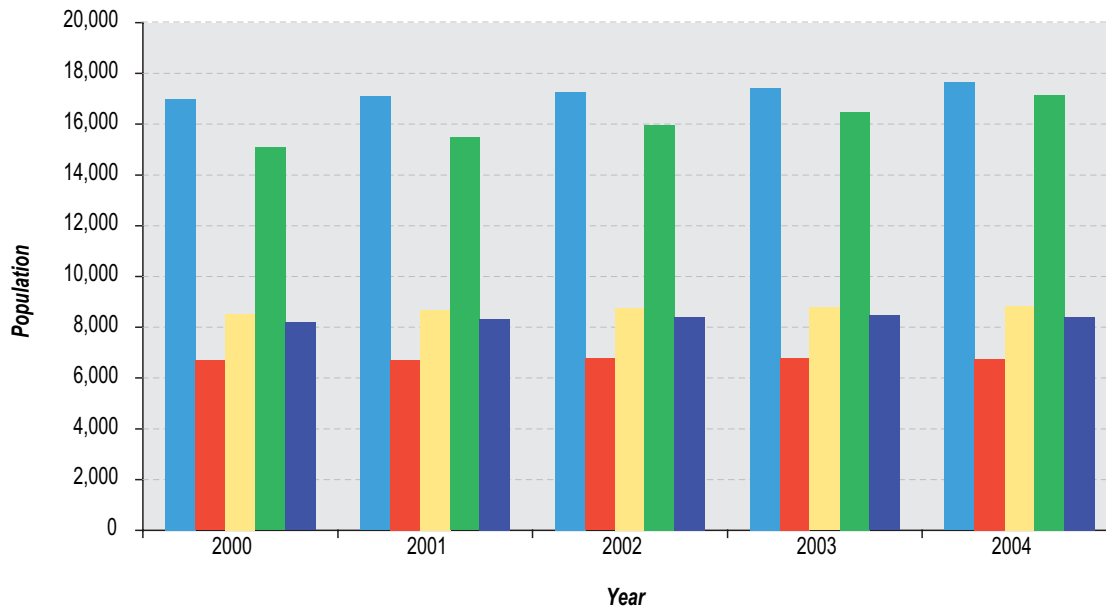
The residents of the study area are predominantly Australian born, ranging from 78% in Brukunga to 88% in Callington. Similarly, most speak English, ranging from 88% in Callington to 97% in Oakbank (see Table 5.8). Immigrants are most commonly from the United Kingdom.

Population change (total study area)



Note:
For the purposes of the socio-economic assessment, the study area is defined as the area within approximately 20 km (or 15 mins drive) from the centre of the project area. Although Murray Bridge is located just outside the defined study area it is likely to be impacted to some extent by the project and is still considered part of the study area.

Population change (defined statistical areas within the study area)



Note:
Between censuses, the smallest spatial unit is the SLA. There are 128 SLAs in South Australia.
Source: Appendix 7

RC = Regional Council DC = District Council SLA = Statistical Local Area

Table 5.8 Key demographic indicators for local towns (2001 census)*

Indicator	Balhanna	Brukungu	Callington	Hahndorf	Macclesfield	Mount Barker	Murray Bridge	Nairne	Oakbank	Strathalbyn	Woodside	Murray Bridge LGA	Mount Barker LGA
Population	1,045	245	337	1,835	773	9,153	13,016	2,782	433	3,218	1,569	16,532	22,863
Indigenous origin	23 (2.2%)	3 (1.2%)	6 (1.8%)	46 (2.5%)	19 (2.5%)	207 (2.3%)	211 (1.6%)	71 (2.6%)	7 (1.6%)	51 (1.6%)	39 (2.5%)	695 (4.2%)	143 (0.6%)
Median age	36	32	30	43	36	32	37	32	36	39	33	36	34
Born in Australia	863 (82.6%)	192 (78.4%)	295 (87.5%)	1,444 (78.7%)	618 (79.9%)	7,629 (83.3%)	11,233 (86.3%)	2,265 (81.4%)	373 (83.1%)	2,767 (86.0%)	1,337 (85.2%)	14,276 (86.4%)	18,661 (81.6%)
Speaks English only	973 (93.1%)	217(88.6%)	321 (95.3%)	1,683 (91.7%)	737 (95.3%)	8,587 (93.8%)	11,864 (91.1%)	2,628 (94.5%)	436 (97.1%)	3,067 (95.3%)	1,513 (96.4%)	7,444 (45.0%)	21,293 (93.1%)
Fully owned private dwelling	169 (16.2%)	6 (2.4%)	30 (8.9%)	319 (17.4%)	101 (13.1%)	977 (10.7%)	1,952 (15.0%)	289 (10.4%)	72 (16.0%)	570 (17.7%)	194 (12.4%)	2,495 (15.1%)	2,883 (12.6%)
Median weekly individual income (gross)	\$400-\$499	\$300-\$399	\$200-\$299	\$300-\$399	\$300-\$399	\$300-\$399	\$200-\$299	\$300-\$399	\$400-\$499	\$300-\$399	\$300-\$399	\$200-\$299	\$300-\$399
Unemployment rate (%)	3.8	13.0	13.8	6.1	5.0	6.0	10.6	6.1	4.8	3.9	4.7	9.8	5.5
Major employment industries (population aged 15 years and over)	Retail trade (90) (11.3%)	Personal and other services (27) (16.6%)	Property and business services (18) (7.8%)	Retail trade (144) (9.5%)	Manufacturing (59) (10.1%)	Retail trade (658) (9.6%)	Retail trade (888) (83.4%)	Retail trade (203) (10.0%)	Property and business services (38) (11.1%)	Manufacturing (215) (8.5%)	Retail trade (143) (13.0%)	Retail trade (1,050) (12.1%)	Retail trade (1,548) (11.8%)
	Health and community services (50) (6.3%)	Construction (8) (4.9%)	Retail trade (17) (7.3%)	Property and business services (84) (5.5%)	Construction (47) (8.0%)	Manufacturing (556) (8.1%)	Manufacturing (797) (74.8%)	Manufacturing (194) (9.5%)	Wholesale trade (27) (7.9%)	Retail trade (200) (7.9%)	Health and community services (81) (7.4%)	Agriculture, forestry and fishing (1,017) (11.7%)	Manufacturing (1,370) (10.5%)
	Manufacturing (49) (6.1%)	Wholesale Trade (6) (3.7%) and Retail Trade (6) (3.7%)	Health and Community Services (12) (5.2%)	Health and Community Services (79) (5.2%)	Retail Trade (38) (6.5%)	Health and Community Services (436) (6.3%)	Agriculture, Forestry and Fishing (473) (44.4)	Property and Business Services (137) (6.7%)	Retail Trade (24) (7.0%)	Health and Community Services (160) (6.3%)	Manufacturing (76) (6.9%)	Manufacturing (956) (11.0%)	Health and Community Services (1,103) (8.4%)

* Census information is not collated for towns with a population of less than 200 people (including Kanmantoo).

The Indigenous population in local towns ranges from 1.2 to 2.5% (see Table 5.8), which is comparable to Australia and the rest of the state (2.4 and 1.7% respectively). Indigenous residents in Mount Barker and Murray Bridge LGAs contribute between 0.6 and 4.2% of the total population, respectively.

5.11.4 Education

The highest level of education achieved in local towns is typically lower than Australia and the rest of the state. A minimum Year 12 education was achieved by between 18.0 and 31.6% of residents in local towns, compared to 27.0 and 37.7% in South Australia and Australia respectively. In 2001, no residents in Callington held a bachelor degree, and other towns and regional centres recorded between 2 and 7% compared with 9.7 and 6.5% in Australia and the rest of the state respectively. The number of people in local and peripheral communities with trade certificates is comparable to South Australia and the rest of Australia, with the exception of Murray Bridge.

5.11.5 Employment

Unemployment

Unemployment levels within the study area in 2001 were frequently lower than the South Australian average of 7%. These unemployment levels varied from 3.8% in Balhanna to 13.8% in Callington. The Mount Barker and Murray Bridge LGAs experienced unemployment levels between 6.0% and 10.6% respectively (see Table 5.8).

Existing Employment

In 2001, the predominant industries of employment within the Murray Bridge LGA were retail trade (12.1%), agriculture, forestry and fishing (11.7%) and manufacturing (11.0%). In Mount Barker LGA the predominant industries of employment were retail trade (11.8%), manufacturing (10.5%) and health and community services (8.4%).

People living within the study area commonly commute to Adelaide for work. The District Council of Mount Barker suggests that 65% of Mount Barker township residents commute to Adelaide daily.

Employment Vacancies

At the time of this study (mid March 2007), the Australian Job Search website had 487 job listings (covering a range of occupations) for the South Adelaide Hills and Murraylands sub-region. Of the 487 jobs, 261 were full-time, 11 were part-time and 215 were casual.

5.11.6 Income

In 2001, the median weekly gross individual income for the local towns was between \$300 and \$399 (Brokunga, Hahndorf, Macclesfield, Mount Barker, Nairne, Strathalbyn and Woodside). Callington and Murray Bridge had the lowest median individual incomes of \$200 to \$299. Oakbank and Balhanna recorded the highest income levels of \$400 to \$499 (see Table 5.8). These incomes are comparable to South Australia and Australia, which both have a median weekly individual income of \$300 to \$399.

5.11.7 Accommodation

Of the occupied dwellings, between 2.4% (Brukunga) and 17.7% (Strathalbyn) are fully owned, between 24% (Murray Bridge) and 55% (Callington) are being purchased and between 11% (Callington) and 36% (Brukunga) are being rented.

Availability

In March 2007, over 600 properties were for sale in the study area, with property prices ranging from \$100,000 to \$1,000,000 (Table 5.9). The greatest number of houses was available in the town of Murray Bridge (200 plus), with 18 being available in the local area (comprising Callington and Kanmantoo). The most affordable housing (between \$100,000 and \$289,000) was available in Callington and Kanmantoo. At the same time, 69 properties were for rent in eight towns within the study area.

Table 5.9 Properties for sale within the study area

Town	Houses for Sale	Price Range
Flaxley	1	\$850,000
Langhorne Creek	1	\$320,000
Rockleigh	1	\$332,000
Woodchester	1	\$243,000
Harrogate	2	High \$200,00 to \$239,500
Monarto	2	\$299,000 to \$315,000
Wistow	5	\$310,00 to \$775,000
Oakbank	6	\$289,000 to \$1,100,000 plus
Callington	9	High \$100,000 to \$289,000
Kanmantoo	9	\$191,000 to \$445,000
Echunga	12	\$220,000 to high \$800,000
Ballhannah	12	High \$200,000 to \$1,000,000 plus
Macclesfield	15	\$200,00 to \$1,400,000
Littlehampton	23	\$220,00 to mid \$660,000
Hahndorf	24	\$30,000 to \$1,000,000
Woodside	24	\$200,000 to high \$700,000
Nairne	54	\$189,000 to early \$400,000
Strathalbyn	100	\$162,500 to \$579,000
Mount Barker	107	\$150,000 to \$1,100,000 plus
Murray Bridge	200 plus	\$119,500 to \$338,000
Total	600 plus	

The perception of community members and real estate agents interviewed is that there is low housing availability within the study area. Over 500 properties are for sale in Adelaide. The median house price in Adelaide in May 2007 was \$300,000.

Temporary accommodation within the MLA area consists of hotels, motels and caravan parks. Temporary accommodation and availability increases with population size, with the town of Murray Bridge having the largest availability.

Property Value

Property values in the towns of Murray Bridge and Mount Barker increased between December 2005 and 2006. Despite this, residential properties in the study area are perceived as affordable compared to Adelaide.

Table 5.10 shows the average number of sales and overall growth rate in the average sales price for properties within the study area. Property prices in Callington rose by 206% between 1993 and 2006, while annual growth rates in Kanmantoo were significantly lower (7.6%) compared to other towns.

Table 5.10 Sales and overall growth rate (1993 to 2006)*

Town	Overall Growth Rate (median sale price)	Overall Growth Rate (average sale price)	Average Number of Sales (per annum)
Callington	206.39%	214.54%	9
Kanmantoo	100.00%	37.82%	10
Nairne	171.23%	141.97%	92
Mount Barker	166.03%	163.52%	218
Strathalbyn	184.21%	135.46%	108
Murray Bridge	173.57%	151.02%	241

Source: Real Estate Institute of South Australia *Only towns with comparable data are included in this table.

Rural property prices have also increased in recent years from approximately \$1,500/acre to \$2,000/acre.

5.11.8 Community Services and Facilities

The towns of Murray Bridge and Mount Barker are the main service centres for the study area and provide a range of general and community services and facilities including:

- Hospitals.
- Education facilities.
- Nursing homes.
- Shopping centres.
- Sporting facilities.
- Entertainment centres.
- Community centres.

Health Care Providers

Towns within the study area are serviced by one private and four public hospitals. The public hospitals provide 219 beds, of which 98 are designated for aged care and other services (including 24 hour accident and emergency, and a range of clinical and surgical services).

Educational Facilities

A number of educational facilities ranging from primary to secondary level are located within the study area, including nine private and two catholic schools. Tertiary education is provided to TAFE level at more than 10 locations within a one-hour drive of the area. Flinders University of South Australia has the closest university campus to the study area and is located approximately 19 km southwest of Adelaide (one hour's drive from

the centre of the study area). The Flinders University Rural Clinical School, located in Goolwa, is approximately 25 km south of the area.

School Buses

Numerous bus routes occur within the study area. Two companies operate school bus services along routes to be used by Hillgrove during construction and operation of the mine.

Police and Emergency Services

Local and peripheral towns are serviced by police, air and road ambulance, fire brigade and state emergency service (SES).

5.12 Indigenous Cultural Heritage

This section describes the existing Indigenous cultural heritage values associated with the MLA area. The information presented is based on an Indigenous archaeology and cultural heritage assessment report undertaken by P. Fitzpatrick (Appendix 8), a site access road inspection undertaken by P. Fitzpatrick (included in Appendix 8) and a previous Indigenous and Non-Indigenous cultural heritage desktop assessment undertaken by Wood (2006).

The survey was based on the recommendations of Wood and included representation from the Peramangk and Mannum Aboriginal Association Incorporated (MACAI) (Wood, 2006). Survey areas concentrated on regions of the MLA area that had not been intensively disturbed by historic mining activities (Figure 5.23), and included:

- Three small ephemeral creeks in the western section of the site.
- The southern creek flat.
- The cave on the ridge of MacFarlane Hill.

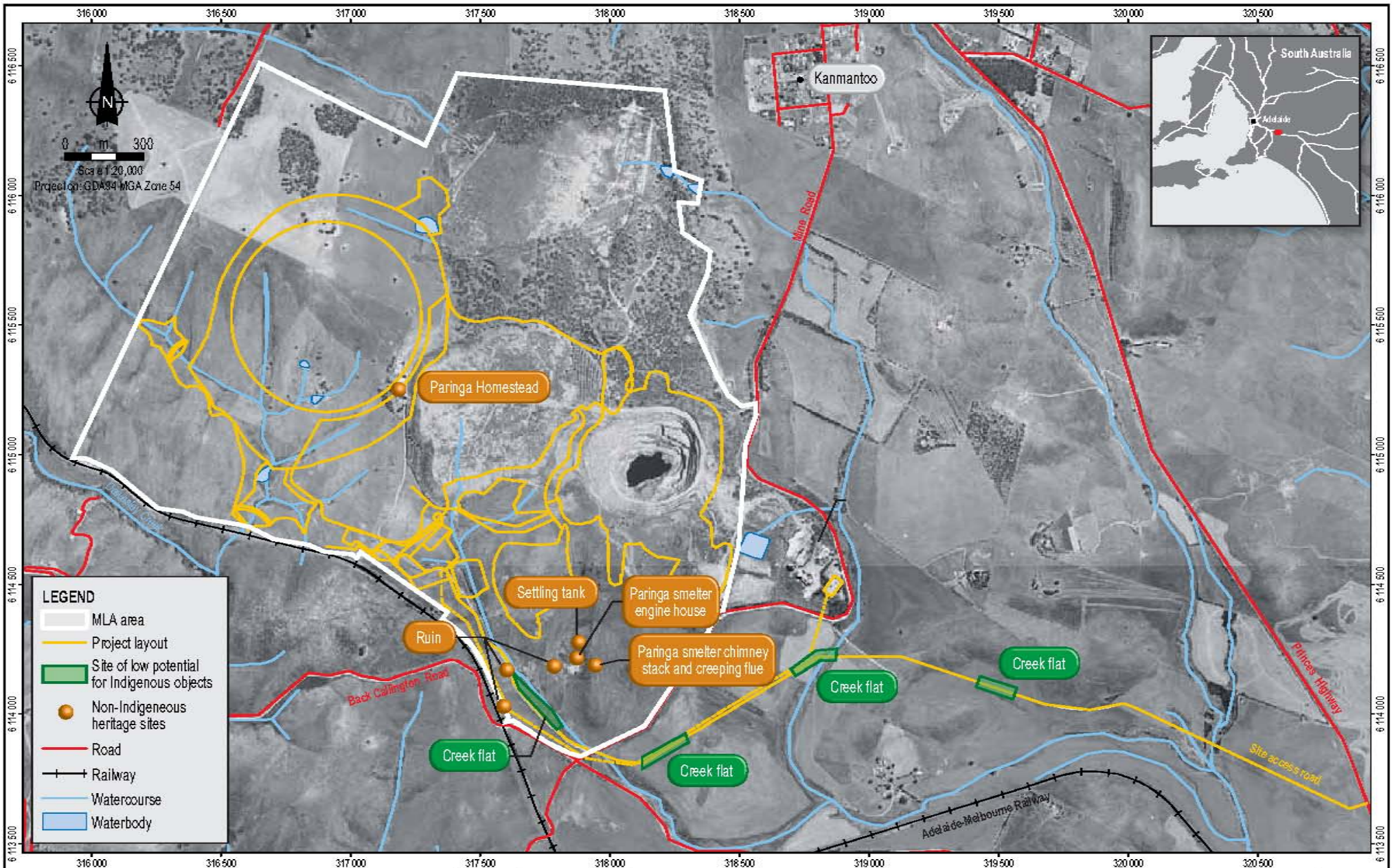
5.12.1 Historical Background

The Kanmantoo⁵ MLA area lies within the traditional territory of the Peramangk people (Tindale 1974 in Wood, 2006). The Peramangk are thought to have occupied a strip of red gum country in the Mount Lofty Ranges between Strathalbyn in the south and Angaston in the north (Tindale 1974 in Appendix 8).

The moderate rainfall and fertile soils of the Peramangk country provided an adequate supply of common foodstuffs, such as acacia gum, cossid grubs and small mammals (Tindale 1974 in Wood, 2006). Historical sources and archaeological evidence have suggested that only small Indigenous populations were supported in the Mount Lofty Ranges, in contrast to the denser populations along the River Murray.

The spread of diseases along established trade routes and densely populated areas preceded European settlement in South Australia and resulted in depopulation amongst

⁵ The name Kanmantoo is thought to derive from the Aboriginal words Kungma and tulco, meaning different speech.



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Kanmantoo Copper Project



Non-Indigenous and potential Indigenous heritage sites

Figure No
5.23

Indigenous tribes. Settlement in 1836 brought further devastation to local Indigenous populations, by both an increased exposure to these diseases and the start of European acquisition of Indigenous land.

Displacement of Peramangk within the Kanmantoo region was accelerated by the discovery of copper in 1839 and the development of early mining works. By 1844, neighbouring Ngarrindjeri had moved into abandoned Peramangk territory (Draper, 1985 in Appendix 8). The Peramangk probably moved into the Adelaide Region where blankets and rations were readily available.

Indigenous groups such as the Peramangk were also known to have settled in missions on the River Murray, such as Manunka, which operated from 1902 to 1911. Today the Peramangk primarily live between Mannum and Berri (Fitzpatrick, pers. com. 2007), and are represented by the descendants of Jinny Christmas, a Peramangk woman and her Ngaralta husband, Jerry Mason, both original residents of Manunka (Tindale 1974 in Appendix 8).

5.12.2 Existing Environment

Database Search Results

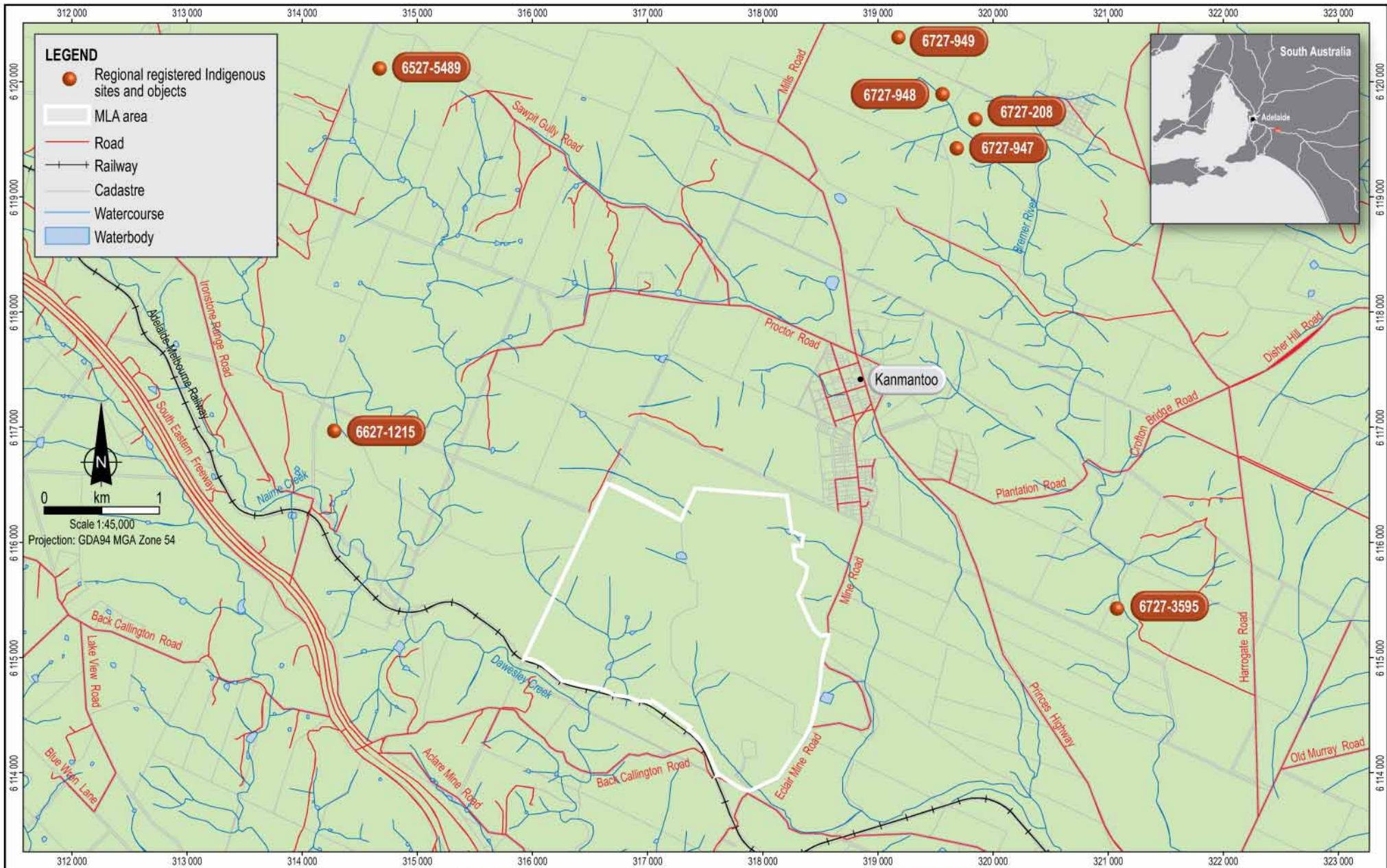
A search of the Register of Aboriginal Sites and Objects (RASO), maintained by the Department of Aboriginal Affairs and Reconciliation (AARD), identified no sites within the MLA area, although several sites outside this region were documented in the north, northwest, east and northeast (Figure 5.24). These sites consist of two scarred trees, two campsites, a painting site, a stone arrangement and a burial site.

The Australian Heritage Places Inventory (AHPI) includes a full listing of sites maintained on the South Australian Heritage Register, National and Commonwealth Heritage lists and the Register of the National Estate. No registered sites exist within the MLA area; however, the Kanmantoo painting site (AARD registered site No 6727-208 and Place ID No. 7586) is also listed on the Register of National Estate. The site consists of human figure motifs, with some other objects such as spears and boomerangs within a rock shelter adjacent to the Bremer River.

Previous Studies of Adjacent Areas

A small number of studies have been commissioned in areas next to the MLA area. These surveys have documented a range of Indigenous sites including painting sites, burials, stone arrangements, scarred trees and campsites. A study carried out during the design and construction of the Monarto Township identified open campsites, middens, burials, scarred trees and painting sites (Ross and Ellis 1974 in Wood, 2006). A further investigation, undertaken for the Tungkillio to Cherry Gardens 275-kV transmission line, recorded a number of sites including a site immediately west of the MLA area (AARD registered site No. 6627-1215 (see Figure 5.24) (Gara 1988 in Wood 2006).

A survey passing to the north of the MLA area for the Telecom optical fibre cable route between Summertown and Bordertown identified a site which included one hearth and a scarred tree (AARD registered site No. 6627-5489) (Johnston 1991 in Wood, 2006).



LEGEND

- Regional registered Indigenous sites and objects
- MLA area
- Road
- +— Railway
- Cadastre
- Watercourse
- Waterbody

0 km 1
Scale 1:45,000
Projection: GDA94 MGA Zone 54



An additional survey undertaken immediately north of the MLA area recorded a hearth site along the banks of the Bremer River.

Survey Results for the MLA Area

No sites or objects of Indigenous archaeological or cultural heritage significance were identified within the MLA area.

Three creeks identified within the area were examined during the field survey, but no archaeological sites were discovered. A search for archaeological sites was also undertaken at three natural springs adjacent to creeks. No archaeological material was observed in the vicinity of the springs and they were not found to have any known traditional significance.

MacFarlane Hill ridge was also surveyed, with a detailed inspection of a small cave. No occupational deposits or rock paintings were observed in the cave, which is not surprising since the rock composition (andalusite) is thought unsuitable for painting and the steep location would have precluded occupation.

The ephemeral creek running parallel to the southern boundary of the site fans out near the historic ruins of what is thought to be the old mine manager's residence. The survey of this area revealed no archaeological deposits. However, a remote potential exists within this area for the discovery of Indigenous burial sites and or other archaeological deposits that are below the surface and not visible during the survey.

All remaining areas were inspected with less detail but no archaeological sites or sites of traditional significance were identified.

Site Access Road Inspection

The inspection of the site access road concentrated on areas of likely archaeological significance, which included three creek flats adjacent to a heavily eroded channel (see Figure 5.23). As with the main MLA area survey, no traditionally significant sites or areas (mythological sites) are known to exist within the proposed site access corridor. However, a remote potential exists for the discovery of burial sites and other archaeological deposits if excavation activities are undertaken within the three creek flats.

5.13 Non-Indigenous Cultural Heritage

This section describes the non-Indigenous cultural heritage values associated with the MLA area. The information presented is based on a non-Indigenous cultural heritage assessment undertaken by Australian Heritage Services (Appendix 9) and a previous Indigenous and non-Indigenous cultural heritage desktop assessment undertaken by Wood (2006).

In order to identify non-Indigenous cultural heritage structures and objects, an intensive search of historic maps, literature and reports was conducted. These sources included historic mining records and plans held by the Minerals Resources Group of Primary Industry and Resources South Australia (PIRSA), and historic accounts of the mining and social history of Kanmantoo and Callington.

A site survey was then undertaken to examine known structures and to search for previously unidentified structures or objects within the MLA area. Localities with known historic relics were covered by a foot-based survey. Examinations were undertaken on a 10 m grid spacing, the accepted optimum distance for efficient and effective site coverage.

The remainder of the MLA area was covered using a combination of foot- and vehicle-based survey techniques.

All historic buildings and objects identified in the course of the survey were comprehensively documented, recording the nature of the structure/object and state of preservation utilising photography, measured scale drawings and GPS coordinates (Appendix 9).

5.13.1 Historical Background

The opening up of the Bremer Valley to non-Indigenous settlement is thought to have coincided with the construction of the overland stock route between Adelaide and the River Murray (Morphett and Schmidt 1983 in Wood, 2006). The stock route traversed directly through Mount Barker and provided a base for squatters searching out suitable grazing land (Hignett and Co 1983 and Mills 1981 in Wood, 2006).

The first survey of South Australia—the Mount Barker Special Survey—was undertaken in the Bremer Valley in 1939 by Captain Finnis and Duncan MacFarlane (Hignett and Co, 1983 in Wood, 2006). It was during this survey that MacFarlane first identified copper in the ridges of Kanmantoo, traces that were subsequently noted by local pastoralist William Giles (Mills 1981 in Wood, 2006).

An application for a Special Mineral Survey was lodged by both MacFarlane and Giles, although MacFarlane's Paringa Syndicate and Giles's South Australian Company agreed to partition the land between the two groups. The South Australian Company acquired 12 x 1,000-acre sections which included the Kanmantoo deposit, and the Paringa Syndicate the remaining eight x 1000-acre sections.

Mineral discoveries by both parties proved to be limited economically, with Paringa mine being sold in 1856. The Paringa Syndicate subsequently set up the Britannia Mining Company and took out mineral surveys near Bremer Creek in Callington, establishing Wheel Friendship, Wheel Maria, Wheel Prosper, Bremer, Tresavean, Menkoo and three other mines.

The Kanmantoo Mine was slightly more successful for the South Australian Company; however, after numerous takeovers the operation collapsed in 1874 with the downturn in copper prices. Small-scale operations continued on site from 1874 by local blacksmith Peter Lewis, until another downturn in copper prices closed the mine in 1880 (Mills 1981 in Wood, 2006).

By 1883, the advent of the Adelaide to Murray Bridge Railway coupled with the copper recovery of the early 1900s saw renewed interest in mining activities at Aclare, Paringa and Kanmantoo. Operation of the Aclare, Paringa and Kanmantoo mines continued until the conclusion of the First World War in 1918.

By 1938, a further evaluation of the mineral resource at Kanmantoo was made by Austral Development Company, who successfully identified a wide zone of low-grade ore (Chilman 1982 in Wood, 2006). While the ore was uneconomic in the late 1930s, improvements in mining and refining techniques leading up to the 1960s saw the Broken Hill South Company re-evaluate the Kanmantoo deposit with additional exploration work. In the early 1970s, Kanmantoo Mines Limited, a joint venture between Broken Hill South Limited and three other companies, commenced an open cut mine and ore treatment plant (GSSA 1972 in Wood, 2006). By 1976, fluctuating copper prices saw the Kanmantoo mine close yet again. In 2003 a small-scale heap leach operation was established to extract copper from the old Kanmantoo copper oxide stockpile. This operation remains active and is scheduled to be completed prior to Hillgrove commencing mining in this location.

5.13.2 Existing Environment

Database Search Results

A detailed search of the Register of National Estate, the South Australian Heritage Register, The Australian Heritage Places Inventory, National Trust listings, the Mount Barker District Heritage Survey and the Mount Barker Development Plan was undertaken in the course of this assessment. There were no heritage-listed sites within the MLA area. However, a number of registered sites exist within the region, primarily associated with historic mining activities, which include the Aclare and Bremer mine sites (see Figure 5.10).

Survey Results for the MLA Area

The survey identified and assessed several historic buildings and unidentified building ruins within the MLA area (see Figure 5.23). These remains were predominantly associated with the operation of the Paringa and Kanmantoo mines and included:

- **The remains of the Paringa creeping chimney and stone stack.** The stone chimney system acted as a flue for the engine house. Both the chimney system and stone stack are in a very poor state of preservation, with sections missing and stone work collapsing. Some members of the community consider the structures to be of high heritage value (although it is not a listed site).
- **The remains of the Paringa engine house.** The Paringa engine house and associated structures were found to be of moderate heritage significance, based on the structural integrity of the main engine building and its collective association with the Paringa smelter creeping chimney and stone stack.
- **The remains of the stone settling tank adjacent to the Paringa smelter.** The structure was found in a reasonable state of preservation (and is protected by a fence), although sections of the foundations are deteriorated. This structure is considered by some in the community to have a high heritage value (although it is not a listed site).
- **The ruin of the mine manager's residence.** Located on the southern boundary of the MLA area within an area of pastoral activity, the site is not currently protected. The site assessment found this structure to be in a very poor state of preservation, with a low heritage significance value.

- **A ruin adjacent to the mine managers residence.** The ruin features a fireplace and a chimney and sections of stone walls that are nearly completely disintegrated. The ruin is of low heritage preservation value due to the poor condition of the structure and lack of artefacts.
- **A ruin near the Paringa smelter engine house.** A stone ruin thought to be a small building is located around 85 m from the Paringa smelter engine house. The site has undergone significant degradation, with only small segments of the original stone walls standing. The structure is of low heritage value.
- **The Paringa homestead.** The homestead is located immediately west of the old waste rock dump and approximately 1.25 km north of historic structures associated with the Paringa Mine and is believed to have been built during the 1880s to 1890s. The homestead is in a reasonable state of repair, with a low degree of historical value.

Remnant mining infrastructure from the Kanmantoo Mine, which includes the old open pit, old tailings dam, old processing plant and an old waste rock dump, within the MLA area, and the old processing plant next to the MLA area (which is currently utilised by Neutrog Fertilisers), is not considered to have heritage significance (see Figure 1.2).

5.14 Infrastructure and Transport

5.14.1 Electricity supply

The MLA area is not connected to grid power. There is, however, an existing 132 kV substation, referred to as the 'Kanmantoo substation', located next to the Neutrog facility.

5.14.2 Water supply

The Murray Bridge to Onkaparinga Pipeline supplies water from the River Murray to Adelaide. The pipeline route begins approximately 3 km north of Murray Bridge, and continues to the Onkaparinga River (which is west of Hahndorf). The pipeline then discharges into the natural Onkaparinga River channel, which carries the water approximately 10 km downstream to Mount Bold Reservoir. The pipeline is designed to deliver 163,100 ML/a of water (SA Water, 2004). A spur pipeline runs between Kanmantoo and the former minesite along Mine Road.

5.14.3 Transport Network

Road

A number of minor and secondary roads and one federal freeway (the South Eastern Freeway which runs directly south of the proposed mine and associated infrastructure) service the MLA area and surrounds (see Figure 5.10). In late 1997, the Adelaide–Crafers Highway was completed, improving the trip between Murray Bridge (including Mount Barker) and Adelaide. This has also improved access to Mount Barker and Adelaide for residents of towns such as Callington and Kanmantoo. In recent years, the Murray Bridge bypass and the Monarto and Swanport interchanges have been constructed (Appendix 7).

The MLA area is about 50 km by road (or 45 minutes drive) from Adelaide, while Kanmantoo and Callington are approximately 2.3 and 4.5 km by road, respectively from the MLA area.

These existing roads range from 6 to 8 m in width, with surfaces comprising limestone rubble or bitumen. The heavy vehicles that will possibly be used to transport concentrate during operation of the project are classified as a Restricted Access Vehicle (RAV). With the exception of East Terrace, none of the roads forming the proposed haul route are designated as gazetted RAV routes.

A traffic survey was undertaken for Back Callington Road and Mine Road for a period of 7 days to determine traffic volumes and types. This information is presented in Table 5.11. Vehicle data for the Princes Highway and East Terrace were obtained from the Department for Transport, Energy and Infrastructure published information.

Table 5.11 Traffic numbers and type

Traffic Type	Traffic count (over 7 days)	Proportion
Back Callington Road		
Cars ¹	196	86.3%
Trucks ²	21	9.3%
Semi-trailers	10	4.4%
Annual average daily traffic	227	N/A
Mine Road		
Cars	457	91.6%
Trucks	28	5.6%
Semi-trailers	13	2.8%
Annual average daily traffic	498	N/A
Princes Highway		
Cars	1000	90%
Trucks and semi-trailers	100	10%
Annual average daily traffic	1100	N/A
East Terrace		
Cars	640	85%
Trucks and semi-trailers	110	15%
Annual average daily traffic	750	N/A

¹ Traffic numbers for cars includes motor bikes.

² Traffic numbers for trucks includes buses.

Source: Appendix 10.

Mine Road is currently utilised by Neutrog Fertilisers which makes between 1 and 10 haul trips per day (between 2 and 20 journeys), using trucks of varying sizes, depending on demand and season. Three roads used by school buses form part of the proposed haul route to and from the mine (Appendix 7):

- Old Princes Highway (Nairne–Callington school bus route).
- East Terrace (Murray Bridge–Strathalbyn school bus route).
- South Eastern Freeway (Murray Bridge–Mount Barker school bus route).

Back Callington Road is currently used by multiple vehicle types including trucks and trailers that service the quarry 1.5 km southeast of the MLA area.

Rail

The Melbourne to Adelaide Railway, a standard gauge line (1435 mm), is located immediately to the south of the MLA area. It crosses Back Callington Road to the southeast of the MLA area. The Australian Rail Track Corporation Ltd owns, and has responsibility for the management of, the rail line between Adelaide and Wolsley (near the South Australian/Victorian border) (ARTC, 2006). Passenger services on the railway are operated by Great Southern Railway (Australian Rail Maps, undated).

Port

The concentrate will be transported by road from the mine site to Port Adelaide for export. The Port of Adelaide, operated by Flinders Ports Pty Ltd, is an existing port and is the main service point for shipping in South Australia. It has an inner and outer harbour, with over 20 wharves (Flinders Ports, 2007).

Air

The closest commercial airport to the MLA area is the Adelaide Airport, which caters for regional, domestic and international flights. Adelaide Airport Limited owns the operating lease for this airport (AAL, undated).

5.14.4 Telecommunications

Marginal Telstra and Optus mobile phone coverage is available in both Kanmantoo and Callington. In-vehicle mobiles generally gain better coverage than hand-held mobiles. Broadband internet is currently not available in Kanmantoo or Callington (Appendix 7).

5.14.5 Other Infrastructure

Mining infrastructure that remains on the site from the Kanmantoo Mine include an old open pit, old tailings dam, old processing plant and an old waste rock dump (see Section 5.13).

The closest neighbour to the proposed mine is Neutrog Fertilisers (Neutrog Australia Pty Ltd), which utilises the facilities remaining from the previous Kanmantoo mining operations.

There are also a number of houses surrounding the MLA area, the closest of which is approximately 230 m away from the MLA area (see Figure 5.4).

Most of the properties east of Mine Road are currently under cultivation, while to the west of Mine Road is the old Paringa sheep station. Therefore, numerous agricultural fences and paddock access tracks are present in the area.

6. Project Description

6.1 Project Overview

Hillgrove proposes to expand the old Kanmantoo Copper Mine (see Section 1.1) using open pit mining techniques over a mine life of approximately eight years. Copper-gold ore (which also contains silver and garnet) will be mined and processed at a rate of 250 tonnes per hour (tph) using a conventional crushing, grinding and flotation circuit to produce about 80,000 tonnes per annum (tpa) of copper-gold concentrate (with silver credits). The concentrate will be transported by road to the Port of Adelaide for shipment to an overseas smelter. Tailings will be placed in an integrated waste (tailings and waste rock) landform located adjacent to the pit.

Key characteristics of the project are summarised in Table 6.1.

Table 6.1 Key characteristics of project

Characteristic	Description
Project location	44 km southeast of Adelaide within the Mount Barker District Council area, South Australia.
Mineral claim numbers	MC 3833, MC 3834, MC 3835, MC 3836, MC 3510.
MLA area	436 ha.
Project footprint	199 ha.
Mining method	Open pit.
Commodity to be mined	Copper, gold, silver and garnet (although garnet will report to tailings).
Mining inventory	15.96 Mt.
Mine life	8 years.
Mining and processing rate	250 tph (2 Mtpa).
Processing method	Conventional, crushing, grinding and flotation.
Product	80,000 tpa of copper-gold concentrate.
Transport route	Dedicated site access road to Princes Highway, then East Terrace to the South Eastern Freeway to the Port of Adelaide.
Operating hours	Continuous, 24 hours per day, 365 days per year (apart from crushing plant which will generally operate from 7 am to 10 pm).
Tailings storage	Integrated waste landform, with the TSF having an underdrainage system and compacted clay liner.
Electricity source	State grid, via a new 1.5-km overhead transmission line from the existing substation (near the Neutrog Plant).
Electricity requirement	52 GWh per annum.
Raw water source	Treated water from the Mount Barker District Council's Laratinga effluent treatment facility.
Raw water requirement	During construction between 30 to 100 kL/day. During operations between 900 to 1,800 kL/day.
Workforce	Over 200 during construction and around 150 people during operations.
Capital expenditure	\$100 million.

A new site access road will also be constructed for the project. This road will be permitted under the Development Act (see Section 4.1.2), therefore its approval is not supported by this MLP; however, as it is an integral part of the project, it is discussed herein.

6.2 Project Components

The major components of the project and their proposed footprints are identified in Table 6.2 and described in detail in the following sections. The proposed project layout and location of related infrastructure is shown in Figures 6.1 and 6.2.

Table 6.2 Project components and approximate footprints

Component	Total Disturbance Area (ha)
Main pit (including O'Neil zone)	39.0
Emily Star pit	8.0
Fresh water dam	1.6
Process sediment pond	1.5
Tailing storage facility (TSF)	45
Northern sediment dam	2.5
TSF return water storage dam	4.0
Process plant	2.9
Run-of-Mine stockpile	2.5
Waste rock storage	74
Topsoil stockpiles	12.5
Haul roads	5.8
Administration areas	0.1
Workshops	0.2
Hardstand areas (around workshops)	1.8
Overlap between waste rock storage and main pit (due to backfilling)	(2.1)
Total	199.3

6.3 Project Schedule

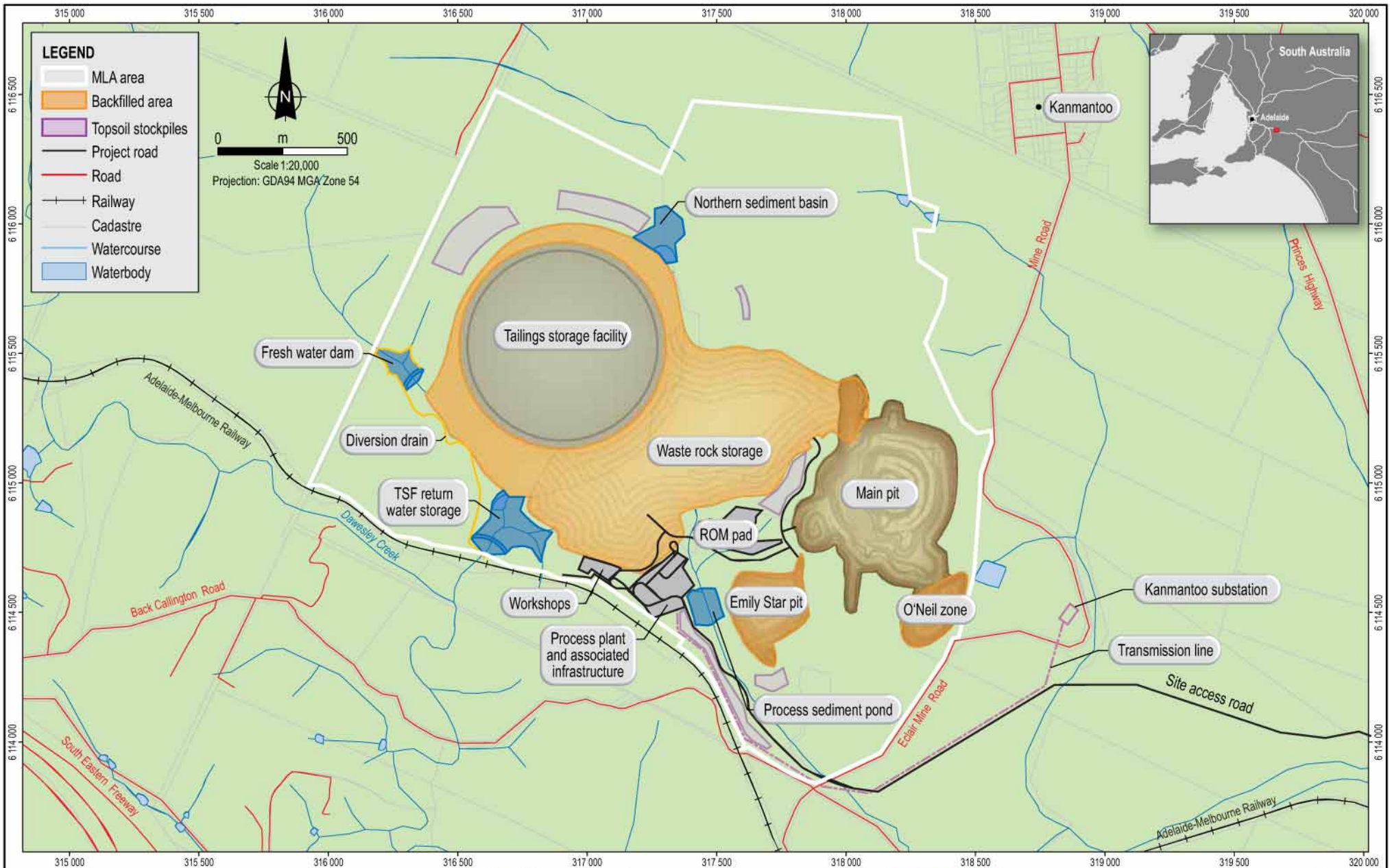
Construction of the project is scheduled to commence in the first quarter 2008, following successful permitting, with the processing plant commissioned in early 2009. The mine life is expected to be eight years. The current project development schedule is shown in Figure 6.3.

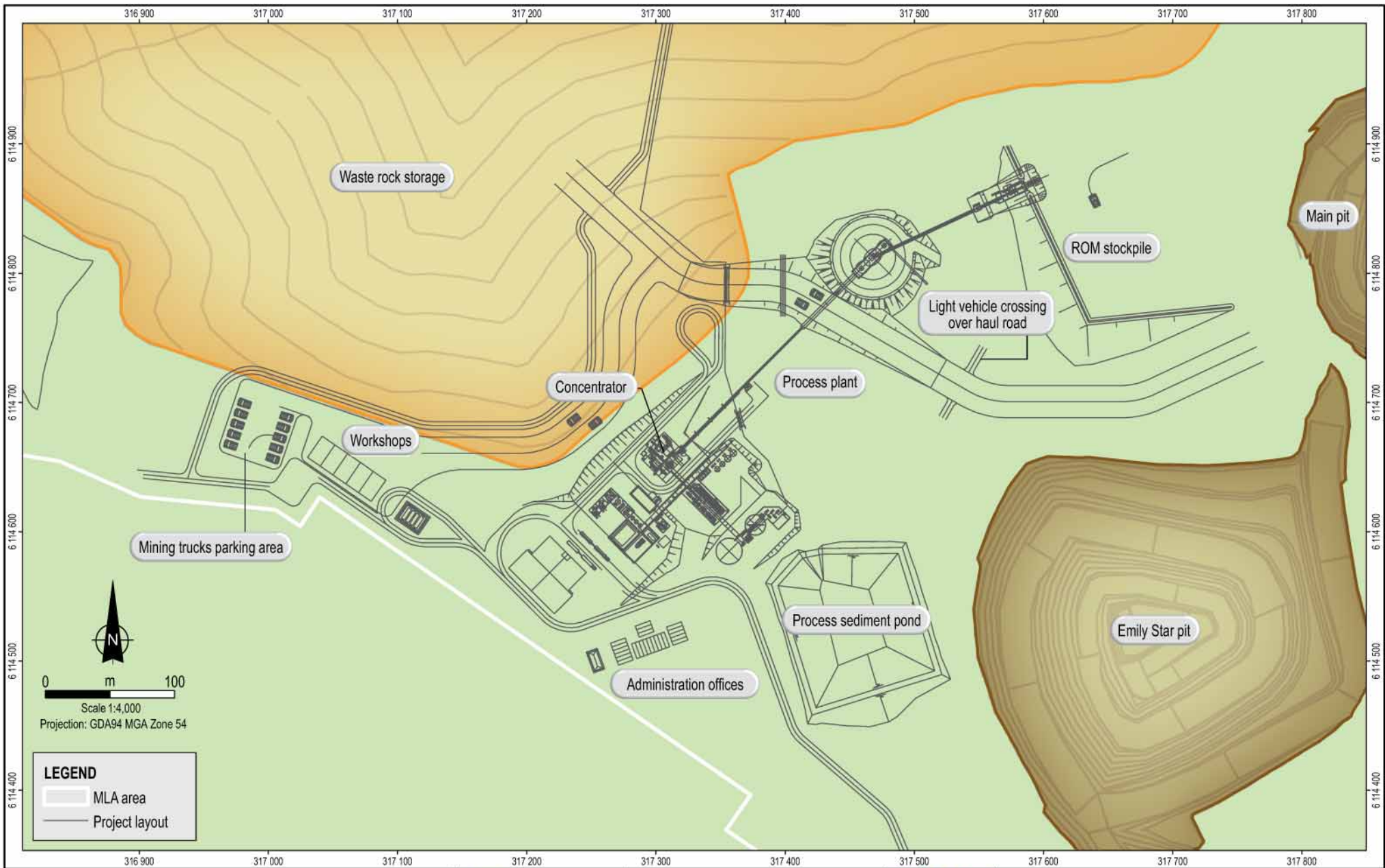
6.4 Mineral Resources

6.4.1 Deposit

The copper-gold deposit is part of the Kanmantoo Trough, which is the youngest of a succession of extensional sub-basins developed within the Adelaide Geosyncline (see Section 5.5 for a description of regional geology).

The Kanmantoo orebody comprises three main mineralised zones: Main, O'Neil and Emily Star. Each of the ore zones contains an oxide, transition and primary sulphide ore





Source:
Project layout from Hillgrove Resources

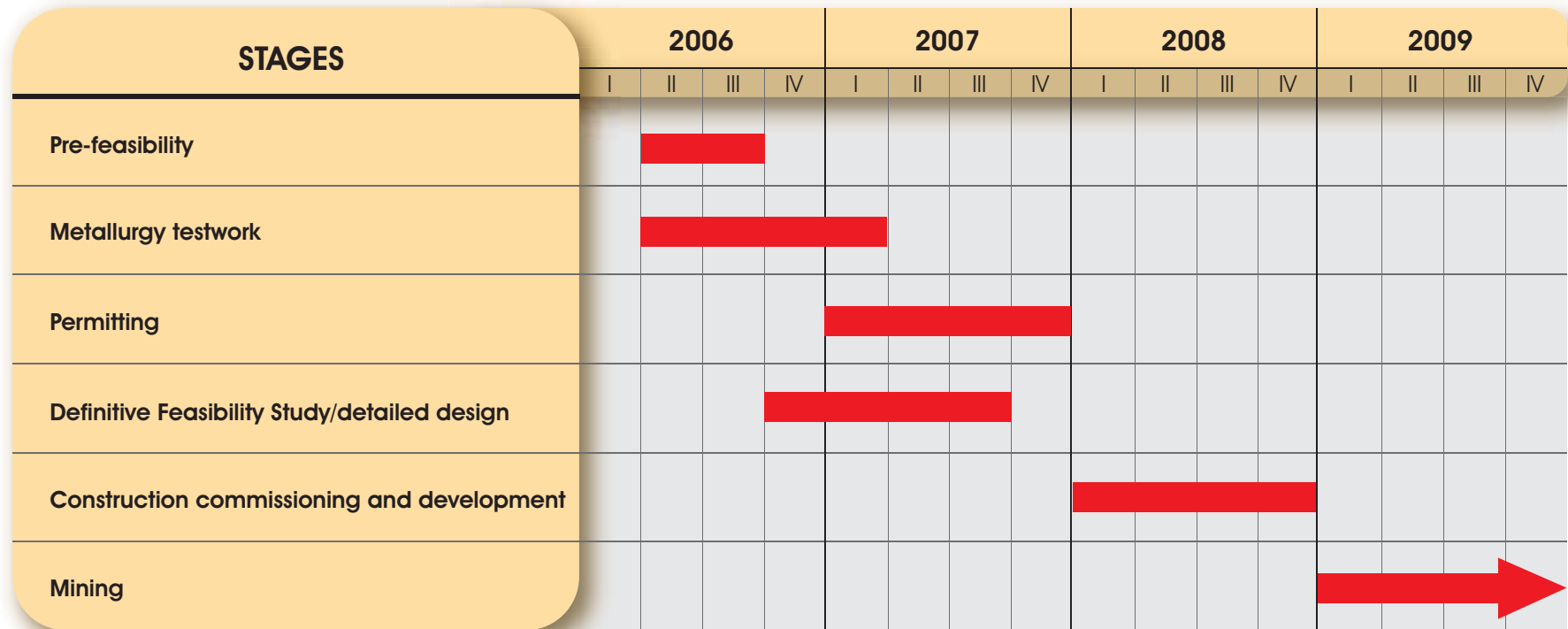

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 Kanmantoo Copper Project



Process plant layout

Figure No:
6.2



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Kanmantoo Copper Project



Project development schedule

Figure No:
6.3

component. The Main Zone is hosted by a garnet-andalusite-biotite schist (GABS) within the Cambrian Kanmantoo Group. Copper mineralisation occurs as disseminations and veinlets of chalcopyrite within a complex series of northern trending steep northeast plunging pipes and lodes 3 to 80 m wide (Figure 6.4) (Resource Evaluations, 2006). Mineralisation is characterised by chalcopyrite, pyrrhotite and magnetite with lesser pyrite.

In the Emily Star Zone, mineralisation is characterised by chalcopyrite and pyrite. Mineralisation in the O'Neil Zone is associated with a garnet-chlorite hydrothermal alteration zone with quartz veining. In comparison with the other zones, the O'Neil Zone is enriched in gold.

Sulphide becomes less common with distance from the ore zone indicating there is likely to be broad zones of non-sulphidic waste rock outside of the main mineralised blocks.

Across the MLA area, there is a distinct weathering zone of approximately 15 m depth that appears to be completely oxidised. This oxidised zone will be an important source of non-acid-forming material suitable for use in encapsulation of the potentially acid-forming waste material (see Section 6.7).

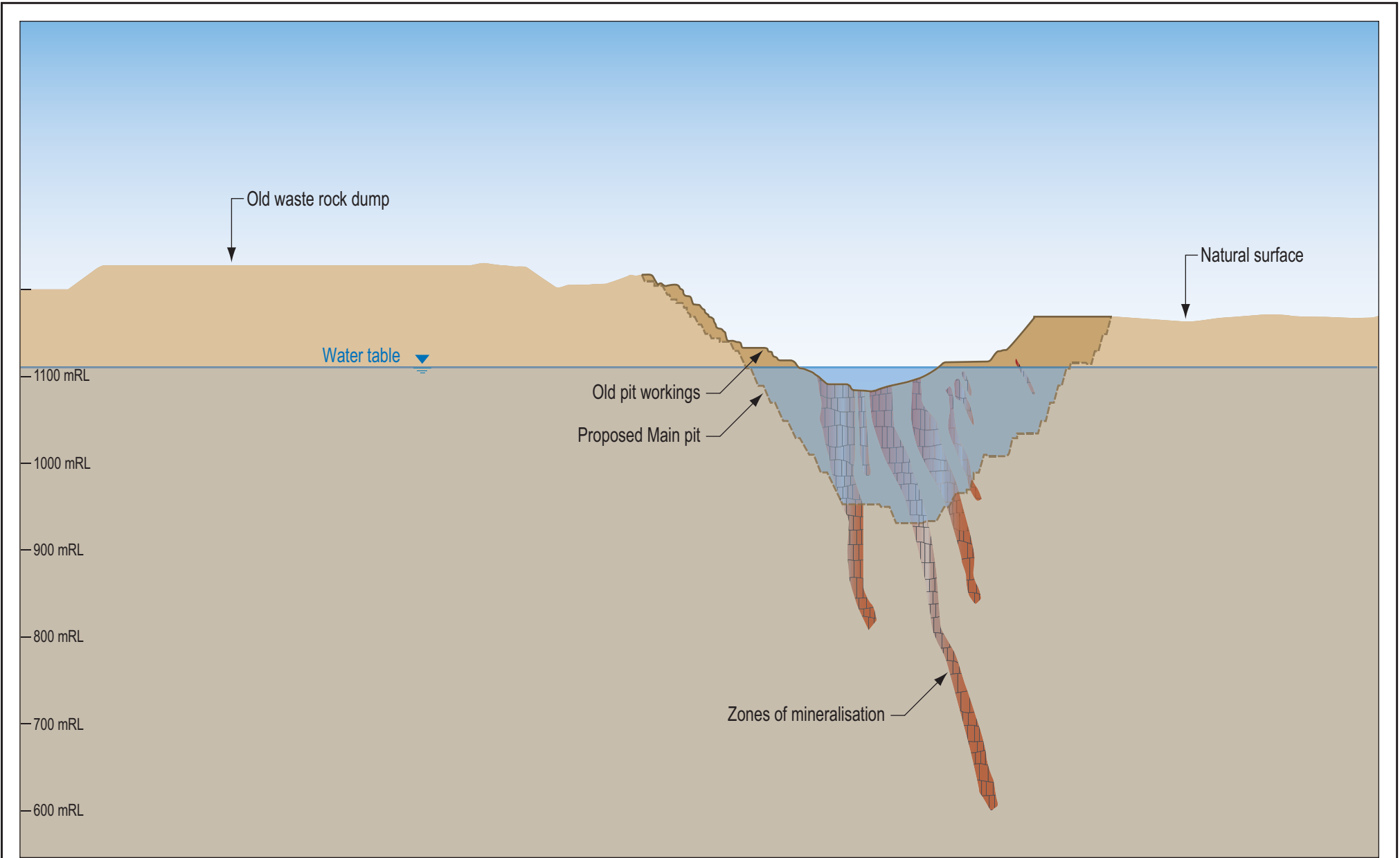
6.4.2 Resource Estimates

The resource estimate as of April 2007, prepared in accordance with the Joint Ore Reserves Committee guidelines (JORC, 2004) is summarised in Table 6.3.

Table 6.3 Kanmantoo deposit resource estimate – April 2007

		Ore Type			Total
		Oxide	Transitional	Fresh	
Indicated Resource					
Tonnes	Mt	0.95	1.09	20.92	22.96
Cu	%	0.8	0.8	0.9	0.9
Au	g/t	0.2	0.2	0.2	0.2
Ag	g/t	3.3	3.1	3.1	3.1
Inferred Resource					
Tonnes	Mt	0.2	0.52	9.76	10.48
Cu	%	0.6	0.7	0.8	0.8
Au	g/t	0.2	0.2	0.2	0.2
Ag	g/t	1.4	1.7	2.3	2.3
Total Resource					
Tonnes	Mt	1.14	1.62	30.68	33.44
Cu	%	0.8	0.8	0.9	0.9
Au	g/t	0.2	0.2	0.2	0.2
Ag	g/t	2.9	2.7	2.8	2.8
Cu Metal	t	8.8	12.3	268.9	290
Au Cut	Oz	7.1	9.8	200.1	216,900
Ag	Oz	108,500	138,000	2,802,400	3,048,800

Source: Resource Evaluations, 2007.



6.5 Mining

6.5.1 Mining Inventory

The following table (Table 6.4) shows the ore that will be mined by the project (i.e., the mining inventory). Garnet is also present in the ore that will be mined, however it will not be extracted in the process and will be contained in the tailings.

This resource estimate is larger than the mining inventory as it includes ore that is uneconomic to mine at the current time due to factors including grade, depth and stripping ratio. The mining inventory is determined by using the Whittle pit optimisation programme and then carrying out a detailed pit design.

Table 6.4 Mining inventory

		Ore Type			Total
		Oxide	Transitional	Fresh	
Tonnes	Mt	1.04	1.32	13.60	15.96
Cu	%	0.8	0.8	0.9	0.9
Au	g/t	0.2	0.2	0.2	0.2
Ag	g/t	3.1	2.9	3.2	3.2

6.5.2 Mining Schedule

Excavation of waste rock (including the overburden) is scheduled to start in mid 2008. A small quantity of ore will also be mined during 2008, with the main mining of ore commencing in early 2009 and continuing until 2016. Estimates of ore and waste rock production over the mine life are given in Table 6.5.

Table 6.5 Mining schedule (Mt)

Year	2008	2009	2010	2011	2012	2013	2014	2015	2016	Total
Ore	0.5	1.7	2.1	2.1	2.1	2.1	2.1	2.1	1.1	15.9
Waste rock	5.0	12.2	11.5	13.5	12.7	9.4	5.8	3.8	1.1	75.0
Total	5.5	13.9	13.6	15.6	14.8	11.5	7.9	5.9	2.2	90.9

Apparent discrepancy with mining inventory is due to rounding.

6.5.3 Mine Design and Development

The project comprises a Main pit, which has two ore zones the Main Zone and O'Neil Zone, and Emily Star pit which will be developed as a satellite pit to the south of Main pit. Mining will be by conventional open pit methods to a depth of about 300 m. The Main pit will be 1,080 m long and 700 m wide at the surface while the Emily Star pit will be 350 m long and 300 m wide.

Minimal pre-stripping is required to expose the ore at the Main pit due to previous open pit mining activities and shallow weathering profiles. Some ore will be mined during the construction phase, as waste material will be required to provide construction material for the integrated waste landform (i.e., the waste rock storage and tailings storage facility structure). This ore will be stockpiled separately for future processing.

The timing of the excavation from the pits will depend on milling requirement. However, mining at the Main and Emily Star pits is scheduled for the start of the project, while the mining of the O'Neil deposit is scheduled later in the project.

Slope parameters used in the design of the pit are shown in Table 6.6. Wall reinforcement will be required on the western wall to achieve these parameters. This reinforcement will involve the installation of cable bolts in clusters of three, to a wall depth of 8 m and at 2 m intervals along the mid-bench height. The cable clusters will be tensioned and interconnected using metal strapping.

Table 6.6 Average wall angles for pit design

	Bench Face Angle (degrees)	Bench Height (m)	Berm Width (m)	Overall Angle (degrees)
West wall	64	20	4.2	55
All other walls	75	20	4.0	65

6.5.4 Ore Stockpiles

Mined ore will be delivered directly to the primary ore crusher where possible. This will minimise stockpiling and handling costs. A run-of-mine (ROM) pad will be located to the west of the Main pit (see Figure 6.1) near the primary crusher to cater for surges in ore mining volumes and provide continuity of feed to the concentrator in the event of mining interruptions. Up to three weeks of ore supply (100 kt) will be stored on the ROM stockpile.

Around 500 kt of surplus ore will be generated during the prestrip phase and will be stockpiled on top of the old waste rock dump. When the processing plant is fully commissioned, the stockpiled ore will be transferred from the old waste rock dump directly to the primary crusher. Due to metallurgical differences between the oxide, transition and primary sulphide material, the oxide material will be processed (and stockpiled) separately from the transitional and sulphide ore.

6.5.5 Mining Methods

Mining will be undertaken by specialist contractors using conventional open pit methods, i.e., drilling and blasting the material and loading it onto haul trucks for removal from the pit. Ore and waste rock will be mined using 5-m-high benches, with a possibility of increasing bench height to 10 m. Benches will be drilled and blasted. Blasted rock will be excavated by hydraulic shovels or excavators.

Blasting will be undertaken using ammonium nitrate/fuel oil (ANFO) and emulsion-based explosives, which will be loaded into blastholes. Hole diameters will vary from 89 to 127 mm, with up to 500 to 600 holes fired in each shot. Blasting will generally be undertaken at lunchtime, Monday to Friday. Blast holes will be backfilled with stemming material to contain the explosion on initiation and hence reduce noise, dust and fly rock. Surface and downhole delays will be used to minimise ground vibration. Non-electric (Nonel) signal tube will be used for downhole and surface tie-ins to improve stemming performance and reduce noise and air blast. Further mitigation and management measures for blasting are described in Section 9.6.2.

The mining contractor's vehicle fleet and equipment necessary to achieve the production schedule is summarised in Table 6.7. The equipment numbers, however, will vary throughout the life of the project as they are dependent on material movements and depth of mining.

Table 6.7 Indicative mine equipment fleet

Equipment Item	Number
Drills	
Blasthole drill rig - 89 to 127-mm-diameter holes	4
Loading Units	
180-t hydraulic face shovel/excavator	1
120-t hydraulic excavator	1
Haul Trucks	
90-t capacity off-highway rear dump haul truck	12
Ancillary	
Large front end loader	1
Large-tracked bulldozer	2
Medium-sized motor grader	2
30,000-L capacity off-highway fuel truck	2
Miscellaneous Equipment	
Service truck	1
Refuelling truck	1
Tyre handler	1
25-t crane	1
Fork lift	1
Scissor lift	1
2-t utility truck	1
Bus	1
Light vehicles	14

6.5.6 Mine Dewatering

Most groundwater flow into the pit will be used directly for mine dust suppression. Excess groundwater and rainfall runoff will be removed using in-pit pumps and piped to the TSF return water storage or process sediment pond for use in the processing facility.

6.6 Processing

6.6.1 Processing Facility

The processing facility has been designed to operate 24 hours a day, 365 days per year and treat approximately 2 Mtpa, at a rate of 250 tph. The ore contains on average 0.9% copper and metallurgical test work indicates copper recoveries of 93%. The plant will produce approximately 80,000 tpa of copper-gold concentrate (with silver credits) for export.

The processing facility will comprise the following unit operations (Figure 6.5):

- Primary crushing.
- Coarse ore storage and reclaim.
- Grinding and classification.
- Copper flotation.
- Concentrate thickening, filtration, storage and dispatch.
- Tailings thickening.

6.6.2 Process Description

A schematic of the ore concentrating process is shown in Figure 6.5. Ore will be reclaimed from the ROM stockpile by a front-end loader and fed into the crushing plant, which will reduce the ore size from 800 to 150 mm. The crushing plant will operate primarily during the day. The crushed ore will be stored on a coarse ore stockpile with a capacity of approximately 9,000 t.

Ore will be recovered from the coarse ore stockpile and conveyed to the semi autogenous grinding (SAG) mill, where the ore particle size will be reduced to 212 μm to enable the valuable copper and gold minerals to be released and recovered by froth flotation.

The flotation circuit comprises roughing, scavenging and cleaning stages. Flotation reagents (lime, collector, gangue depressant and frother) will be added in this circuit.

Copper-gold concentrate will be thickened and then filtered by a pressure filter to produce a de-watered concentrate product with a moisture content of approximately 9%. Flotation tailings will be thickened to a solids density of 55% or greater before being pumped to the tailings storage facility (described in Section 6.8.2).

6.6.3 Concentrate Storage and Transport

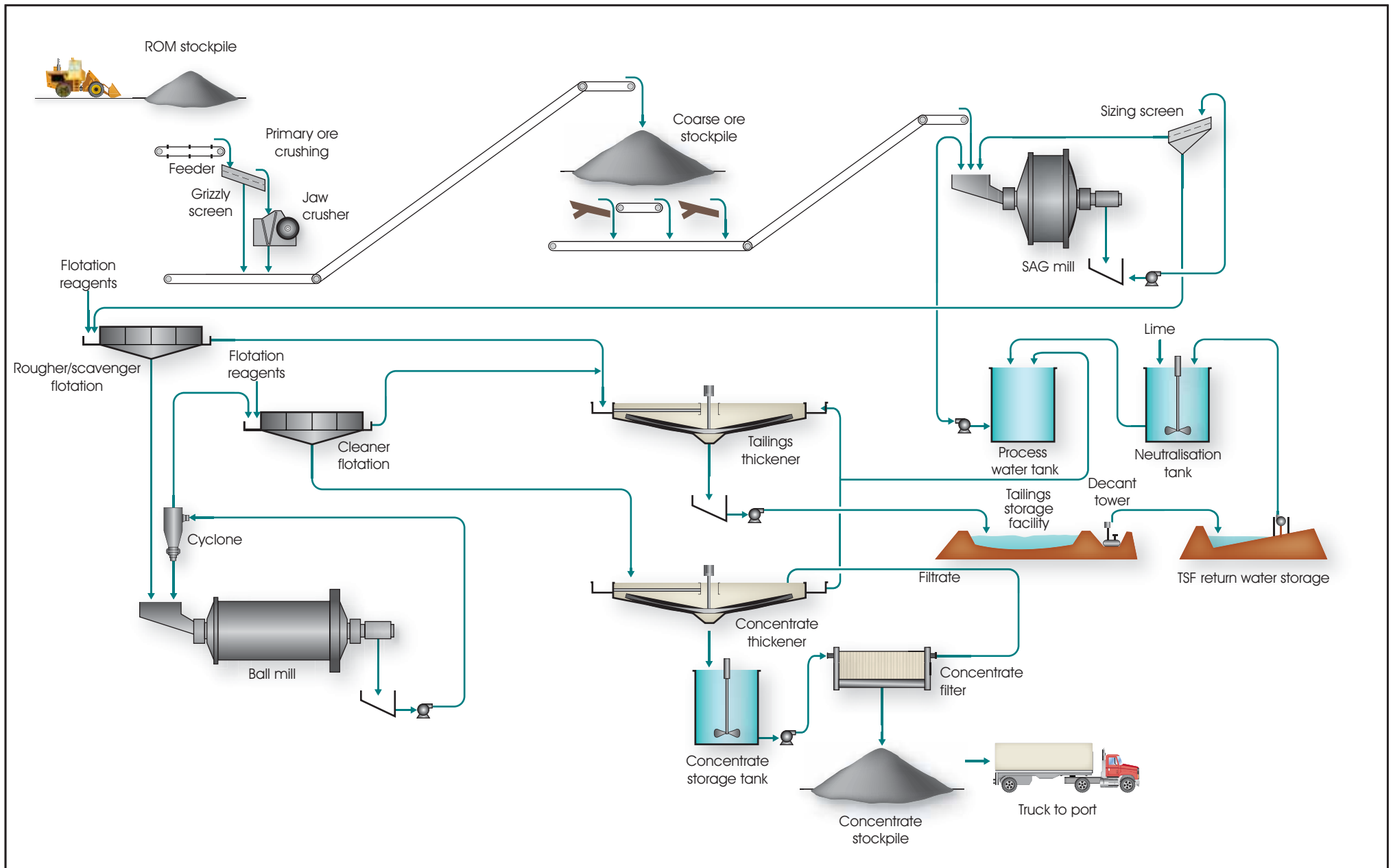
Filter cake will be stored in a concentrate storage shed, which will provide up to three days of storage. Concentrate will be transported from the mine by road to the Port of Adelaide by trucks, which will be covered by tarpaulins to prevent concentrate spillage along the route.

Prior to leaving site, the concentrate vehicles will be cleaned using a pressure cleaner to ensure the outer surfaces are free of concentrate, or any other material. At the port, a covered storage facility will provide up to ten weeks of concentrate storage. The concentrate will be loaded into ocean-going vessels (via a double-sided 'sandwich' conveyor which clamps the concentrate between two conveyor belts to minimise spillage) in quantities of between 5,000 and 10,000 wet tonnes for shipment to overseas smelters.

6.6.4 Reagents and Consumables

The reagents used in the process plant will include:

- Hydrated lime (pH modifier)—Lime will be delivered in 25-t bulk tankers and pneumatically transferred to a 40-t-capacity storage silo, after which it will be made up to 15% w/w slurry and used to control the pH in the flotation process.



- Potassium amyl xanthate (PAX) (collector)—PAX will be delivered in bulk bags and mixed in a mixing tank with agitator to produce a 10% w/v solution, which will be metered to the flotation circuit when oxide and transition ores are processed.
- Methyl iso-butyl carbinol (MIBC) (frother)—MIBC will be delivered to the site in bulk containers and pumped to a 35-m³ storage tank in the flotation building.
- Sodium hydrosulphide (NaHS) (sulphidising agent for oxide ore)—NaHS will be delivered to site in bulk bags. The solid will be mixed to a 25% w/w solution and dosed to the flotation circuit when oxide ores are treated.
- Flocculant—Flocculant will be delivered to site in 700-kg bulk bags, made up to a dilute solution (0.25% w/w) and dosed to each thickener by dosing pumps.

6.7 Waste Rock

A waste rock storage will store the waste rock generated from the open pits (see Figure 6.1). The Emily Star pit and part of the Main pit will also be backfilled with waste rock. The footprint of the waste rock storage is around 74 ha and will be incorporated with the TSF into an integrated waste landform (total footprint of 119 ha). The waste rock storage will be developed as a lift and an extension to the old waste rock dump developed during the last mining phase, and will be located immediately west of the Main pit.

6.7.1 Waste Rock Characterisation

An assessment of acid rock drainage potential was undertaken by Environmental Geochemistry International Pty Ltd and is provided as Appendix 11. The assessment involved inspection and chemical analysis of the old pit water and old waste rock dump and geochemical assessment of a selection of representative waste rock samples from the site.

The old waste rock dump shows scattered occurrences of pyrite in individual rocks and boulders on the dump top and slopes, together with jarosite and other sulphide oxidation products on rock surfaces. The old open pit has occurrences of jarosite and sulphate salts on the pit walls and edges of the pit lake as a result of pyrite oxidation.

The old pit water and old tailings dam seepage pond water were found to be strongly acid (pH 2.8 and 2.6, respectively) and brown in colour, indicating high iron sulphate content. Water quality tests at both locations showed elevated iron, copper, manganese, cobalt, nickel and zinc concentrations. Strong efflorescence was also observed at the base of the old tailings dam and immediately above the pond indicating the presence of acid rock drainage.

A geochemical assessment of 99 representative waste rock samples from the mineralised zones classified 60% of the samples as either potentially acid forming (PAF)¹, potential acid forming – lower capacity (PAF-LC)² or uncertain, expected to be

¹ NAPP > 0 kg H₂SO₄/t and NAGpH < 4.5.

PAF (UC(PAF))³. The remaining 40% of samples were classified as non-acid forming (NAF)⁴.

Of the three holes tested from the Main Zone, only one hole, collared on the natural ground surface, had a significant portion of NAF rock. Samples taken from the other two holes, collared on the floor of the Main pit, were mostly PAF/PAF-LC. This indicates that waste rock between the ore lenses in the Main Zone may be mainly PAF or PAF-LC and management to prevent acid rock drainage from waste rock materials will be required.

Current estimates are that, of the 75.0 Mt of waste rock to be mined at least 23 Mt is NAF. The remaining waste rock (52.0 Mt) is still to be classified either PAF or NAF. Further work that will be undertaken by Hillgrove before construction to further characterise the waste rock material and inform management strategies, includes:

- Preparation of a sulphur distribution model based on the existing data from the geological database and application of the 0.2% sulphur cut-off to produce a preliminary acid rock drainage distribution model.
- Identification of data gaps in the sulphur distribution model and infill testing, as required.
- Validation of the sulphur cut-off criteria with additional testing of selected samples across the various deposits
- Geochemical characterisation of additional Emily Star samples to ensure adequate representation of potential geochemical variation in this deposit.
- Geochemical characterisation of materials close to the expected pit shells to assess the acid rock drainage potential of final voids.
- Leach column testing of waste rock materials to determine rates of reaction and likely leachate compositions to assist finalising collection and treatment requirements.
- Preliminary investigations into waste rock storage and TSF cover design requirements and potential sources of cover materials.

6.7.2 Waste Rock Management

The waste rock storage will be constructed from the south towards the north. Construction will be staged in 10-m-high horizontal lifts eventually reaching a maximum operating height of 70 m. At the completion of the mining operations, the top 20 m (approximately 4 Mm³) of the waste rock storage will be relocated to the top of the TSF as part of the mine closure and rehabilitation program (Snowden, 2007).

² PAF samples with NAG acidities to pH 4.5 ≤ 5 kg H₂SO₄/t.

³ NAPP ≤ 0 kg H₂SO₄/t and NAGpH < 4.5.

⁴ NAPP ≤ 0 kg H₂SO₄/t and NAGpH < 4.5.

To minimise the size and impact of the waste rock storage facility, the Emily Star pit and parts of the Main pit (including the O'Neil Zone) will be backfilled.

The South Australian Mining Resources (SAMR) heap leach operation (involving the extraction of copper from the old copper oxide stockpile using the heap leach method) is scheduled to be completed prior to Hillgrove commencing mining in the area. Remnant leached ore from SAMR's operation will be taken to the waste rock storage area and encapsulated, with other PAF material, in NAF material.

Due to the presence of PAF waste rock material, an encapsulation strategy will be adopted so that the outer layer of the final waste rock storage comprises NAF material. Proposed thicknesses of NAF-material encapsulation layer are 2.5 m on the top, 1.5 m on the batters and 5 m on the base of the waste rock storage. Current estimates of the relative volume of PAF and NAF (see Section 6.7.1), indicate that around 30% of the 52 Mt of unclassified waste rock material needs to be NAF to ensure there is sufficient NAF material to encapsulate the PAF. Further work (see Section 6.7.1) is currently being undertaken to understand further the likely volumes of NAF and PAF material. The final surface will be shaped to prevent ponding of water, spread with a 0.15 m layer of topsoil, and contoured and revegetated.

The integrated waste landform will be contoured and revegetated on mine closure (and progressively where possible) as described in Chapter 11.

6.8 Tailings

6.8.1 Tailings Characterisation

Geochemical Testwork

Geochemical testwork of a tailings slurry sample derived from a bench-scale metallurgical study indicates that the tailings will contain trace amounts of sulphide minerals in a gangue devoid of carbonate minerals (Table 6.8) (Campbell, 2007). The sample was dominated by marcasite with subordinate pyrrhotite and classified as potentially acid forming (PAF) due to the reactive nature of the marcasites.

Table 6.8 Acid base analysis and net-acid-generation results for tailings sample

MC	Total-S	SO ₄ -S	Sulphide-S	CO ₃ -C	ANC	NAPP	NAG	NAG-pH	Classification
(% w/w)	%	%	%	%	Kg H ₂ SO ₄ /tonne				
20.5	0.80	0.03	0.78	0.01	9	16	13	3.6	PAF

Source: (Campbell, 2007)

MC = Moisture content, ANC = Acid-Neutralisation Capacity, NAPP = Net-Acid-Producing Potential, PAF = Potential-Acid Formation, NAG = Net-Acid Generation.

The multi-element composition and mineralogy of the tailings solids indicate that the tailings were enriched in silver, bismuth and selenium.

The tailings liquor sample did not have significant concentrations of contaminants, with the concentration of elements close to or below, the respective detection limits (Table 6.9) and was circum-neutral with a pH value of 6.1 and a salinity of 650 mg/L TDS (Campbell, 2007).

Table 6.9 Analysis results for tailings liquor sample

Major-Ions (mg/L)								
Na	K	Mg	Ca	Cl	SO ₄	HCO ₃	CO ₃	OH
96	27	23	65	200	290	10	<1	<1
Minor-Ions (mg/L)								
Fe	Cu	Ni	Zn	Co	Al	Cd	Pb	Cr
0.19	0.01	0.24	0.11	0.51	0.10	0.00033	0.0006	<0.01
Hg	As	Sb	Bi	Se	B	Mo	P	F
<0.0001	0.0004	0.00014	<0.000005	0.0030	0.04	0.00009	0.1	0.2
Ag	Ba	Sr	Tl	V	Sn	U	Th	Mn
<0.00001	0.059	0.38	0.00006	<0.01	<0.0001	0.00013	<0.000005	0.72

Source: Campbell, 2007.

Old Tailings Dam Geochemical Testwork

The old tailings dam from the previous mining operations (see Section 11.4) contains tailings from the same orebody that this project will mine, so it has been subjected to investigation and geochemical testing to obtain an understanding of its performance and provide information for the design of the new TSF.

Geochemical testing of the tailings samples from the old tailings dam was undertaken by Graeme Campbell & Associates and reported in the document titled 'Geochemical Characterisation of Tailings – Profile Samples from Existing Tailings-Storage Facility' dated July 2007 (Appendix H of Appendix 12). Based on this assessment it is anticipated that the underdrainage-water reporting from the TSF underdrainage system will have (Appendix 12):

- A pH above 5 with low amounts of latent acidity in the form of soluble Fe(II) forms.
- Low Al concentrations (e.g. near-mg/L range possibly), due to the anticipated pH.
- Cu concentrations within the range 1 to 10 mg/L.
- Potential for the water to acidify due to its latent acidity to pH 4 (+/-) upon surfacing in the TSF return water storage, although this will be offset by decant water that is discharged in larger quantities at a pH likely to be similar to the pH at discharge, i.e., pH in the range 8 to 9.

Physical Characteristics

The tailings are predominantly sand with non-plastic fines and are classified as Silty Sand (based on the unified soil classification). This means that the tailings will settle rapidly, releasing water for return via a decant system, as they will readily 'bleed', resulting in free water discharge. The tailings will also 'self drain', resulting in water percolation into the tailings stack and reporting to the underlying underdrainage system.

6.8.2 Tailings Storage Facility

The TSF design (and associated details for its construction and operation) has been prepared by Coffey Mining (see Appendix 12) and is summarised below.

The TSF is based on an integrated landform concept where the TSF is surrounded by the waste rock storage. The location of the TSF is shown in Figure 6.1.

The tailings delivery pipeline (i.e., to deliver tailings from the plant to the TSF) is a steel pipeline with a polyethylene liner. Both the tailings delivery pipeline and the return water pipelines will be banded to contain any spillage of materials from leaks or ruptures.

Design Standard

The TSF design is in accordance with:

- The draft EPA/PIRSA draft guidelines for Tailings and Tailings Storage Facilities (EPA/PIRSA, 2007).
- The Western Australian Department of Minerals and Energy 'Guidelines on the Safe Design and Operating Standards for Tailings Storage' (DME, 1999).
- Australian National Committee on Large Dams (ANCOLD) 'Guidelines on Tailings Dam Design, Construction and Operations' (DOIR, 1999).

Construction

Prior to construction of the starter embankment, the TSF area will be cleared of vegetation and topsoil (150 mm below the surface). The internal base of the TSF will be graded, scarified, watered and compacted. A 750-mm-thick clay liner will be constructed over the insitu clay on the tailings storage floor (see 'Seepage' below for further detail).

The perimeter containment embankments of the TSF will comprise a starter embankment constructed with a 6-m-thick compacted clay layer against the adjacent waste rock storage to 215 m AHD.

Future lifts will be undertaken utilising the downstream construction method, in which raises are constructed outwards and overlap the top of existing embankments. Embankments will be constructed using compacted clay and mine waste materials. The height of the embankment at the final design will be approximately 240 m AHD, with the height of tailings generally varying between 19 m on the northwest side of the TSF and 60 m on the southern side of the TSF (due to the sloping nature of the natural ground surface).

The embankments will have design slopes of 1:1.5 (vertical to horizontal) for the inner slope. The outer or downstream slope will be formed by the waste rock storage, which is likely to initially be at its natural angle of repose, approximately 1:1.5 (vertical to horizontal).

Dimensions and Capacity

The TSF is circular with a nominal diameter of 630 m and a footprint of approximately 31 ha at the base. At the final crest level, the surface area will be 45 ha.

The starter embankments have been designed to provide an initial storage capacity of 12 months. Staged construction will provide additional capacity on an 'as required' basis, and will generally be aimed at providing an additional one-year storage capacity with each lift. The total capacity of the TSF will be 15.23 Mt (10.15 Mm³) of tailings solids.

This will provide for tailings storage over the life of the mine based on the production of 1.9 Mtpa of tailings solids at an average in situ, dry density of 1.5 t/m³ (Appendix 12).

Tailings Discharge

Tailings in the form of a slurry (at least 55% solids) will be discharged sub-aerially from around the TSF perimeter via one or more active discharge points, which will be regularly moved to ensure even development of the tailings beach.

The sloped tailings beach will ensure that any surface water pond, formed from the liberation of water from the deposited tailing, is maintained around the central decant structure, which has a gravity outfall to the TSF return water storage.

Water Recovery System

A system of gravity decants (two temporary and one permanent) will facilitate surface water recovery (Figure 6.6). Recovered water will flow by gravity to the TSF return water storage from where it will be pumped back to the processing plant for use in processing.

Each decant structure comprises slotted concrete pipes, which will be surrounded by 'clean' rock fill to allow safe access to the structure for maintenance. The decant structures are raised along with the perimeter embankments as part of any stage construction works.

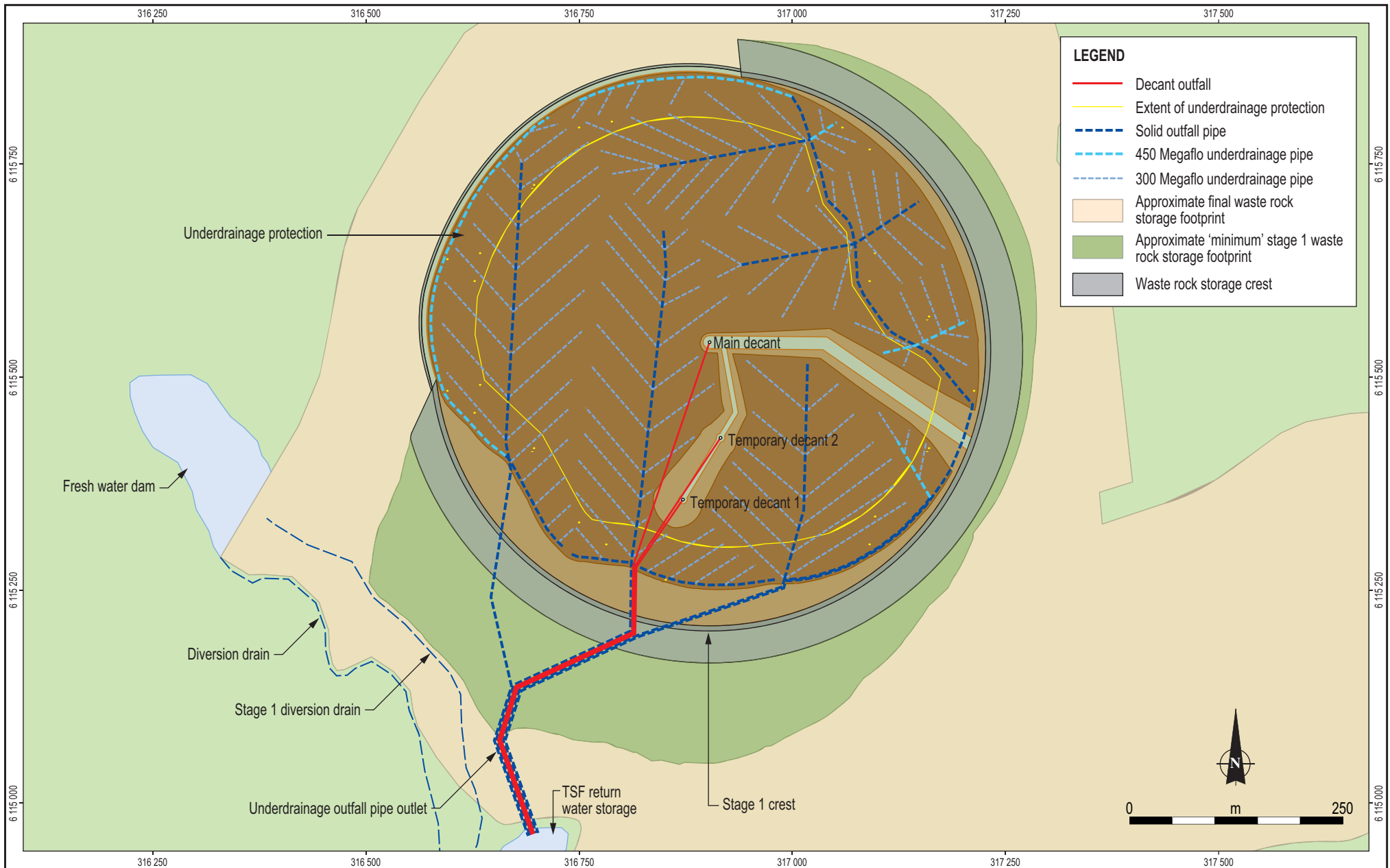
The TSF will also have an extensive underdrainage system in the base which lies over the compacted 750-mm-thick clay liner to capture water that percolates through the tailings stack during the operation of the facility. The underdrainage system has a total design flow capacity estimated at approximately 1,075 L/sec.

The TSF return water storage will be double HDPE-lined and have a leak detection system. The storage has a capacity of 125,000 m³ to contain water recovered by the decant towers and underdrainage system and also water from the TSF following extreme rainfall events, so that the volume stored on the TSF itself is minimised.

Seepage

A key design aspect of the TSF is the TSF return water storage which has been designed to store all decant water and underdrainage for reuse in the process plant. Storage of decant water in a separate HDPE lined pond removes the majority of water from the TSF and subsequently the head required for seepage to occur.

Seepage studies were undertaken using the computer model, SEEPW, which simulates pressure heads and water tables (phreatic surfaces) for the TSF (Appendix 12). The studies considered a range of scenarios and underdrainage designs, and were used to optimise the underdrainage design to effectively preclude vertical seepage. This was done by ensuring the underdrainage capacity exceeds the predicted seepage rate through the tailings bed, resulting in a piezometric head above the compacted clay liner on the floor of the TSF that is effectively zero and a negligible probability for seepage. For each scenario modelled, the worst case scenario of the tailings surface at final height and water on the tailings surface was assumed.



LEGEND

- Decant outfall
- Extent of underdrainage protection
- Solid outfall pipe
- - - 450 Megaflo underdrainage pipe
- - - 300 Megaflo underdrainage pipe
- Approximate final waste rock storage footprint
- Approximate 'minimum' stage 1 waste rock storage footprint
- Waste rock storage crest

Source: Appendix 11



Job No:
5000
File No:
5000_02_F06.06_HB

Hillgrove Copper Pty Ltd
Kanmantoo Copper Project



**TSF underdrainage and
decant pipeline plan**

Figure No:
6.6

The permeability values adopted for the tailings and other materials is shown in Table 6.10. Further work is still required to confirm the insitu permeability values of the underlying material.

Table 6.10 Permeability values adopted for seepage studies

Material	Permeability m/s
Deposited tailings	8.5×10^{-6}
Compacted clay liner (750 mm)	1×10^{-9}
Insitu clay foundation (below compacted clay liner) (1,000 mm)	1×10^{-8}
Clay liner (perimeter embankment to RL 1,225 m)	1×10^{-8}
Clay liner (perimeter embankment from RL 1,225 to 1,240 m)	1×10^{-8}
Mine waste	1×10^{-3}
Foundation (weathered rock below compacted clay liner)	1×10^{-8}

Source: Appendix 12.

The model predicted that the minimum timeframes for seepage to penetrate the 750 mm-thick compacted clay liner would be between 10 and 40 years, under full hydraulic head (i.e., when the TSF is at full capacity based on current eight year mine life and associated throughput), with seepage rates of between 8.99×10^{-10} to 1.50×10^{-9} m/s (Table 6.11). Effectively, this means that the minimum timeframe for seepage to penetrate the clay liner is between 18 and 48 years after tailings deposition commences (i.e., the minimum timeframe computed by the model plus the 8 year period of TSF operation in which the tailings level builds up to the full hydraulic head).

Table 6.11 Results of seepage analysis

Case	TSF Slope	Approx. Area at that Slope	Average Hydraulic Head (m)	Effective Drainage Spacing (m)	Estimated Flow Through Clay Liner (m/s)	Timeframe for Seepage to Penetrate Clay Liner (years)	Estimated Seepage over Sloped Area (m ³ /year)
1	7%	130,000	24	25	1.29×10^{-9}	28	5,300
2	10%	60,000	25	30	1.33×10^{-9}	34	2,500
3	20%	75,000	35	30	1.50×10^{-9}	40	3,500
4	30%	16,000	47	30	8.99×10^{-10}	12	450
5	40%	30,000	42	30	9.95×10^{-10}	10	950

Source: Table 8, Appendix 12.

The seepage modelling does not however, take into consideration what happens after the TSF is closed. Once the tailings deposition ceases the TSF will be capped (see 'Closure Design' below) thereby preventing any additional water entering the tailings stack and any increase in the hydraulic head. The underdrainage will then continue to operate for a period of three years, allowing the tailings to drain thereby reducing the hydraulic head. Consequently the minimum timeframes indicated by the modelling for seepage to occur will increase beyond the predicted 10 to 40 years.

Furthermore, the minimum timeframe of 10 years for seepage to penetrate the clay liner is for a TSF base slope of 40% which represents 9.6% of the total TSF base. The majority (85%) of the TSF base is comprised of slopes of between 7 to 20%.

Therefore, based on the modelling predictions, for a mine life of only eight years there is negligible probability for seepage to occur (i.e., seepage will be effectively zero).

If the underdrainage system became blocked during the operation of the TSF the phreatic surface within the embankment is likely to increase and there is a risk that seepage may occur. To reduce the potential for blockage a multiple filter system with multiple drainage outlets has been provided in the TSF design.

There is also potential for seepage to occur if the permeability of the underlying material is higher than allowed for in the current model. Hillgrove will also undertake further studies as part of the detailed design phase on the permeability of the insitu material and if necessary on the fate of any seepage if it were to occur.

Although, current modelling indicates seepage into the groundwater is not reasonably likely to occur, Hillgrove may seek an exemption under the EPA's Environment Protection (Water Quality) policy. The EPA has advised that, if subsequent assessment of the model parameters indicates that residual seepage may occur, it will be appropriate for Hillgrove to apply for an exemption under the policy.

Potential impacts to surface water and groundwater associated with the TSF operation are discussed in Sections 9.3 and 9.4, respectively.

Freeboard

The TSF will incur inflows from incident rainfall. Therefore, the design will provide for an operational freeboard (defined as the vertical distance between the tailings beach and the adjacent embankment crest) sufficient to contain a one-in-a-100-year, 72-hour rainfall event (minimum 300 mm). The total freeboard volume, based on a storm event of 1-in-10,000-year, 72-hour duration, is approximately 135 Mm³ or approximately 42% of the total volume of the depressed cone contained within the TSF.

Closure Design

The underdrainage and decant systems are fitted with airlocks to prevent entry of air into the base of the tailings stack at closure (thereby limiting ingress of oxygen and subsequently potential for acid rock drainage).

Drainage of fluids through the tailings stack and into the underdrainage is predicted to continue for a period of up to three years following the cessation of tailings deposition and covering of the tailings stack with the closure cover of an HDPE liner and regolith (NAF waste rock) (see Chapter 11). Once the tailings have drained and the flow from the pipes is significantly reduced, the outfall pipes will be capped and sealed.

Further detail on TSF closure is provided in Chapter 11.

6.8.3 Tailings Management

Operational procedures for the TSF include (further detail is provided in Appendix 12):

- The underdrainage and decant systems are continuously operated to remove water from the top and base of the tailings stack.

- Moving the active discharge locations (spigot points) daily to ensure even development of the tailings beaches.
- Discharging tailings at the lowest possible velocity through the spigot locations.
- Construction monitoring by an independent third party to verify the implementation of the design through construction, operations and closure.
- Frequent inspections (minimum of one per production shift) of the perimeter embankments, tailings delivery and discharge lines, discharge points, size of supernatant pond and the position of the supernatant pond in relation to the perimeter embankment, decant and underdrainage flow to the TSF return water storage, and water level in the TSF return water storage.
- Annual review of operational procedures during an inspection by a suitably experienced and qualified engineer.

6.9 Infrastructure and Transport

6.9.1 Electricity Supply

Consumption and Demand

The project will operate 24 hours per day, 365 days per year, apart from the crushing plant and some of the office facilities which will generally operate from 7 am to 10 pm. The average electrical power load during operations is estimated to be 5.87 MW, with the total annual energy consumption estimated to be about 52.1 GWh (Table 6.12).

Table 6.12 Estimated annual power consumption

Component	Installed Power (kW)	Utilisation (%)	Load Factor	Average MWh consumed annually
Crushing	462	75	0.69	2,558
Milling (excluding SAG mill)	1,389	91.3	0.75	8,358
SAG mill	3,600	91.3	0.69	20,008
Flotation, concentrate handling and tailings pumping	2,120	91.3	0.77	13,107
Concentrate regrind mill	800	91.3	0.89	5,706
Buildings and mining services	186	100	0.53	857
Water pumping	304	100	0.58	1,538
Totals	8,861			52,132

Supply Infrastructure

Electricity will be sourced from the state grid through a retail electricity provider. Accessing the state grid will require construction of an overhead transmission line from the existing Kanmantoo substation (near the Neutrog Plant) to a 132-kV substation at the mine site. The proposed alignment of the transmission line is shown in Figure 6.1. Power will be distributed from the substation via an overhead line and terminate at an 11 kV switchboard at the processing plant site.

6.9.2 Water Supply

Project Water Requirements

Project water supply requirements during operations will comprise:

- Ore processing water—Within the process plant, water will be used in the mill and flotation process to make up liquid reagents for sealing the glands on slurry pumps, for washing the concentrate, to slurry ore and for general wash-down and housekeeping purposes.
- Tailings slurry—The tailings will be pumped at solids concentration of approximately 55% by weight to allow standard centrifugal pumps to be used.
- Dust suppression and vehicle washdown water—Water carts will operate on haul roads and the ROM stockpile.
- Potable water for site amenities and laboratory (approximately 15 kL/day).

Water Supply

Hillgrove has entered into a Memorandum of Understanding with District Council of Mount Barker to supply water for the project from the Laratinga effluent treatment facility. If viable, this is Hillgrove's preferred water supply option and commercial negotiations with the council are currently being completed.

Opportunities to harvest surface water, capture pit ingress water and recycle process water on site have been maximised. Two storages will be constructed on the site for the purposes of storing water:

- A double HDPE-lined, TSF-return water storage with leak detection system, will be constructed on the southern side of the TSF to collect decant and underdrainage water from the TSF. Water currently contained in the old pit will be pumped to this storage and neutralised for use during construction.
- A process sediment pond will store runoff from the process plant area and other areas disturbed by the operations. This pond will not be used to store process water, although it will be the main surge facility for process operations.

Water ingress into the open pits and surface water runoff from the waste rock storage and other disturbed areas will be pumped to either the TSF return water storage or process sediment pond for use in processing. The northern sediment dam will also be constructed to collect runoff from the waste rock storage.

The percentage of the total water supply requirements that water harvesting and recycling will provide for the project is dependent on climatic conditions. All raw water requirements will be sourced from the Laratinga effluent treatment facility. However, should this water source not be available temporarily, Hillgrove will use groundwater bores on the site to supplement the mine's water supply.

A conservative⁵ water balance summary for dry, average and wet years is provided in Table 6.13. During operations, the raw water requirement (i.e., water to be sourced externally) will be between 900 to 1,800 kL/day. Potable water will be sourced from an existing SA Water pipeline, which currently provides chlorinated water to the site. This pipeline will feed a 45-kL head tank. A gravity supply will be installed to the site amenities, office buildings and laboratory.

Table 6.13 Water balance summary by season

Flow, kL/d, Typical month	Dry Year (10 th percentile)		Average Year (50 th percentile)		Wet Year (90 th percentile)	
	Summer (Dec)	Winter (Jun)	Summer (Dec)	Winter (Jun)	Summer (Dec)	Winter (Jun)
Inputs						
Runoff	34	116	220	433	472	755
Pits	378	378	378	378	378	378
Treated effluent [#]	15	15	15	15	15	15
Raw water	1,991	1,276	1,800	937	1,535	579
Total	2,418	1,785	2,413	1,763	2,400	1,727
Losses						
Product	16	16	16	16	16	16
Tailings (net)	1,424	1,281	1,418	1,259	1,405	1,223
Dust suppression	810	405	810	405	810	405
Evaporation	169	83	169	83	169	83
Total	2,418	1,785	2,413	1,763	2,400	1,734

[#] Treated effluent from the onsite BioCycle plant.

Construction Water Supply

The old pit contains an estimated 100,000 kL of acidic water. This water will be pumped to the TSF return water storage, dosed with lime to neutralise the acidity and used for construction purposes, wherever possible.

If the pit water is not suitable for specific purposes, a standpipe connected to the water main along Mine Road will be used for construction purposes until the water pipeline from the Laratinga effluent treatment facility is established.

Between 30 and 100 kL per day of water will be required at the peak of construction.

6.9.3 Wastewater Treatment and Disposal

All process water on the site will be reused until it is lost either to evaporation or locked up in the tailings in the storage facility. Water returned to the process plant from the tailings storage will be tested and any acidity present neutralised before being re-used. Because of the losses, the mining operations will have a net demand for raw water and there will be no need to release process or TSF decant water off site.

⁵ Conservative water balance is based on a water lock-up in the TSF at 30%.

Domestic sewage from the offices will be treated by an onsite aerobic process (BioCycle) and the treated effluent used to supplement the process water supply (approximately 15 kL/d).

6.9.4 Road Access and Transport

Site Access and Concentrate Export Route

Hillgrove has investigated a number of transport routes in conjunction with various stakeholders and the community via the Kanmantoo Callington Community Consultative Committee. The preferred route for heavy and light vehicles is via a new private road between the mine site and the Princes Highway, which bypasses the township of Kanmantoo as shown in Figure 6.1.

Concentrate will be transported in trucks along the specially built designated heavy vehicle road to the Princes Highway. Coarse gravel will be laid down on the road immediately prior to the turnoff onto the Princes Highway to minimise the transfer of sediment/mud onto the highway. Vehicles will continue east down the Princes Highway, turn south into East Terrace and then on to the South Eastern Freeway interchange. From the interchange along the South Eastern Freeway, the vehicles will follow a designated heavy vehicle route (Portrush Road and Grand Junction Road) to the Port of Adelaide.

Hillgrove is in the process of formally applying to the relevant road authorities to gazette the full route from the MLA area to the port as a restricted access vehicle route.

Traffic and Transport

The type and volume of traffic anticipated to be associated with construction and operation is shown in Table 6.14. It is expected that the construction period will extend over one year and that there will be an overlap period of three months when mining operations will occur at the same time as construction activities. The number of heavy vehicles used is dependent on type of truck used (i.e., B-double or semi-trailer).

Table 6.14 Estimated daily construction and operation traffic movements

Vehicle type	Construction				Operations
	Q1	Q2	Q3	Q4	Typical year
Light vehicles	80	142	212	232	182
B-doubles (Semi-trailers)	1 (1.5)	1 (1.5)	1 (1.5)	13 (19)	17 (25)
Trucks	2	2	2	4	3
Oversize loads	1	1	1	1	-
Total (with semi-trailers)	84 (84.5)	146 (146.5)	216 (216.5)	250 (256)	202 (210)

6.9.5 Ancillary Infrastructure

Ancillary infrastructure located on the mining lease will include:

- Administration facility.
- Site amenities.
- Workshop and stores area.

- Wash-down bay.
- Mine contractor's office, amenities and workshops.
- Explosives storage.
- Reagents store.
- Fuel storage.
- Metallurgical laboratory.

The administration facilities will be transportable buildings that provide for the central administrative function of the mine. The offices will be located near the processing plant and workshop areas so they can be shared by the different services. The workshop and stores facility will accommodate maintenance, mechanical, boiler making, electrical and instrumentation equipment that is required to support mining and processing operations.

The explosives storage area will be located separately to the north of the old waste rock dump. The facility will be designed to meet the requirements of the relevant Australian standards and state legislation (e.g., *Explosives Act 1936*), including the use of earth bunding around magazines, if required.

The reagents store building will be open, well ventilated and located near the reagents mixing area. Material safety data sheets (MSDS) will be kept for all chemicals in the store. Reagents anticipated to be stored in the building include:

- Sodium hydrosulphide (12 t).
- Collector (30 x 120-kg drums).
- Frother (4 x 210-L drums).
- Caustic soda (1 x 20-kg drum).
- Flocculant (6 t).

Hydrated lime will be stored in a 40-t silo (see Section 6.6.4). Site fuel usage has been estimated at 660,000 L of diesel fuel per month. This fuel will be stored in four 60,000-L bunded tanks located near the mining contractor's facilities.

6.9.6 Communications

All main site offices will be equipped with telephone lines and internet ports. These systems will be connected to the telephone system in Adelaide via communications towers.

Site communications will be via a UHF radio system. Radio transceiver units will include fixed base units at administration and workshop buildings, mobile units on light vehicles and mobile plant and hand held sets.

6.10 Water Management

6.10.1 Mine Water

Mine water comprises pit-dewatering water from groundwater inflows and incident rainfall over the pit area. Mine water will drain to a sump at the base of the pit and be pumped to the TSF return water storage or process sediment pond for use during operations.

6.10.2 Site Runoff

The surface water management plan is based on the principle of diverting clean surface water runoff away from disturbed areas, and intercepting runoff from disturbed areas and directing it through sediment control structures prior to discharge to the downstream environment (Appendix 13).

Figure 6.7 shows the main surface water management features proposed for the site.

The key features of this plan are:

- A fresh water dam to collect water from an ephemeral tributary of the Dawesley Creek that is intercepted by the integrated waste landform.
- A diversion channel to allow water from the fresh water dam to flow around the toe of the integrated waste landform, and join with the creek on the southern boundary of the site.
- Diversion bunds at the base of the integrated waste landform to separate sediment runoff from the clean runoff diversion channel. The diversion bund will direct sediment-laden runoff to either the TSF return water storage or to the northern sediment basin located north of the TSF.
- A series of small sediment basins located near the northeastern toe of the TSF designed to operate wet, i.e., they do not need to be emptied between storm events.
- Bunding and small scale sediment traps around the ROM stockpile. Overflow will be directed to the process sediment pond or a sediment basin located on the drainage line adjacent to the processing plant.
- Drains and culverts along haul roads and access track to direct runoff to a number of small sediment traps.

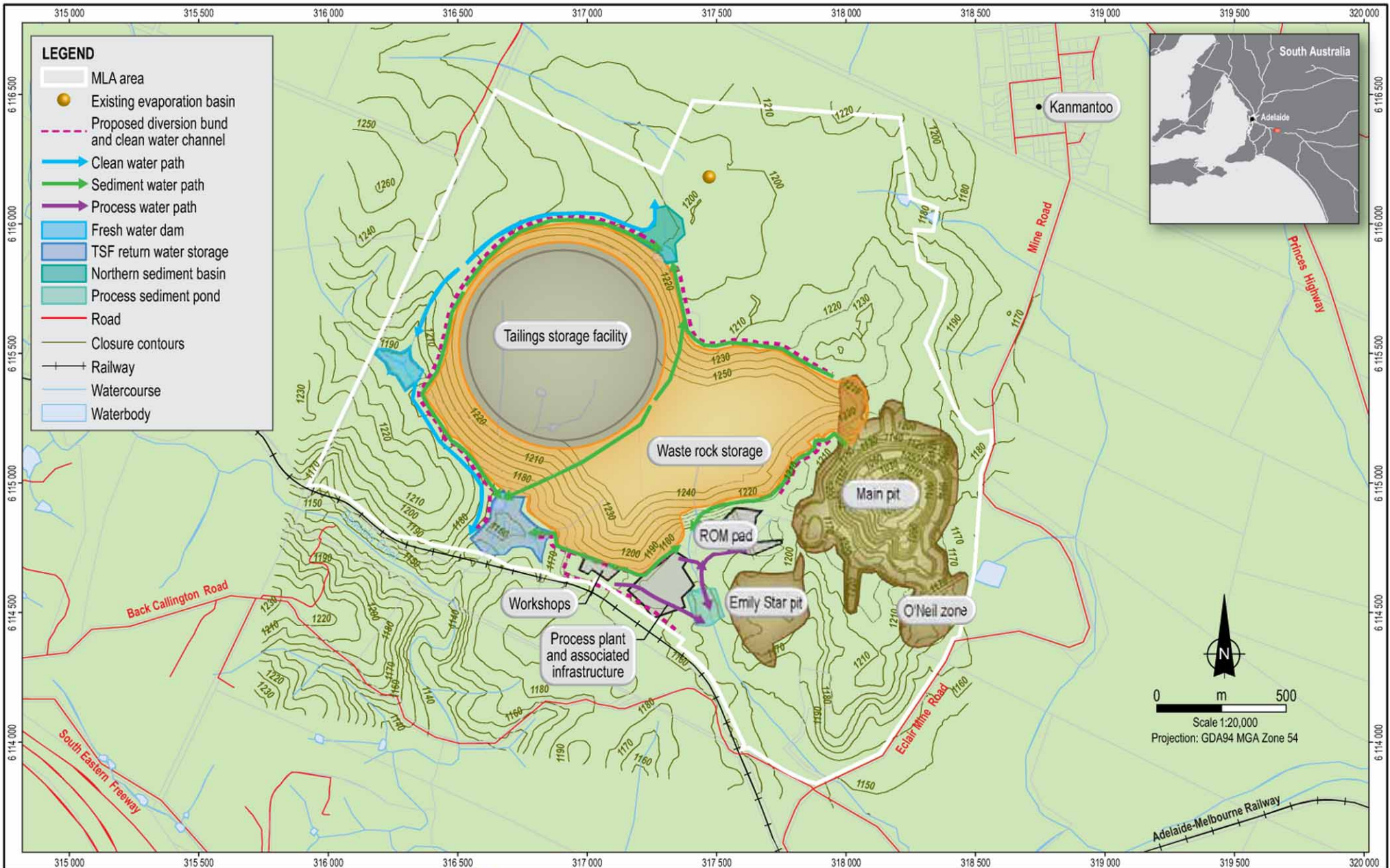
To protect the downstream environment from potential contamination, hydrocarbon interceptors and chemical containment areas will be included (where required) as close as possible to the potential source of the containment.

6.10.3 Monitoring Bores

A number of water monitoring bores (see Section 5.8.3) have already been installed by REM to monitor groundwater and provide data on fluctuations in the water quality.

6.10.4 Process Water and TSF Decant

The bulk of the process water used on the plant will be recovered in the tailings and concentrate thickeners, and recycled via the process water tank for immediate re-use. Water entrained in the tailings discharge is partially recovered by the TSF underdrainage and decant towers (the remaining moisture stays in the tailings or evaporates). The underdrainage and decant water will gravitate via pipes to the TSF return water storage. The TSF return water storage will be double HDPE-lined with leak detection and will also collect rainfall runoff from the waste rock storage surrounding the TSF. Water collected in the storage will be neutralised if acidic and returned for use in the process plant.



Source:
 Place names, cadastre, roads, rail and drainage from DEH (optimum scale 1:50,000). Closure contours from Snowden.
 Project layout from Hillgrove Resources


 Date: 16.08.07
 MXX: HillgroveResources_KanmantooGIS
 Job No: 5000_02_F06.07_GIS_AI

Hillgrove Copper Pty Ltd
 Kanmantoo Copper Project



Proposed surface water management features

Figure No:
6.7

Any wastewater arising from the mining services areas, such as from vehicle washdown, will be collected, passed through an oil and grease trap and allowed to join other area runoff water that is collected in the process sediment pond for re-use as process water. The process sediment pond will not be HDPE-lined.

6.11 Waste and Hazardous Materials Management

During the project, domestic and industrial wastes such as waste oils, packaging drums and general refuse will be generated. Hazardous materials require specific transport, storage, handling and disposal procedures that will comply with the relevant legislation, codes and manufacturer's material safety data sheet (MSDS). Only appropriately trained and licensed operators will handle explosives, which will be stored in secure, licensed magazines away from direct heat and ignition sources. Minimum practical bulk quantities of fuel and other hazardous wastes will be ordered and stored in drums and tanks with impervious bunds to contain spillages.

Management measures that will be implemented for the various types of solid wastes that will be generated are summarised in Table 6.15 and incorporate the standard waste minimisation priorities of avoid, reuse, reduce, recycle, treat and dispose.

Table 6.15 Solid waste management procedures

Waste Type	Minimise	Reuse/ Recycle	Treatment/ Destruction
Putrescible/ biodegradable litter	Minimise over-ordering.	-	Collect in 200-L drums located at designated points around site.
Packaging, paper, plastic, recyclable cans, containers, glass	Purchase in bulk.	Separate paper and PET-HPDE, glass, plastic, cans and collect for recycling.	Collect in 200-L drums located at designated points, transfer to holding point then send off site for recycling.
Scrap steel	Minimise over-ordering.	Collect for recycling.	Store at designated site and periodically send off site for recycling.
Tyres	Maintain vehicles and equipment.	Collect for recycling.	Store at workshop and periodically send off site for recycling (or dispose by burying in the waste rock storage).
Hazardous wastes	Minimise over-ordering/ purchase in bulk. Minimise spills.	Where possible return hazardous wastes and packaging to supplier for recycling.	Store in designated areas with periodic collection/disposal by registered contractor (or supplier).

6.12 Construction

Construction is scheduled to commence in first quarter 2008 (subject to permitting) after all the necessary approvals have been obtained. The construction period is anticipated to be 58 weeks and will comprise a number of separate work disciplines and work packages, including:

- Site preparation works including earthworks.
- Civil foundation works.
- Structural fabrication and erection.

- Platework fabrication.
- Mechanical installations.
- Electrical installations.
- Piping installations.
- Water delivery system, supply and installation.
- Infrastructure and support buildings supply and installation.

6.12.1 Site Preparation Works

Installation of Surface Water Drainage

Prior to major earthworks commencing, the site surface water drainage system will be constructed to minimise potential for soil erosion and discharge of sediment-laden water to the downstream environment during construction. The surface water drainage system will divert surface runoff water away from areas to be disturbed and collect sediment-laden (dirty) water from disturbed areas. Section 6.10.2 contains further details on this drainage system.

Site Clearing

The extent of site clearing and incidental site disturbance will be minimised by the clear demarcation of areas that require clearing for infrastructure construction, in particular the integrated waste landform. Site clearing will be undertaken progressively so as to minimise site disturbance and the potential for erosion.

Vegetation clearing and grubbing will be the first step of site clearing. Cleared vegetation will be stored in windrows and, where possible, used to assist with erosion control on topsoil stockpiles and progressive rehabilitation of disturbed areas. Vegetation will not be burnt. Topsoil will then be stripped and stored in stockpiles for subsequent use in rehabilitation. Topsoil stockpiles will be located as close as possible to where they will be reused and will be shaped into low, uncompacted, flat-topped mounds up to 2 m high (see Figure 6.1). To minimise the potential for erosion of topsoil stockpiles, cleared vegetation and an initial spray of water will be used to stabilise the stockpile surface and perimeter drainage will be installed to prevent both surface water run-on eroding the stockpiles and the discharge of sediment-laden water from the stockpiles to the surrounding environment.

Earthworks

Major earthworks will be undertaken to provide suitable bases for roads, the process plant and other site infrastructure. Earthmoving will be undertaken using loaders, trucks, dozers and graders. Water trucks and water sprays will be used as necessary to manage dust (and the use of dust suppressants will also be considered). Areas will be trimmed to final grade and compacted on completion of bulk earthworks.

6.12.2 Process Plant Construction Works

A construction laydown area will be established and the foundations for components of the process plant will be installed prior to erecting structures. Fuel storage and metering facilities will be constructed early in the project adjacent to the mobile equipment workshop area to supply both construction and mining mobile equipment.

Concrete works are anticipated to take 22 weeks and will use concrete delivered to site in mixer trucks from batching plant in the surrounding towns.

Structural steel will be fabricated by workshops in Adelaide or the surrounding areas and, following the concrete works, structural steel erection and equipment installation will take place, with platework and installation of the piping being undertaken as access to the structure and equipment becomes available. Electrical installation will run in parallel with piping.

Services, including sewerage, potable water, power and communications, will be progressively installed in the service corridors and linked to infrastructure facilities.

At the completion of the construction works, road and drainage systems will be reformed to their final design configurations and maintained during the life of the project.

6.12.3 Mining Facilities

Mining activities are scheduled to start before milling operations in order to provide a stockpile of ore for commissioning the plant. Pre-strip material will be used to build the TSF, construction of which will be scheduled to allow the placement of the clay base layer in spring or autumn.

The mining construction works will include construction of the haul roads required to transport the pre-strip waste material to the TSF.

6.12.4 Substation and Electricity Transmission Line

Off-site construction activities for electricity supply will involve the establishment of an overhead 132-kV line from the Kanmantoo sub-station to the site.

At the minesite, the transmission line will be continued for a distance of approximately 400 m to a new substation. The substation will consist of a fenced 50 x 75-m pad where circuit breakers, transformers and switchgear will be housed.

6.12.5 Access Road

The site access road from the main gate to the Princes Highway will be constructed to a formation width of 8 m and consist of a sub-base 125 mm thick constructed from quarry rubble, overlain by a 125-mm-thick base, also of quarry rubble. The gravel surface will be crowned along the centreline of the road with crossfalls of approximately 2% to shed water into table drains along each side of the road alignment. Rubble will be sourced from an existing quarry in the region.

Intersections with the public roads, Mine Road and Princes Highway will be constructed in accordance with the standards prescribed by the DTEI and the District Council of Mount Barker.

6.13 Plant and Machinery Requirements

Equipment required for site development and construction of fixed plant and infrastructure facilities, services and utilities generally comprises:

- Earthmoving equipment and associated service vehicles.

- Fixed and mobile construction equipment.
- Mobile equipment subsequently used for operations such as earthmoving.
- Specialised earthmoving equipment for the borrowing and compaction of the clay for the TSF liner.

Equipment required for operations generally comprises mining equipment (described in Section 6.5.4), site mobile equipment (Table 6.16), and the process plant components (e.g., crusher, SAG mill, hydrocyclones, screens, flotation tanks, thickener tanks and filters).

Table 6.16 Site mobile equipment

Description	Number
Sedan (2WD)	1
4WD vehicle	9
15-t Franna crane (or equivalent)	2
Manitou forklift M30 (3 t)	1
CAT992G front-end loader (or equivalent)	1
CAT/IT62 front-end loader (or equivalent)	1

6.14 Construction and Operating Standards

6.14.1 Management Structure

Hillgrove will establish a small 'owner's team' to oversee construction and will appoint a resident manager and project manager. The resident manager will have overall responsibility for site safety during construction and operations and will oversee the execution of the mining contract.

It is anticipated that the plant and infrastructure component of the project will be undertaken on an engineering/procurement/construction management (EPCM) basis. The owner's team, under the project manager, will be responsible for the coordination and completion of all engineering design works.

The mining operations are likely to be carried out on a contract basis at a schedule of rates.

6.14.2 Occupational Health and Safety

Hillgrove will formulate an occupational health and safety policy that, as a minimum, meets the requirements of the relevant legislation and regulations. Safety hazards, for which management procedures will be required, are expected to be similar to those found at other open pit mining operations.

Due to the proximity of the site to emergency services, an ambulance is not required on site, although, the project will have a trained rescue team, OH&S officer and first aid room. A majority of personnel will also be trained in first aid.

6.14.3 Site Security

The MLA area will be fenced and a security company employed by Hillgrove to maintain the security of the site and, in particular, control access to and from the site.

6.15 Workforce and Accommodation

6.15.1 Construction Workforce

Site works are expected to occur over a 58-week period in which the construction workforce, including construction management and supervision, is expected to peak at 85. The workforce will source accommodation in nearby towns or Adelaide.

6.15.2 Operations Workforce

The operations workforce will vary during the mine life, depending on the level of mining activity. Where possible, employees will be recruited in and from South Australia, but additional recruitment from the rest of Australia may be necessary. Personnel requirements during operations (approximately 150 people), including the 85 personnel anticipated to be engaged by the mining contractor are summarised in Table 6.17.

Table 6.17 Operations workforce

Position	Number
<i>Administration</i>	<i>10</i>
Resident Manager	1
Secretary	1
Accounts/Payroll Clerks	2
Administration Manager	1
Human Resources Officer	1
Occupational, Health and Safety Adviser	1
Environmental Scientist	1
Administration Assistant	1
IT Support	1
<i>Mining</i>	<i>14</i>
Mine Superintendent	1
Mining Engineer	2
Pit Supervisor	1
Chief Surveyor	1
Geologists	3
Field Assistants	6
<i>Processing Plant</i>	<i>41</i>
Mill Manager	1
Plant Metallurgist	1
Metallurgical Clerk	1
Production Supervisor	4
Crusher Operator	2
Milling/Flotation Operator	4
Concentrate Dewatering Operator	4
Control Room Operator	4

Table 6.17 Operations workforce (cont'd)

Position	Number
Processing Plant (cont'd)	
Reagent/Tailings Operator	1
Relief Operators	4
Maintenance Supervisor	1
Maintenance Planner	1
L/H Mechanical	1
L/H Electrical Supervisor	1
Fitter/Welder	3
Electrical/Instrument Technician	4
Purchasing/Stores	1
Maintenance Relief Crew	3
Mining Contractor's Workforce	85
Project Manager	1
Production Supervisors	3
Leading Hand	2
Site Engineer	2
Drilling Supervisor	3
Safety/Training Officer	1
Site Clerk	1
Mobile Plant Superintendent	1
Mobile Plant Leading Hand	1
Mobile Plant Operators	30
Mobile Plant Fitters	9
Electricians	1
Servicemen	4
Drill Operators	12
Blast Crew	6
Drill Fitters	3
Storeman	1
Boiler Maker	1
Radio Technician	1
Auto Electrician	2
Total	150

N.B. Shift work: 4 crews; 12 hour shifts; 4 days on 4 days off.

7. Alternatives

Resource development projects are restricted in the manner of their development in the following ways:

- Physically, by the location of the orebody and the climatic, topographic and geotechnical constraints imposed by the surrounding landscape.
- Environmentally, by the environmental sensitivities of the project setting.
- Socially, by the expectations and concerns of affected communities.
- Economically, by the need to extract and process the ore profitably.

In particular, a fundamental constraint of all mineral resource developments is that they can only occur where a commercial deposit is found. Therefore, the alternative to the development of the project is no development.

The current project design represents the optimisation of engineering, economic, environmental and social considerations. These will be further refined during detailed design.

7.1 Not Proceeding with the Project

The direct consequences of not proceeding with the project can be summarised as follows:

- The social and economic benefits described in Section 9.10 would be lost at all levels, i.e., local, regional, South Australian and national. In particular, the jobs created directly at the mine during operations and indirectly through the infrastructure and services required at the mine would not be available.
- The land, water, air and amenity impacts associated with the development of an open pit mine would not occur.
- The improvement and rehabilitation of the current landforms in the MLA area would not proceed.

7.2 Alternatives Considered in Project Planning

7.2.1 Mining

The three mining methods considered for the project were surface mining by conventional excavator and truck, in-pit crushing and conveying, and underground mining.

Given the proximity of the mineralisation to the surface, underground mining was cost-prohibitive when compared to open pit methods. The in-pit crushing and conveying method, where rock is crushed and transported from the mine via a conveyor, was also cost-prohibitive due to the capital cost of the crushing and conveying equipment. This method also did not allow for the mining flexibility required for mining the satellite pits.

Therefore, surface mining using conventional excavators and trucks proved to be the most viable mining method.

The original mine plan contained a number of additional satellite pits. These additional pits were rejected in subsequent refinements of the mine plan as current economics indicated that it was not feasible to develop these pits. Further exploration will be carried out to further evaluate some of these opportunities during operations.

7.2.2 Processing

The processing of the sulphide minerals using the flotation process is anticipated to recover in excess of 90% of the metal values present in the ore to be mined. Alternative process routes such as heap leaching followed by solvent extraction and electrowinning of copper metal are not feasible as the sulphide minerals that constitute the bulk of the reserves on the site do not dissolve in acid.

While smelting of the concentrate to crude copper was practiced on the site during the mining operations of the late 1800s, the establishment of a modern smelter is not viable for the low throughput rates that will be produced by the proposed operations. Smelting would also produce emissions of sulphur dioxide that would most likely be unacceptable to the nearby Kanmantoo and Callington communities.

7.2.3 Tailings and Waste Rock Storage

Five tailings storage facility options were considered:

- A conventional stand-alone paddock-type storage.
- Central thickened discharge (cone disposal).
- In-pit tailings storage.
- A valley-type facility.
- An integrated waste landform.

The conventional stand-alone paddock-type storage and central thickened discharge options were not pursued, as the topography of the site was not considered suitable. Past experience has also shown that these methods often have higher environmental and operational risk than the other options. The in-pit tailings storage option was considered but no pits were available at the site to allow the option to be viable.

Therefore, the two options that were examined in detail were a valley-type facility and integrated waste landform. Both options were designed to utilise mine waste from the pre-stripping operations to form the downstream zone of the facilities.

Investigations concluded that the integrated waste landform option offered the following advantages over a valley-type facility:

- Progressive rehabilitation can occur on the outer face of the waste rock storage.
- Enhanced aesthetics and amenity.
- High water and reagents recovery rates.
- Savings in rehabilitation costs and reduced ongoing liability for rehabilitation.

The potential for backfilling pit voids to reduce the size and footprint of the integrated waste landform facility was assessed. The results of this assessment found that

backfilling the Emily Star pit and partially backfilling the Main pit, including the O'Neil Zone, is a viable option for the project. Complete backfilling of the Main pit is not feasible and will not be undertaken.

7.2.4 Traffic and Transport

Concentrate Transportation Method

Three different options for transporting the concentrate from the mine site to the Port of Adelaide were considered: rail; trucks (30 t loads); and B-double trucks (41 t loads).

Road transport was selected over rail transport due to the following factors:

- Although rail passes within 1 km of the MLA Area, in order to load the concentrate to a rail car, it would be necessary for Hillgrove to construct a 800 m long rail siding, which, because of the steep terrain, would require significant earthworks and additional infrastructure.
- The rail system currently terminates approximately 3 km from Port Adelaide Berth 29, (the berth from which the ship leaves) which would therefore require transfer to trucks from rail for the final 3 km of transport, effectively leading to triple handling of the concentrate.
- Rail transport costs are significantly higher than road transport costs for the transport of concentrate from the mine to Port Adelaide.
- Capital costs of transport by rail are higher than transport by road.

Hillgrove recognises that there may be some benefits of rail transportation over road, such as lower greenhouse gas emissions, and will re-evaluate this option should the rail track be extended the additional 3 km to Berth 29 at the Port of Adelaide.

The transportation of concentrate by trucks or B-double trucks had similar safety and environmental concerns. Both minimise concentrate handling and allow for flexibility in the event of truck breakdowns. They present similar concerns to the community in terms of traffic, noise, vibration and safety issues associated with an increase of trucks on local roads. The cost over the life of the mine of transporting the concentrate by B-double trucks was calculated to be marginally less than standard trucks, but the use of smaller trucks would have the potential advantages of allowing more local drivers to be employed. Following further discussion with local haulage contractors and consultation with the local community, a final decision of the type of trucks to be used to haul the concentrate will be made.

Transportation Routes

Three different route options were considered for the transportation of concentrate from the mine site to the Port of Adelaide:

- Option 1: Back Callington Road, Callington Road, Princes Highway, East Terrace, South Eastern Freeway.
- Option 2: Mine Road, Princes Highway, East Terrace, South Eastern Freeway.

- Option 3: Private access road, Princes Highway, East Terrace, South Eastern Freeway.

Option 1 presents the shortest distance from the mine site to the South Eastern Freeway. However, significant upgrades to the road and two railway crossings are necessary for this option to be viable.

Option 2 is mostly sealed, but passes through a residential area in the township of Kanmantoo. There was significant community concern expressed during Hillgrove's stakeholder consultation process (see Chapter 8) about the safety and potential amenity impacts of heavy vehicles using this route.

Option 3 was investigated following concerns raised by the community and was found to be feasible. This option presents an acceptable route to Hillgrove and Kanmantoo residents and therefore has been adopted as the preferred option.

7.2.5 Power Supply

Two power supply alternatives were considered during project design:

- On-site generation by diesel or gas turbine generators.
- Connection to the South Australian electricity grid.

Connection to the South Australian electricity grid was chosen as the base case option as it proved to be the most economic option in terms of initial capital and operating cost over the life of the mine. Additionally, the grid connection option was anticipated to have less impact on the surrounding environment and communities, in terms of noise and air emissions associated with the combustion of diesel or gas.

7.2.6 Water Supply

Project water supply requirements include potable water and raw water. SA Water has confirmed that the potable water requirements can be sourced from the existing Kanmantoo/Callington town water supply. Raw water supply options that have been considered are:

- Rainwater harvesting.
- Groundwater.
- Treated water from Mount Barker District Council.
- River Murray water (Murray Bridge to Onkaparinga Pipeline).

Hillgrove has maximised opportunities to recycle water on site and harvest surface water runoff to reduce the volume of raw water required for the project from external sources. Treated water from the Mount Barker District Council's Laratinga effluent treatment facility was selected as the preferred option (pending the viability of this option) over sourcing the raw water from the River Murray, and Hillgrove has entered into a Memorandum of Understanding with Mount Barker District Council to supply this water. The main reasons for this decision was that it avoids placing any additional pressure on the River Murray water and it utilises a water source that would otherwise require disposal.

8. Stakeholder Consultation

An effective, ongoing consultation program involving Hillgrove, government, local residents, communities and other stakeholders is essential to the successful development of the project. Consultation commenced with key interest groups and individuals in early 2004 and will continue during the remaining project planning process, the construction and operations phases, and mine closure.

8.1 Consultation Program Objectives

The primary goals of Hillgrove's consultation program are to:

- Achieve mutual understanding between Hillgrove and its stakeholders.
- Ensure the smooth and efficient development and operation of the project.

The specific objectives that will allow these goals to be met are to ensure that:

- Stakeholders are included in the impact assessment and permitting process.
- Stakeholders are well informed about the project and its potential impacts.
- Issues or concerns are addressed as early as possible.
- The appropriate regulatory requirements are met.
- Positive stakeholder relationships are established and maintained throughout the project life (i.e., from permitting through to construction, operations and closure phases).

To meet these objectives Hillgrove has established a consultation framework and program that is supported by relevant technical investigations during project development. A feature of the program is, and will continue to be, Hillgrove's willingness to ensure that the focus is on *consultation*, i.e., a two-way communication process that involves both talking and listening, rather than simply *information dissemination*. This is in line with the Ministerial Council on Mineral and Petroleum Resources (MCMPR, 2005) principles of communication, transparency, collaboration, inclusiveness and integrity, and also with PIRSA's 'Mining Approvals in South Australia' guidelines regarding stakeholder engagement (PIRSA, 2007a). One example of this is Hillgrove's involvement in the community consultation groups and committees that have been established to gain an understanding of issues of concern to community members.

8.2 Consultation Approach

The consultation program is ongoing and will continue through the life of the project to ensure due consideration of all project-related opportunities and concerns. The program will ensure the opportune dissemination of project information and enable stakeholders to communicate concerns. The program is being implemented in three phases: exploration/pre-feasibility study, definitive feasibility/MLP assessment phase (i.e., current phase) and the post project approval phase.

Two forums for establishing formal community consultation have been initiated:

- The Kanmantoo–Callington Focus Group (K–CFG).
- The Kanmantoo/Callington Community Consultative Committee (K/CCCC).

To date, Hillgrove has actively participated in both forums.

During the PFS stage, the K–CFG held a series of open meetings (approximately every two months) where interested parties were encouraged to observe proceedings and initiate discussion. Minutes from the meetings were published on the Hillgrove website.

During the DFS, the K/CCCC has held meetings every two months (or more frequently if required). As with the K–CFG, stakeholders (community and government representatives) act as ‘community champions’ for particular portfolios (areas of interest or concern), and provide leadership on topics and issues relevant to their area of expertise. Recommendations on the project development that have come out of the K/CCCC are summarised in Section 8.4.4 (see Table 8.2) and presented in full in Table 8.3 along with Hillgrove’s response and a cross-reference to where this has been captured in this MLP.

A database is being, and will continue to be, kept that records all stakeholder contact.

8.3 Stakeholders

Stakeholders are parties with an interest in the project and who can potentially influence, or are influenced by, its development. The Kanmantoo Copper Project stakeholders include:

- The ‘local’ community (i.e., people associated with the immediate area and who are directly affected by project-related activities), which comprises nine landowners, traditional owners (i.e., the Peramangk group represented by the Mannum Aboriginal Community Association), local business owners and residents of Kanmantoo and Callington (approximately 900 people) (see Section 5.11.1).
- ‘Peripheral’ communities (i.e., communities that are proximal to the MLA area and may or may not be affected by the project in some way, e.g., through increased employment opportunities), which comprise residents and business owners within approximately 20 km of the MLA area, and the major service centres of Murray Bridge and Mount Barker (see Section 5.11.1).
- ‘Other’ communities (i.e., communities that are distant from the MLA area and that may still be affected by the project in some way). This includes Adelaide, the state capital, located approximately 44 km from the MLA area from where supplies, services and people will be sourced, and private landholders located within the exploration tenements further a field.
- Local government.
- State government and agencies (e.g., PIRSA, Planning SA, SADEH, DWLBC and relevant ministers and members of parliament).
- Australian Government, including the Department of the Environment and Water Resources (DEWR) and interested ministers and members of parliament.

- Special interest groups (e.g., Kanmantoo–Callington Landcare Group, Adelaide Hills Regional Development and Murraylands Regional Development Board Inc., University of South Australia, Environment Protection Authority).
- Media (regional, state and national).
- General public (particularly within South Australia).
- Hillgrove (e.g., board, employees and shareholders).
- Contractors/suppliers (including infrastructure providers) to Hillgrove.
- Financiers (e.g., brokers, bankers and investors) and their advisors.
- Australian Stock Exchange (ASX).
- Mining industry (e.g., other mineral explorers or producers in the area, South Australian Chamber of Mines and Energy (SACOME), the Minerals Council of Australia (MCA) and Resource Industry Alliance).

8.4 Consultation to Date

8.4.1 Exploration/PFS Phase

Consultation activities within the local community commenced in April 2004 (when Hillgrove began exploration activities) and involved:

- One-on-one consultation with landholders.
- Liaising with affected landholders and interest groups (via a landholder information letter) prior to commencing drilling activities/test work and issuing of notice of entry form 21 days prior to intended commencing of drilling activities/test work.
- Establishment of the K–CFG (see Section 8.2).
- Establishing and maintaining good relationships between Hillgrove, the community (including directly affected landholders) and government through ongoing involvement in the K–CFG and one-on-one stakeholder consultation.
- Monthly project update newsletter detailing planned activities (including time, and location), community events and information on various technical aspects of the project (see Attachment 1 for an example of a project update newsletter).

Representation at the Kanmantoo—Callington Focus Group included:

- David Hopton, PIRSA Principal Legislation Officer.
- Dale Ferguson, Hillgrove Resources Exploration Manager.
- John Popow, Hillgrove Resources Land Holder Liaison Officer.
- Steve Sickerdick, SAMR Mining Director.
- Angela Crimes, Department Environment/Heritage Senior Environment Officer.
- Bob Goreing, Adelaide Hills Development Board CEO.
- Mark Goldsworthy, State Government Local Member of Parliament.
- Greg Sarre, Mount Barker Council Environment Officer.

- Lyn Stokes, Mount Barker Councillor.
- Harry Seager, Kanmantoo-Callington Landcare Group.
- Andrew Crompton, Mount Barker Environment Group.
- Alex Wells, Kanmantoo resident.
- Bill Filmer, Kanmantoo resident.
- Peter McCormack, Kanmantoo store owner.
- Kathy Roberts, Kanmantoo resident.

8.4.2 DFS/MLP Assessment (Current Phase)

Consultation during the DFS/MLP assessment phase includes:

- Participation in the establishment of the K/CCCC.
- Maintaining good relationships between Hillgrove, the community (including directly-affected landholders) and government through ongoing involvement in the K/CCCC and one-on-one stakeholder consultation.
- Establishing contact with other key stakeholders as new issues arise.
- Supplying latest information on the project activities via the monthly newsletter and special bulletins for project milestones. Monthly newsletters are available on the Hillgrove website (www.hillgroveresources.com.au).
- Disseminating information to, and having discussions with, stakeholders on key issues raised during the DFS/MLP assessment. To date this has involved:
 - Presentation of findings of specialist consultant reports at the K/CCCC.
 - Posting of the summary of findings and K/CCCC recommendations on the Hillgrove website (www.hillgroveresources.com.au).
 - Considering K/CCCC recommendations and formally accepting or accepting in principle all recommendations.
 - Modifying the mine plan and mining method to accommodate recommendations.
 - Incorporating recommendations into the MLP.
- Implementation of the formal consultation program, required by the *Mining Act 1971*. This will involve submission of an annual report to PIRSA demonstrating compliance with environmental objectives.
- Presentations and/or briefings to Government departments and agencies, councils, members of parliament, landholders, non-government organisations and similar groups.
- Media releases, information displays, and interviews and articles in local and metropolitan media.
- An email address and phone number to provide direct access to project managers.
- Open days at the site.

Groups represented at the K/CCCC include:

- Hillgrove.
- Directly-affected landholders.
- Broader community (including business, sporting and recreational interests).
- Heritage and culture representatives.
- Health and community services.
- PIRSA.
- Schools and other education services.
- Mount Barker District Council.
- South Australian Government.
- Environment groups (such as Kanmantoo–Callington Landcare Group and Murray-Darling Basin Natural Resources Management Group).

8.4.3 Post Project Approval Phase

Consultation after the DFS/MLP assessment phase will involve:

- Ongoing participation in the K/CCCC or its successor.
- Disseminating information to, and having discussions with, stakeholders on key issues raised during the DFS/MLP assessment.
- Addressing specific concerns of various stakeholders after the DFS/MLP assessment.
- Routine reporting.
- Media releases, information displays, and interviews and articles in local and metropolitan media.
- An email address and phone number to provide direct access to a Hillgrove representative.
- Open days at the site.

8.4.4 Consultation Summary

A summary of consultation undertaken up to May 2007 and the matters discussed is detailed in Table 8.1. This does not include consultation with, or information dissemination to, stakeholders such as the ASX or potential financiers.

Table 8.1 Stakeholder consultation to date

Stakeholder	Date	Matters Discussed
Local communities	Apr 2004	Land access, introduction to stakeholders.
	May 2004	Land access, information provision.
	June 2004	Land access, sampling, information about the community complaints procedure.
	Sept 2004	Land access, infill work on Paringa, damage to Neutrog back gate.
	Oct 2004	Land access, information provision, soil sampling, newspaper article content, provision of feedback re: newsletter.

Table 8.1 Stakeholder consultation to date (cont'd)

Stakeholder	Date	Matters Discussed
Local communities (cont'd)	Nov 2004	Land access, information provision.
	Dec 2004	Land access.
	Jan 2005	Information provision re: restart of operations, land access, soil sampling, drilling program.
	Feb 2005	Land access, information provision re: rehabilitation, soil sampling, drilling program, communication of outcome of council meeting.
	Mar 2005	Land access, information provision, drilling program, communication with developers, sponsorship, land purchase negotiations, soil sampling, access track construction, K-CFG.
	Apr 2005	Land access, information provision, drilling program, management of community concern, sponsorship, community complaint, back-filling of sumps, K-CFG, rehabilitation of drill area completed.
	May 2005	Land access, information provision, drilling program, land purchase negotiations, miners fair, sponsorship, investigation and resolution of community complaint re: stock losses, rehabilitation of drill area completed, provision of accommodation for field and drill crews.
	June 2005	Land access, information provision re: exploration program, drilling program, sponsorship (Callington Football Club and miners' fair), new person appointed to K-CFG, investigation into community complaint re: pollution.
	July 2005	Land access, information provision, soil sampling, fencing, K-CFG, community enquiry re: vegetation, drilling program, community complaint, exploration program, discussion re: legal proceedings.
	Aug 2005	Land access, information provision, soil sampling, drilling program, exploration program, employment, sponsorship.
	Sept 2005	Land access, information provision, exploration program, drilling program.
	Oct 2005	Land access, information provision re: property valuation, site visit, weed management, exploration program, community query re: council involvement.
	Jul 2006	Land access, drilling program.
	Sept 2006	Employment, drilling programs, stock feed availability, land access, rock chipping, soil sampling, specialist studies, K-CFG, rehabilitation, drilling program, project update, injured stock.
	Oct 2006	Land valuation and purchase, community complaints, employment, project update, fence construction, specialist studies, exploration program, K-CFG, land access, pest animal control, road works, dust suppression, access to tailings dam.
	Nov 2006	Land access, accommodation, equipment training, drilling program, specialist studies, land purchase sponsorship, Callington Primary school, employment opportunities and training requirements, contractor appointment, project information (incl. role of State Government), K-CFG, land purchase, water usage, pest animal control.
Dec 2006	Employment (contractor and operations staff).	

Table 8.1 Stakeholder consultation to date (cont'd)

Stakeholder	Date	Matters Discussed
Local communities (cont'd)	Jan 2007	Specialist studies, employment, land access, sponsorship, drilling program, pest animal control, noise, land purchase, exploration program.
	Feb 2007	Specialist studies, sponsorship, employment, community concerns about native vegetation, land valuation and purchase, land access, title change, bore locations, contractor appointment, attendance at clearance sale, specialist study results.
	Mar 2007	Contractor appointment, land purchase, specialist studies, drilling program, safety concerns, railway line, noise levels, drilling programs, employment community complaints, soil sampling program, land access, sponsorship (Callington Kindergarten).
	April 2007	Employment, legal issues, tenders, drilling program and specialist studies, land access, water licence arrangements, relocation costs, accommodation options, infrastructure placement, fire safety inspection, <i>Lomandra</i> revegetation, native vegetation (<i>Eucalyptus odorata</i>), investigation into community complaint, contractor appointment, drilling program, rehabilitation program.
	May 2007	Specialist studies, land access, employment, site tour, property purchase.
Peripheral communities	Aug 2005	Rehabilitation program, land access.
	Sept 2006	Land access, specialist studies, land purchase, drilling program, sponsorship (football and cricket), photo library.
	Oct 2006	Land purchase, employment, waste disposal contract, land valuation, sponsorship (cricket).
	Nov 2006	Credit application, accreditation documents, contractor appointment, specialist studies, land valuation.
	Jan 2007	Contractor appointment, supply of <i>Lomandra</i> for revegetation program.
	Feb 2007	Callington Primary School, specialist studies, railway line, location of project infrastructure, waste rock disposal location, ATM.
	Mar 2007	Specialist studies, contractor appointment, project schedule, road signage.
	Apr 2007	Contractor appointment, land access.
	May 2007	Contractor appointment, miners' reunion, land access, drilling program, specialist studies.
Individuals within the exploration tenements	Nov 2004	Project information, land access, drilling program.
	Dec 2004	Meeting with Landcare group.
	May 2005	Information provision, specialist studies, K-CFG (member selection).
	June 2005	Sponsorship of environmental program at Callington Primary School, K-CFG (member selection).
	Jul 2005	K-CFG meeting, seed program, miners fair, land access, vegetation (<i>Eucalyptus odorata</i>).
	Aug 2005	Fauna survey results, miners fair, other specialist studies, Landcare.

Table 8.1 Stakeholder consultation to date (cont'd)

Stakeholder	Date	Matters Discussed
Individuals within the exploration tenements (cont'd)	Sept 2005	Fence repairs, K-CFG, investigation into dust emissions, land valuations, flora survey results, miners fair, sponsorship, information provision, site visit.
	Oct 2005	Information provision, community complaint re: information provision, drilling program, site tour, fencing.
	Oct 2006	K-CFG, Callington Fair, broadband access, sponsorship, threatened species management, employment opportunities.
	Nov 2006	Drilling program, sponsorship, information update to council, specialist studies, land access, sponsorship (cricket club, Community Fire Service).
	Dec 2006	Employment opportunities, equipment supply opportunities, Callington Primary School.
	Jan 2007	Specialist studies, K-CFG, sponsorship.
	Feb 2007	Specialist studies, land access, Callington Primary School, noise levels, acquisitions, K/CCCC, visual screen, sponsorship (Little Athletics, Hills Football League, Callington Football Club).
	Mar 2007	Site visit, specialist studies, sponsorship, Callington Primary School, land access, stock fencing, removalist costs, monitoring (dust), K/CCCC, exploration lease conditions.
	Apr 2007	Infrastructure placement, K/CCCC, media liaison, site visit, pest animal control program, information distribution, Callington Primary School 150 year anniversary.
May 2007	Pest control, highway access, specialist studies, site tour, sponsorship.	
Other communities	Mar 2007	Specialist studies, project information.
Local Government (including Local Council)	May 2004	Land access.
	June 2004	Land access.
	July 2004	Land access, information provision.
	Aug 2004	Land purchase enquiry.
	Sept 2004	Enquiry regarding public concern about heavy vehicles, land purchase enquiry, Kanmantoo residential development.
	Jan 2005	Advice re: start up of operations.
	Feb 2005	Survey work, land access, information provision.
Local Government (including Local Council)	Aug 2005	Land sale, survey work, statement regarding delivery of crops, community complaints, building on mine road paddock advised that his would be in the exclusion zone, Callington Football Club.
	Sept 2005	Land valuations.
	Sept 2006	Proposed road works, site visit, sponsorship, involvement in neighbourhood watch.
	Oct 2006	Information release (PFS), land access, infrastructure placement, Callington fair, Callington Football Club.
	Nov 2006	Access to Eclair Mine, permit application, information provision to council, land access, sponsorship, specialist studies.
	Jan 2007	Speed signs, rail crossings, K-CFG meeting, project information update (infrastructure placement).

Table 8.1 Stakeholder consultation to date (cont'd)

Stakeholder	Date	Matters Discussed
Government (including Local Council) (cont'd)	Feb 2007	Land negotiation.
	Mar 2007	Callington Primary School, land purchase, K/CCCC commitments, title searches, specialist studies, working bee.
	Apr 2007	Water supply, site visit by councillors, change of contact person details, media liaison, investigation into community complaint, house sale, council inspection, miners' reunion, pest animal control, K/CCCC.
	May 2007	Kanmantoo miners' reunion.
	June 2005	K-CFG meeting.
	July 2005	K-CFG meeting.
	Sept 2006	Monarto landfill.
	Oct 2006	Information release (PFS).
	Nov 2006	Title information.
Australian Government	Jan 2007	Project update.
	Feb 2007	Submission of EPBC referral.
	Mar 2007	K/CCCC agenda.
	Sept 2006	Site visit (Murray Darling Basin Natural Resources Management Group).
	Oct 2006	Resource industry alliance, Terramin.
	Dec 2006	Resource industry alliance.
	Feb 2007	Rain shadow film crew.
	Mar 2007	K/CCCC agenda.
Special Interest Groups	Sept 2006	Site visit (Murray Darling Basin Natural Resources Management Group).
	Oct 2006	Resource industry alliance, Terramin.
	Dec 2006	Resource industry alliance.
	Feb 2007	Rain shadow film crew.
	Mar 2007	K/CCCC, rain shadow film crew, site visit (Mannum Minerals Club).
	Apr 2007	Fire safety inspection.
	May 2007	Site access for University students, film crew.
Members of Parliament	Jun 2005	K-CFG meeting representation.
	Jul 2005	K-CFG meeting representation.
	Dec 2007	Robyn Gerhart re: project update.
	Feb 2007	Callington Primary School.
	Mar 2007	Alexander Downer and John Quirke, re: sponsorship of the Callington Primary School environmental complex.

Kanmantoo Callington Community Consultative Committee Presentations

Like any other new development, Hillgrove's proposed re-development of the old Kanmantoo mine must balance the concerns of the community, other stakeholders and the environment while still producing a project which is financially viable. The process undertaken through the K/CCCC and consultation with other stakeholders and

government departments has helped identify key interest areas for the various stakeholders.

The formal process involved 16 presentations (see Table 8.1) to the K/CCCC and other stakeholders on the various aspects of the project (i.e., water, traffic, flora, fauna) and Hillgrove's preliminary ideas/plans for the management of these aspects. The presentations were prepared and delivered by the consultants that undertook the specialist studies for this report. Each presentation was followed by question and answer sessions with the consultants, Hillgrove and the stakeholders. Recommendations (verbal and written in the case of the K/CCCC) from stakeholders were made on many of the aspects presented.

Hillgrove then reviewed all the recommendations made through the consultation process and the potential impacts on the viability of the project and then, where possible, modified the plans for the project to accommodate these recommendations. This process resulted in Hillgrove fully accepting 109 of the 129 K/CCCC recommendations and accepting in principle the remaining 20, as summarised in Table 8.2 and presented in full in Table 8.3 along with Hillgrove's response and a MLP cross-reference. Where recommendations were accepted in principle, the issue was further defined and a solution to the refined issue provided (see Appendix 7).

Table 8.2 Acceptance of K/CCCC recommendations by issue

Issue	Number of recommendations	Accepted in full	Accepted in principle	MLP section cross reference
Flora	10	7	3	9.8
Fauna	9	6	3	9.9
Non-Indigenous Heritage	7	3	4	9.12
Aboriginal Heritage	6	6	0	9.11
Noise	10	10	0	9.6
Processing/Mining	4	3	1	6.4, 6.5, 7.2.2
Visual	8	7	1	9.13
Socio-Economic	5	5	0	9.10
Mining	6	6	0	6.4
Air, Odour, Greenhouse Gas	11	8	3	9.5, 9.7
Groundwater	14	13	1	9.4
Traffic	21	17	4	9.14
Integrated Waste Landform	8	8	0	6.7
Mine Closure	10	10	0	11
Total	129	109	20	

Outcomes of Consultation Activities

The broad outcomes of these consultation activities include:

- Increased government and community awareness and understanding of the project.
- Involvement of regulatory authorities in determining the environmental assessment and permitting route.

- Identification of areas of concern to local landholders, community members and other stakeholders.
- Relationship-building with local and peripheral communities.
- Progression of land access agreements.
- Increased understanding of the local community's opinions and concerns.

Specific outcomes of note include:

- Hillgrove's development of a number of community-orientated commitments, such as sponsorship of the Callington Football Club and the Kanmantoo Miners' Reunion.
- A broad understanding of the importance of issues to stakeholders (including those issues raised during the K/CCCC), in particular:
 - Traffic, specifically use of existing roads.
 - Water, specifically use of water from the Murray River.
 - Existing native vegetation, particularly *E. ordorata* low woodland and *L. effusa* open tussock grassland.
 - Heritage.
 - Framework for an ongoing consultation process through the KCCCC or its successor, including a clear complaints process.
- Revision of the original project layout following, mine optimisation and also consideration of stakeholder and specialist study recommendations. Some of the key changes made include:
 - Removal of the two small pits to the north and one small pit to the south.
 - Redesign of the haul roads, TSF and site layout to reduce the impact of the project on flora and fauna, and noise and dust on the surrounding residents.
- Commissioning of an economic evaluation of the project to support the Social and Economic Impact Assessment (Appendix 7) in response to a request by the community.
- Conducting further detailed assessment of blasting, involving an additional specialist study looking specifically at vibrations and overpressure from proposed blasting activities.
- Conducting a Spring 2007 flora and fauna survey in response to concerns about the timing of the original surveys.

8.4.5 Socio-economic Assessment Consultation

In March 2007, 24 community members were informally interviewed as part of the socio-economic assessment (Appendix 7).

Feedback relating to the consultation process and Hillgrove was that most community members felt informed about the project through newsletters and the K/CCCC forum, although others knew very little about the project and had no opinion of Hillgrove. Of those interviewed, four felt that the K/CCCC forum 'only heard what it wanted to hear' or were reserving judgement about the adequacy and effectiveness of the K/CCCC forum until issues had been adequately dealt with. Most of those interviewed (approximately 75%) had a positive attitude toward Hillgrove.

Feedback on aspects or issues associated with the project was that most community members interviewed were concerned about traffic impacts associated with the project, [note: these issues have largely been resolved through Hillgrove's commitment to construct a site access road]. Two Kanmantoo residents expressed concern about potential environmental impacts, particularly those on existing vegetation and revegetated areas. Four people were aware of contamination issues relating to the Brukunga mine and expressed concern about contamination of groundwater at Kanmantoo.

Feedback relating to benefits of the development was that approximately 95% of interviewees believed that the project would increase employment. Support and sponsorship of local sporting teams was most commonly cited as the best aspect of Hillgrove's involvement in the community.

Further detail regarding the socio-economic assessment is provided in Sections 5.11 and 9.10, and Appendix 7.

Table 8.3 K/CCCC recommendations and Hillgrove responses

K/CCCC Recommendations and Hillgrove Responses		MLP Section
Flora		
1	<p>Special attention should be paid to the <i>Eucalyptus odorata</i> (peppermint box) habitat and <i>Lomandra effusa</i> (iron grass) habitat located to the north and south of the existing pit respectively.</p> <p>Accepted.</p>	<p>9.8.1; The clearing of some vegetation to accommodate project components such as the open pit, integrated waste facility, ROM pad, processing plant and access and other site roads is unavoidable (summary of all vegetation that will be cleared is presented in Table 9.27, 9.8.1).</p> <p>9.8.2; Some areas with communities of conservation value will be avoided, including <i>E. odorata</i> low woodland to the north of the old pit in good condition (7.7 ha) and patches along the northern boundary (12.5 ha) and in the northwest corner of the MLA area in moderate condition (7.0 ha), <i>L. effusa</i> open tussock close to the southern boundary of the MLA area in very good and good condition (1.0 and 2.0 ha).</p>
2	<p>No mining activity should be conducted on high biodiversity woodland areas, especially those of <i>E. odorata</i>, to the north of the pit.</p> <p>Accepted in principle, Hillgrove recognises the value of the woodlands to the north, but in order for the project to remain viable the full extent of the main pit needs to be maintained.</p>	<p>9.8.2; Some areas with communities of conservation value will be avoided, including <i>E. odorata</i> low woodland to the north of the old pit in good condition (7.7 ha) and patches along the northern boundary (12.5 ha) and in the northwest corner of the MLA area in moderate condition (7.0 ha).</p>
3	<p>Proposals to revegetate or regenerate alternative areas (as an offset strategy) should not be used as a compensation measure for any disturbance to the <i>E. odorata</i> woodland to the north of the pit.</p> <p>Accepted in principle, with the practical solution being to work with the stakeholders to design an appropriate offset measure (SEB) for any small residual disturbance of <i>E. odorata</i> in the northern reaches of the pit</p>	<p>9.8.2; In addition to restoration and revegetating an offset area Hillgrove will improve and expand <i>E. odorata</i> and <i>L. effusa</i> communities through weed management and stock exclusion.</p> <p>9.8.2; Since project onset, by modification to the mine design, Hillgrove has reduced the area of vegetation to be cleared from 31.6 to 26.7 ha. In particular, the area of <i>E. odorata</i> low woodland to be cleared has been reduced from 8.6 ha to 3.9 ha, and the area <i>Austrostipa sp.</i> open tussock grassland to be cleared has been reduced from 3.7 to 0.8 ha.</p>

Table 8.3 K/CCCC recommendations and Hillgrove responses (cont'd)

K/CCCC Recommendations and Hillgrove Responses		MLP Section
Flora (cont'd)		
4	<p>Follow up flora surveys and habitat studies should be conducted over the coming winter and spring, followed by a commitment to longitudinal studies using a standardised methodology agreed with other interested parties such as DEH, PIRSA and local landcare groups.</p> <p>Accepted in principle with the practical solution being to undertake a spring 2007 survey and once operations commence an annual survey of vegetation transects will be undertaken together with surveys of revegetated areas. Hillgrove will have an environmental department who will implement and monitor a series of programs, mitigations and offsets and as always we will endeavour to include all parties.</p>	<p>9.8.5; Ongoing vegetation monitoring will be conducted to allow identification of any impacts of mine construction and operations on native flora. Monitoring will be conducted during spring 2007 to identify annual and ephemeral species not recorded in initial investigations, then annually thereafter during construction and operation. Monitoring will be undertaken using the standard SA DEH survey method.</p> <p>9.8.2; Specific management and monitoring measures for the offset area will be developed as part of the SEB offset area management and monitoring plan to be prepared by Hillgrove, but will include an annual survey of vegetation transects to be undertaken together with surveys of revegetated areas.</p> <p>9.8.5; Transects will be used to allow the comparison of quantitative data on shrub numbers in the different vegetation communities, and between near-mine and control sites.</p>
5	<p>The extent of any likely affected areas of grasslands and other sensitive areas should be confirmed as soon as practicable to allow for the development of appropriate offset and impact minimisation strategies.</p> <p>Accepted.</p>	<p>9.8.5; All areas to be cleared for project purposes will be documented, recording the area and the nature of the vegetation cleared. Each area cleared will be inspected to ensure clearance is conducted in accordance with the conditions outlined in Appendix 14.</p>
6	<p>Offset programs in relation to the areas of <i>L. effusa</i> predominantly to the south of the pit, should be applied to achieve the greatest environmental benefit possible.</p> <p>Accepted.</p>	<p>Refer to response 1.</p> <p>To compensate for the unavoidable removal of some native vegetation by the project (including <i>L. effusa</i>), Hillgrove are required to ensure that the project results in a significant environmental benefit (SEB) (see Section 9.8.2 and Appendix 14).</p>
7	<p>Offset measures for unavoidable clearance of the habitats mentioned in this report, including the habitats of special significance and the lesser sites, should involve large, contiguous blocks.</p> <p>Accepted.</p>	<p>9.8.2; Hillgrove intend to meet the significant environmental benefit (SEB) requirements which include maintaining vegetation remnants that are connected across the landscape and providing links for dependent fauna.</p>

Table 8.3 K/CCCC recommendations and Hillgrove responses (cont'd)

K/CCCC Recommendations and Hillgrove Responses		MLP Section
Flora (cont'd)		
8	<p>Cooperation should be sought from surrounding landowners in regard to offsets generally, as many of these landowners have undertaken, or are intending to undertake, revegetation activities.</p> <p>Accepted.</p>	<p>9.8.2; Hillgrove will support community initiatives occurring offsite through donations of plants, equipment and funding.</p> <p>Appendix 14, Section 5.3; Where significant stands of vegetation occur on nearby or adjoining properties, Hillgrove may provide monetary incentives to landholders to enter into Heritage Agreements. This would guarantee in perpetuity protection for vegetation communities. Vegetation communities on adjoining or nearby land proving links between vegetation communities for threatened fauna species would be preferentially targeted.</p>
9	<p>Minor realignment of some of the proposed sites for processing facilities, tailings settlement and waste rock dump for example, should be undertaken to minimise impacts on more scattered remnants such as the patches of <i>E. odorata</i> in the northwest corner of the project site.</p> <p>Accepted.</p>	<p>9.8.2; Native vegetation clearance will be minimised by locating access tracks outside of remnants where possible and minimising the length and number of access tracks in native vegetation.</p> <p>9.8.2; Hillgrove has relocated the tailings storage facility and designed the open pit and haul road (relocating this to the western side of the pit) to avoid disturbance to <i>E. odorata</i> low woodland.</p>
10	<p>The establishment of a seed collection and cuttings process and bank should be undertaken as a matter of urgency.</p> <p>Accepted.</p>	<p>9.8.2; The establishment of a seed bank and cutting collection protocol will occur as soon as possible after project approval.</p>
Fauna		
11	<p>Special attention should be paid to the <i>E. odorata</i> and <i>L. effusa</i> habitat located to the north and south of the existing pit respectively.</p> <p>Accepted.</p>	<p>Refer to response 1.</p>

Table 8.3 K/CCCC recommendations and Hillgrove responses (cont'd)

K/CCCC Recommendations and Hillgrove Responses		MLP Section
Fauna (cont'd)		
12	<p>No mining activity should be conducted on high biodiversity woodland areas, especially those of <i>E. odorata</i>, to the north of the pit.</p> <p>Accepted in principle Hillgrove recognises the value of the woodlands to the north, but in order for the project to remain viable the full extent of the main pit needs to be maintained.</p>	Refer to responses 1 and 2.
13	<p>Proposals to revegetate or regenerate alternative areas (as an offset strategy) should not be used as a compensation measure for any disturbance to the <i>E. odorata</i> woodland to the north of the pit.</p> <p>Accepted in principle, with the practical solution being to work with the stakeholders to design an appropriate offset measure (SEB) for any small residual disturbance of <i>E.odorata</i> in the northern reaches of the pit.</p>	Refer to response 3.
14	<p>Follow-up flora surveys and habitat studies should be conducted over the coming winter and spring, followed by a commitment to longitudinal studies using a standardised methodology agreed with other interested parties such as DEH, PIRSA and local Landcare groups.</p> <p>Accepted in principle with the practical solution being to undertake a spring 2007 survey and once operations commenced an annual survey of vegetation transects will be undertaken together with surveys of revegetated areas. Hillgrove will have an environmental department that will implement and monitor a series of programs, mitigations and offsets and, as always, Hillgrove will endeavour to include all parties.</p>	Refer to response 4.

Table 8.3 K/CCCC recommendations and Hillgrove responses (cont'd)

K/CCCC Recommendations and Hillgrove Responses		MLP Section
Fauna (cont'd)		
15	Offset programs in relation to the areas of <i>L. effusa</i> predominantly to the south of the pit, should be applied to achieve the greatest environmental benefit possible. Accepted.	Refer to response 6.
16	Offset measures for unavoidable clearance of the habitats mentioned in this report, including the habitats of special significance and the lesser sites, should involve large, contiguous blocks. Accepted.	Refer to response 7.
17	Cooperation should be sought from surrounding landowners in regard to offsets generally, as many of these landowners have undertaken, or are intending to undertake, revegetation activities. Accepted.	Refer to response 8.
18	A site management plan should be developed that includes consideration of activities such as traffic movements and dust generating processes, with a view to minimising the impacts on fauna species. Accepted.	12.2.2; A risk-based environmental management plan (EMP) will be developed for the project. The EMP will be based on the in-principle commitments outlined in Chapter 9 of the MLP and be monitored and evaluated against key environmental performance standards to ensure environmental compliance. Individual plans for water management; air quality; noise and vibration; and traffic management will be developed. 9.14.2; The traffic management plan will be developed in accordance with appropriate authorities such as Transport SA with a focus on preserving amenity and the environment (e.g., impacts of mine traffic on the local community amenity and natural environment). These impacts will be minimised by addressing noise and vibration, dust, splash and spray, and monitoring in the plan.

Table 8.3 K/CCCC recommendations and Hillgrove responses (cont'd)

K/CCCC Recommendations and Hillgrove Responses		MLP Section
Fauna (cont'd)		
19	<p>The location of some of the proposed sites for processing facilities, tailings settlement and waste rock dump for example, should be undertaken to minimise impacts on more scattered remnants such as the patches of <i>E. odorata</i> in the northwest corner of the project site and the species of fauna they host.</p> <p>Accepted.</p>	<p>Refer to responses 2 and 9. Processing facilities located to the south of the main pit.</p>
Non-Indigenous Heritage		
20	<p>All parties should acknowledge that it is important to protect significant items of mining heritage, both on-site and across the broader community. A statement to this effect should be drafted.</p> <p>Accepted.</p>	<p>9.12.2; Measures to avoid, minimise and manage impacts to these non-Indigenous heritage structures will be undertaken within Hillgrove's cultural heritage management plan.</p>
21	<p>The conservation of the major heritage items on site (such as the Paringa chimney) should be encouraged.</p> <p>Accepted in principal with the practical solution being the development of a region-wide mining heritage conservation plan through the K/CCCC. It is envisaged that the elements of any plan to include photographic records, library of artefacts, heritage trail and salvage of materials. Hillgrove will actively support this plan through the K/CCCC.</p>	<p>Refer to response 20.</p>

Table 8.3 K/CCCC recommendations and Hillgrove responses (cont'd)

K/CCCC Recommendations and Hillgrove Responses		MLP Section
Non-Indigenous Heritage (cont'd)		
22	<p>The development of an inventory of non-Indigenous heritage items, including key information such as condition, should be undertaken as a key first step to conservation. Heritage SA should be involved in the production of this baseline documentation.</p> <p>Accepted in principal with the practical solution being the development of a region-wide mining heritage conservation plan as above.</p>	9.12.2; Non-Indigenous site inventory will be established to identify and monitor site preservation and integrity. These assessments will be undertaken quarterly during the first year of operation, and then on an annual basis. These reports will be made available to the local community.
23	<p>The scope of work in preparing an inventory should extend to include objects, artefacts and structures on the site and across the wider community.</p> <p>Accepted in principal with the practical solution of this forming part of the conservation plan to be managed by the K/CCCC.</p>	Refer to response 22.
24	<p>Urgent assessment of the condition of some of the significant remnants (including the Paringa chimney) should be undertaken.</p> <p>Accepted.</p>	Refer to response 20.
25	<p>Where items must be disturbed, other more radical methods such as moving the item or rebuilding it from authentic materials should be considered.</p> <p>Accepted in principal with the practical solution being that it would form part of the mining heritage conservation plan managed by the K/CCCC.</p>	<p>9.12.3; The only structure to be directly impacted by proposed mining operations is the Paringa Homestead.</p> <p>9.12.2; As the Paringa Homestead has a low degree of heritage value, no preservation/ relocation of this structure is proposed, rather, Hillgrove will make available all raw building materials from to the local communities for use in historical restorations.</p>
26	<p>In the development of any future mining operations, Hillgrove Resources should avoid where possible, direct impact on areas containing significant items of mining heritage.</p> <p>Accepted.</p>	Any future development would be subject to an additional assessment process.

Table 8.3 K/CCCC recommendations and Hillgrove responses (cont'd)

K/CCCC Recommendations and Hillgrove Responses		MLP Section
Indigenous Heritage		
27	The importance of identifying the appropriate Indigenous people to speak for the land is recognised. Accepted.	5.12.2; Identifies the MLA area lying within the traditional territory of the Peramangk people. Peramangk representatives were consulted by the Indigenous archaeology and cultural heritage survey conducted by P. Fitzpatrick (Appendix 8).
28	The Peramangk people have been identified by the consultant as the traditional owners for the area in which the old Kanmantoo mine site is located. Accepted.	Refer to response 27.
29	Contact details of the traditional owners should be kept and regularly updated. Accepted.	Noted; to be included in the cultural heritage management plan (12.2.2).

Table 8.3 K/CCCC recommendations and Hillgrove responses (cont'd)

K/CCCC Recommendations and Hillgrove Responses		MLP Section
Indigenous Heritage (cont'd)		
30	<p>Particular attention should be paid to the Southern Creek Flat area as a possible previous Aboriginal burial site.</p> <p>Accepted.</p>	<p>9.11.2; Hillgrove’s cultural heritage management plan will address the potential for discovery of indigenous sites within these creek flats. Specific components to be incorporated in this plan include:</p> <ul style="list-style-type: none"> • Incorporating Indigenous site and object recognition training in the site inductions, ensuring employees and contractors are aware of their obligations under the <i>Aboriginal Heritage Act 1988</i>, especially with respect to the discovery of burial sites or objects. • Clearance/disturbance forms will be required for any ground disturbance within the MLA area. This will enable any future proposed disturbance of the southern and or southeastern creek flat to be monitored by Peramangk representatives or trained Hillgrove staff members. • The boundaries of these creek flats will be reproduced on all project base maps. This will allow the sensitivity associated with this zone to be identified during all site works, therefore reducing the likelihood of damage to any undiscovered sites. • A specific protocol will also be followed in the event a suspected Indigenous sites, object or burial is discovered, that will fulfil requirements under the <i>Aboriginal Heritage Act 1988</i>.
31	<p>A dedicated section of any future site management plan should be included that clearly identifies the protocols that must be followed if human remains were ever uncovered anywhere on the site.</p> <p>Accepted.</p>	<p>Refer to response 30.</p> <p>9.11.2; A specific protocol that will fulfil requirements under the <i>Aboriginal Heritage Act 1988</i> will be followed in the event a suspected Indigenous sites, object or burial is discovered.</p>
32	<p>These protocols should also be included in site induction programs and general training manuals for field staff on site.</p> <p>Accepted.</p>	<p>Refer to response 30.</p>

Table 8.3 K/CCCC recommendations and Hillgrove responses (cont'd)

K/CCCC Recommendations and Hillgrove Responses		MLP Section
Noise		
33-34	<p>Restricting noise at source to acceptable levels (as defined by strict standards) through measures such as choosing plant and equipment that is less noisy.</p> <p>Using noise suppression technology.</p> <p>All accepted.</p>	<p>9.6.2; Equipment will be fitted with 'white noise' reversing tone alarms (e.g., BBS-Tek Back Alarms), if necessary. All equipment will be serviced regularly to ensure noise levels do not exceed prescribed levels, standard noise abatement devices (e.g., mufflers) will be fitted to machinery and vehicles, and physical barriers will be installed as noise blocks between the source of noise and sensitive residential receptors if necessary.</p>
35-37	<p>Managing noise to restrict carriage (as defined by strict standards) through measures such as:</p> <ul style="list-style-type: none"> • Building noise barriers between noise sources and residential locations. • Locating plant and equipment with consideration to reducing the potential for noise emissions. • Restricting certain activities to daylight hours. <p>Accepted.</p>	<p>Refer to response 33.</p> <p>Plant equipment and blasting operations will be placed to ensure developments are located in a way that minimises impacts caused by noise.</p> <p>Blasting will generally occur around midday. No blasting will occur outside daylight hours.</p>
38	<p>A clear distinction should be made between measures to be applied during construction and after commissioning.</p> <p>Accepted.</p>	<p>9.6.5; Monitoring of noise levels at potentially affected residences and/or other sensitive receptors quarterly during construction and; monitoring of operational noise levels at potentially affected residences and/or other sensitive receptors annually, and when triggered by complaint.</p> <p>9.6.2; Hillgrove will conduct noise and vibration monitoring at selected sensitive noise receptors during the early stages of construction and operation of the project to validate the predictions of noise and vibration modelling. Should results contradict the predicted noise and vibration levels (reported in Appendices 15 and 16), Hillgrove will consider additional management and mitigation measures.</p>

Table 8.3 K/CCCC recommendations and Hillgrove responses (cont'd)

K/CCCC Recommendations and Hillgrove Responses		MLP Section
Noise (cont'd)		
39	Special consideration should be given to using new 'white noise' technology for reversing warnings on mobile plant. Accepted.	Refer to response 33.
40	Particular attention should be paid to ensuring that noise and vibration levels associated with blasting meet Australian standards. Additional information for the community, more specifically identifying these standards, should be provided. Monitoring of noise and vibration levels, and regular reporting to the community, should be a feature of the mine and operations management plan. Accepted.	9.6.3; Ground vibration and airblast noise due to blasting operations will be within limits set by Australian Standard AS2187.2 for sensitive sites. Monitoring of noise and vibration will be done by complainant; these results will be reported to the complainant and PIRSA. In addition local residents will be kept informed about the blasting program, including regular advising of blasting times and any changes to blasting times. A suitably qualified person will design each blast, with initial blasts being conservatively designed to ensure minimal disturbance from blasting.
41	A special recognition of 'nuisance noise' should be included in the mine and operations management plan, with potential sources identified and specific mention of how these will be managed. Accepted.	9.6.5; Environmental objectives for noise and vibration, the assessment criteria and a summary of the control measures. 9.6.3; Monitoring of blasting impacts by complaint will occur. The results of monitoring will be reported to both the complainant and PIRSA. If necessary, additional mitigation measures will be introduced.
42	A community complaints process should be established with performance targets agreed with the community. A link should be made to the role of the Community Consultative Committee, through a standing item that includes the regular reporting of incidents. Accepted.	10.2, Table 10.1; a complaints register will be established. 10.1.3; Hillgrove is committed to establishing a complaints register to contain records of relevant complaints and actions/responses taken to show no reasonable complaint is unaddressed. Hillgrove aims to resolve complaints received from stakeholders as soon as practicable. The nature of the complaint will determine the timeframe and actions taken.

Table 8.3 K/CCCC recommendations and Hillgrove responses (cont'd)

K/CCCC Recommendations and Hillgrove Responses		MLP Section
Processing		
43	<p>It is noted that ore processing (like geology and mining) is a fundamental consideration of the project. Each of the presentations related to issues such as noise, water or heritage for example, will influence the design, function and management of these core elements.</p> <p>Accepted.</p>	Not applicable.
44	<p>Environmental and safety recommendations identified in dedicated presentations (e.g., noise, water etc) should be reflected in the design and function of the ore processing facilities. Appropriate standards should be identified and met.</p> <p>Accepted.</p>	Noted, this will be reflected in the design and operating procedures for the process plant.
45	<p>A special effort should be made to ensure that the community understands the measures that are used to decide between various alternatives in the project design, function and management of key facilities. For example, a clear explanation should be presented related to how costs and benefits are included in infrastructure decisions, including costs and benefits that accrue (or may accrue) to the community.</p> <p>Accepted in principle, practical solution being a presentation to the K/CCCC when required.</p>	7.0; Project alternatives are presented in this section. Additional presentations will be made by Hillgrove on these issues if the community require further information.
46	<p>Public safety should be a priority for the project and measures taken in this regard such as controlling access to site and taking appropriate responsibility for off-site functions (e.g., transport).</p> <p>Accepted.</p>	<p>11.6.2; An abandonment bund that cannot be crossed by vehicles will be constructed of competent rock to prevent inadvertent public access.</p> <p>13.4.1; The site had been fenced to prevent public access, particularly from Éclair Mine Road. Standard industry practice is to construct an earth bund around the perimeter of the pit to prevent accidental vehicle access.</p>

Table 8.3 K/CCCC recommendations and Hillgrove responses (cont'd)

K/CCCC Recommendations and Hillgrove Responses		MLP Section
Visual		
47-51	<p>The recommendations of the visual impact assessment should be accepted. These include:</p> <ul style="list-style-type: none"> • Landscaping of the proposed integrated waste facility to mimic the natural undulating landscape. Accepted. • Extensive planting of appropriate vegetation to screen aspects of the site. Accepted. • The inclusion of valleys and gullies as refuges for vegetation and fauna habitat towards the lower levels of the integrated waste facility. Accepted in principle with practical solution of ensuring that any sculpting of the integrated waste landform does not affect its stability. • Avoidance of light spillage through careful design and management of lighting where night operations were contemplated. Accepted. • The inclusion of a colour scheme in building specifications that blends with the natural background colouring. Accepted. 	<p>9.13.2; Hillgrove is committed to undertaking:</p> <ul style="list-style-type: none"> • Superficial contouring of the integrated waste landform base to provide valleys and gullies as refuges for vegetation and fauna. • Native trees and shrubs will be planted around the project boundaries to visually close out any sensitive vantage points. • Restrict omni-directional exterior lighting where possible. • Preferential use of vertical beams, shields and spotlights will be used to minimise the spill of stray light. <p>Natural colour schemes will be incorporated during the construction phases to reduce the contrast between the built form and the surrounding landscape.</p>
52	<p>Whilst it was understood that the viewpoints for purposes of the study were located at publicly accessible sites, the amenity of private landowners should also be seen as important and taken into account in the design of various landscapes.</p> <p>Accepted.</p>	<p>9.13.3; Details the assessment technique used to assess likely visual impacts derived from project development. This quantitative assessment utilised four viewpoints within the local and sub-regional area, as typical of worst-case representations of the development in the landscape.</p>

Table 8.3 K/CCCC recommendations and Hillgrove responses (cont'd)

K/CCCC Recommendations and Hillgrove Responses		MLP Section
Visual (cont'd)		
53	<p>The opportunity to improve the visual impact of the existing waste rock dump as seen from the freeway should be a priority in the landscape planning.</p> <p>Accepted.</p>	<p>6.7; The new waste rock stockpile will be developed as a lift and an extension to the existing waste dump developed during the last mining phase.</p> <p>9.13.2; Specific measures to minimise the visual impact of the new combined integrated waste landform facility include:</p> <ul style="list-style-type: none"> • Contouring the base and top of the integrated waste landform to represent a more natural weathered profile. • Undertaking extensive tree and shrub planting along the base of the structure and along the benches. • Planting trees and shrubs along the northern and western edges of the MLA area to integrate the integrated waste landform into the surrounding landscape.
54	<p>The appeal of rolling grasslands / pastures as well as native vegetation should be considered in possible landscape features through consultation with the local community.</p> <p>Accepted.</p>	<p>11.3; The closure consultation process aims to keep stakeholders informed by developing and agreeing on final closure objectives and criteria, and on a process for the handover and relinquishment of the leases following closure.</p>
55-57	<p>The recommendations of the social and economic impact assessment should be accepted. These included:</p> <ul style="list-style-type: none"> • Holding supplier briefings with local suppliers. • Various training and employment initiatives. • Engaging in discussions with various community service providers including emergency services, police, schools and hospitals to assist in the future allocation of resources. <p>Accepted.</p>	<p>9.10.3; Hillgrove will hold supplier briefings so that local businesses can diversify to accommodate the needs of the mine. Hillgrove will also discuss training and skill requirements with local registered training organizations and will liaise with the Hills Murray Local Service Area police regarding where the project workforce resides so that additional resources can be allocated to towns within the area if necessary.</p>

Table 8.3 K/CCCC recommendations and Hillgrove responses (cont'd)

K/CCCC Recommendations and Hillgrove Responses		MLP Section
Visual (cont'd)		
58	<p>Whilst the difficulties related to determining economic costs and benefits are acknowledged, some further assessment in this area should be conducted to assist forward planning in aspects such as local business participation, jobs growth, schools and other infrastructure provision.</p> <p>Accepted.</p>	<p>8.4; In response to a community request, an economic evaluation of the project to support the Social and Economic Impact Assessment has been undertaken.</p> <p>9.10.4; Refer to response 55-57.</p> <p>In addition, the majority of the workforce will be sourced from Adelaide and other regional centres within the state. It is estimated that approximately 20% will come from the local and peripheral communities, specifically Mount Barker and Murray Bridge.</p>
59	<p>Where possible, further information related to the potential impact of the proposed mine redevelopment on property prices in the area should be provided for the community. Particular attention should be paid to a differentiation between the township properties and rural holdings around the existing mine site.</p> <p>Accepted, note additional detail will be provided in the MLP.</p>	<p>9.10.4; It is considered that impacts on rural property prices will be negligible as the project is being developed on an existing mine site. In addition, impacts to amenity will be minimised through implementation of management and mitigation measures</p> <p>9.10.3; A set of environmental objectives for the construction, operation, rehabilitation and closure of the project as part of its MLP (this document), accompanied by measurable criteria, will be used by Hillgrove and others (such as external environmental auditors) to assess progress and/or compliance with each objective.</p>
60	<p>A conservative approach to blasting in the early stages should be taken, while the model is confirmed and data is produced to confidently demonstrate on-going compliance.</p> <p>Accepted.</p>	<p>6.5.5; Hole diameters will vary from 89 to 127 mm, with up to 500 to 600 holes fired in each shot. Blasting will generally be undertaken at lunchtime. Blast holes will be backfilled with stemming material to contain the explosion on initiation and hence reduce noise, dust and fly rock. Surface and downhole delays will be used to minimise ground vibration.</p> <p>Each blast will be designed by a suitably qualified person, with initial blasts being conservatively designed to ensure minimal disturbance from blasting.</p> <p>Non-electric (Nonel) signal tube will be used for downhole and surface tie-ins to improve stemming performance and reduce noise and air blast.</p>
61	<p>'Fine tuning' of blasting processes should be carried out in the early stages of mining, to ensure that Australian Standards in respect of noise and vibration, are met. The CCC understands that this is possible through adjustment of depth and diameter of the blast hole.</p> <p>Accepted.</p>	<p>Refer to response 60.</p> <p>In addition; 9.6.2; Ground vibration and airblast noise due to blasting operations will meet Australian Standard AS2187.2 (SA, 2006) (cited in Appendices 15 and 16) for sensitive sites.</p>

Table 8.3 K/CCCC recommendations and Hillgrove responses (cont'd)

K/CCCC Recommendations and Hillgrove Responses		MLP Section
Visual (cont'd)		
62-63	<p>An appropriate monitoring regime for noise and vibration should be established that has two parts:</p> <p>An on-going, longitudinal data collection regime to demonstrate that the mining operation is complying with the noise and vibration standards.</p> <p>A reactive and responsive monitoring program for noise and vibration, as part of a meaningful response to complaints.</p> <p>All accepted.</p>	<p>9.6.5; A program will be established to monitor noise levels at nearby residences and other sensitive receptors to confirm the noise modelling results and ensure noise mitigation measures are effective. The program will be established in consultation with the EPA. Monitoring will be conducted annually or when triggered by complaint.</p> <p>9.6.2; Monitoring of blasting impacts will be done by complaint. The results of monitoring will be reported to both the complainant and to PIRSA. If necessary, additional mitigation measures will be introduced.</p>
64	<p>A complaints process including, but not restricted to, noise and vibration should be established as part of a set of community procedures agreed with the CCC before mining commences.</p> <p>Accepted.</p>	Refer to response 42.
65	<p>Routine blasting times should be scheduled when there is likely to be least impact on the wider community. Any non-routine blasting should be publicly notified using an agreed process and timeline. A notification process should be part of a set of community procedures agreed with the CCC before mining commences.</p> <p>Accepted.</p>	<p>9.6.2; Blasting will generally occur around midday, when it is likely that no ground-based or low-level atmospheric temperature inversions are present. Blasting will occur 365 days of the year and will be coordinated as to not coincide with the passing passenger trains. No blasting will occur outside daylight hours.</p> <p>In addition, informing local residence of the nature of the blasting impacts and the blasting program, including regular advertising of blasting times and any changes to blasting times will be undertaken.</p>

Table 8.3 K/CCCC recommendations and Hillgrove responses (cont'd)

K/CCCC Recommendations and Hillgrove Responses		MLP Section
Air Quality, Noise and Greenhouse Gas		
66-72	<p>The recommendations made in the various air studies should be accepted.</p> <p>Accepted.</p> <p>These include:</p> <ul style="list-style-type: none"> Internal haul roads should be subject to dust control measures such as watering. <p>Accepted.</p> <ul style="list-style-type: none"> Activities such as blasting should be scheduled for times during the day when dispersion conditions are at their best. <p>Accepted.</p> <ul style="list-style-type: none"> Buffers should be maintained between the mining operation and the local residents as defined in the EPA draft guidelines for separation distances. <p>Accepted.</p> <ul style="list-style-type: none"> Odororous sources should be enclosed where possible. <p>Accepted in principle, but must meet OHS requirements.</p> <ul style="list-style-type: none"> Air emissions should be extracted through a stack at the processing. <p>Accepted in principle, with a practical solution that collector systems will be put in place to ensure that all EPA guidelines are met.</p> <p>The existing buffer between the mining operations and the local residents should be maintained.</p> <p>Accepted.</p> <ul style="list-style-type: none"> The proposed mining operation should investigate the potential for trading in carbon credits if and when a market is established. <p>Accepted.</p>	<p>9.5.2. Water or dust suppressants will be used on trafficked roads (i.e., internal haul roads), exposed surfaces and similar to reduce emissions.</p> <p>Refer to response 36.</p> <p>9.5.2; Areas containing odours will be enclosed where required.</p> <p>Refer to response 36.</p> <p>9.7.2; Trading in carbon credits upon the implementation of State, Territory and Commonwealth Government carbon trading schemes (proposed for introduction at the end of 2010 and 2014)</p>
73	<p>Environmental considerations should be a priority when dust suppression strategies are being developed for haul roads.</p> <p>Accepted.</p>	<p>9.5.2; Using water or dust suppressants on trafficked areas (i.e., internal haul roads), exposed surfaces and similar to reduce emissions.</p> <p>9.5.5; During construction a program will be established in consultation with the EPA to monitor dust emissions.</p>

Table 8.3 K/CCCC recommendations and Hillgrove responses (cont'd)

K/CCCC Recommendations and Hillgrove Responses		MLP Section
Air Quality, Noise and Greenhouse Gas (cont'd)		
74	<p>The approach of adopting the metropolitan area odour target of 2OU instead of 8OU is strongly supported by the CCC.</p> <p>Accepted in principal, but note that Hillgrove will be seeking further information from the EPA as to why they have assigned a compliance level 25% of what would normally be expected in this environment.</p>	<p>9.5.3; Results of tests indicate that odours emitted from the MLA area are no greater than 2 OU (odour units).</p> <p>9.5.3; 16 sensitive residential receptors identified around the Kanmantoo mine, the predicted odour level is 2 OU (i.e., the odour can be smelt by some people) for one receptor.</p> <p>9.5.3; The EPA OU objective (as cited in Table 9.16) or advisory limit of 2 OU is not exceeded at any sensitive residential receptors.</p>
75	<p>A complaints process should be established as part of a set of community procedures agreed with the CCC before mining commences. This would identify the various regulators responsible for particular standards and include an ongoing education / information program for new and existing residents.</p> <p>Accepted.</p>	<p>9.5.2; The need for additional management measures will be considered in response to complaints received, taking into account frequency of occurrence, intensity, duration, offensiveness and location.</p>
76	<p>The proactive initiative of Hillgrove Resources to include a greenhouse gas study as part of the DFS is acknowledged by the K/CCCC.</p> <p>Accepted.</p>	<p>Noted.</p>
Groundwater		
77	<p>Groundwater from pit dewatering and surface runoff from mining-affected areas should be used as process water supply in preference to other water supplies. The level of mine drainage water may be indicated by the flows dealt with during the last period of mining activity on this site.</p> <p>Accepted.</p>	<p>6.9.2; Opportunities to harvest surface water, capture pit ingress water and recycle process water on site have been maximised. Water ingress into the open pits and surface water runoff from the waste rock storage and other disturbed areas will be pumped to either the TSF return water storage or process sediment pond for use in processing. The northern sediment dam will also be constructed to collect runoff from the waste rock storage.</p>

Table 8.3 K/CCCC recommendations and Hillgrove responses (cont'd)

K/CCCC Recommendations and Hillgrove Responses		MLP Section
Groundwater (cont'd)		
78	<p>Groundwater from supply wells should only be used to sustainable levels with acceptable impacts. More work would be need to be done to establish what these sustainable use limits are.</p> <p>Accepted.</p>	<p>6.4.2; Hillgrove has entered into a Memorandum of Understanding with Mount Barker District Council to supply water for the project from the Laratinga Effluent Treatment Facility. This is Hillgrove's preferred water supply option and commercial negotiations with the Council are currently being completed. In addition water from processing will be captured and reused (see response 77). Groundwater levels will be monitored at wells adjacent to the MLA area to ensure the impacts of groundwater use for the project are acceptable.</p>
79	<p>Surface water runoff generated on-site in disturbed areas should be captured and re-used.</p> <p>Accepted.</p>	<p>Refer to response 77.</p>
80	<p>Off-site discharge of surface water unaffected by mining activities should be facilitated by establishing diversion drains. The direction of any such water should be carefully planned to avoid exacerbating existing or creating new erosion or flood impacts, especially in relation to the residents of Callington.</p> <p>Accepted.</p>	<p>9.3.2; All clean up-gradient runoff not required for the project will be diverted around the infrastructure and back into the existing drainage paths using channels and bunds, thereby minimising the potential of disturbance to downstream aquatic ecosystems.</p>
81	<p>Tailings should be thickened to maximise recycling of water.</p> <p>Accepted.</p>	<p>6.9.2 and 9.9.2; Tailings slurry will be thickened prior to discharge to recover as much of the water as possible for reuse as makeup water in the process plant.</p>
82	<p>Engineered, compacted clay or other suitable liner should be constructed under the tailings storage facility to avoid seepage.</p> <p>Accepted.</p>	<p>6.9.2 and 9.3.2; The TSF has been designed with an underdrainage system and compacted clay liner to capture seepage.</p>

Table 8.3 K/CCCC recommendations and Hillgrove responses (cont'd)

K/CCCC Recommendations and Hillgrove Responses		MLP Section
Groundwater (cont'd)		
83	Decant water and underdrainage from the tailings storage facility (TSF) should be harvested and reused. Accepted.	6.9.2; The decant pond will collect water from the TSF supernatant and from the TSF underdrainage system which will be reused at the processing plant during processing.
84	Groundwater and surface water monitoring should continue during mining to meet regulatory requirements and to refine the hydrogeological model. Accepted.	9.4.5; Ten monitoring wells have been installed in the MLA area and initial monitoring has commenced. Hillgrove will install two new monitoring wells to better define down-gradient groundwater quality, sampling of wells will be undertaken fortnightly for water levels on the mine site, monthly for general water quality, metals and major ions until levels stabilise, then quarterly there-after. Any extracted groundwater will be also be monitored. Surface water will be measured opportunistically after rainfall events. Surface water samples will be analysed for general water quality measures, metals and major ions. Surface water will be analysed for sediment quality annually.
85	Regulations and good practice that cover minimising the impacts from groundwater extraction on bores / wells on neighbouring properties must be adhered to and regular reporting on compliance should be provided for the community. The issue of potential draw down of the resource should be addressed by the establishment of baseline extraction rates for the wells/bores in the immediate vicinity. This should be done immediately to establish usage patterns over as long a time frame as possible. Accept in principle , with the practical solution of reviewing the hydrogeological model and targeting bores on adjoining properties.	9.4.2; Assessment of drawdown and seepage will be undertaken using the 'observational approach' adopted by the minerals industry to manage impacts. Hillgrove will monitor water levels and quality from samples taken from 19 groundwater wells surrounding the MLA area. The local council and local community including landholders will be informed of any information in relation to the hydrology of the region.
86	Continual monitoring of strategic wells should be maintained for the life of the mine as part of the routine water monitoring and management plan. Accepted.	Refer to response 84.

Table 8.3 K/CCCC recommendations and Hillgrove responses (cont'd)

K/CCCC Recommendations and Hillgrove Responses		MLP Section
Groundwater (cont'd)		
87	<p>Dedicated monitoring wells should be identified between nearby wells on neighbouring properties any point of extraction on the site.</p> <p>Accepted.</p>	9.4.5; Hillgrove will install two new monitoring wells to better define down-gradient groundwater quality (vertical and lateral).
88	<p>Clear benchmarks for supply and quality impacts should be established as a priority to enable the monitoring program to be meaningful, given that watertable conditions vary with seasons and other usage. The Bremer Barker Catchment Group has conducted a long term monitoring program of bores in this region. Reference to this information and other associated studies may be useful in relation to this issue.</p> <p>Accepted.</p>	9.4.4; Noted.
89	<p>Useful information in relation to the hydrogeology of the region that has been identified in the water studies should be made available to the community including local landowners and the local Council.</p> <p>Accepted.</p>	Refer to response 85.
90	<p>An indication of the magnitude of the expected water use during the mine operation, and the expected source of the water to be used, should be made available as soon as practical.</p> <p>Accepted. (around 500ML/yr).</p>	<p>6.9.2; Expected water use is between 30 and 100 kL per day at the peak of construction. During operations, make-up water requirements range from approximately 900 to 1,800 kL per day.</p> <p>6.9.2; Hillgrove has entered into a Memorandum of Understanding with Mount Barker District Council to supply water for the project from the Laratinga effluent treatment facility. If viable, this is Hillgrove's preferred water supply option and commercial negotiations with the Council are currently being completed.</p> <p>Opportunities to harvest surface water, capture pit ingress water and recycle process water on site have been maximised. Two dams will be constructed on the site for the purposes of storing recycled water for the project.</p>

Table 8.3 K/CCCC recommendations and Hillgrove responses (cont'd)

K/CCCC Recommendations and Hillgrove Responses	MLP Section
Traffic	
<p>91-94 A comparison of rail and road to meet the heavy transport needs of the proposed mine development, should be further investigated. A clear explanation as to why rail is not viable should be presented to the community before accepting the road option. Amongst the aspects of the rail option that should be discussed are:</p> <ul style="list-style-type: none"> • The issues surrounding the development of a rail siding at the mine site. • The potential for a conveyor loader to be built to service railcars to remove the need for double handling at the mine site. • The opportunity for the State Government to support an extension to the rail head at Port Adelaide. • An understanding of the fixed costs (e.g., fuel) and other costs / benefits (e.g., greenhouse gases) of rail and road. <p>All accepted in principal with the practical solution of re-considering the option down the track should the rail be extended from the rail head to Berth 29 where the concentrate would be shipped from.</p>	<p>7.2.4; Road transport was selected over rail transport due to the following factors:</p> <ul style="list-style-type: none"> • Although rail passes within 1 km of the MLA area, in order to load the concentrate to a rail car it would be necessary for Hillgrove to construct a rail siding. • The rail system currently terminates approximately 3 km from Port Adelaide Berth 29 (the berth from which the ship leaves) which would therefore require transfer to trucks from rail for the final 3 km of transport, effectively leading to triple handling of the concentrate. • Rail transport costs are significantly higher than road transport costs for the transport of concentrate from the mine to Port Adelaide. • Capital costs of transport by rail are higher than transport by road. <p>Hillgrove recognise that there may be some benefits of rail transportation over road such as lower greenhouse gas emissions and will re-evaluate this option should the rail track be extended the additional 3 km to Berth 29 at the Port of Adelaide.</p>
<p>95 Priorities in the selection of potential road routes and the management of traffic along those routes should emphasise public safety (with special emphasis on the safety of children and families) and general amenity (e.g., noise).</p> <p>Accepted.</p>	<p>7.2.4; Three alternative route options were considered for the transportation of concentrate from the mine site to Port Adelaide. A private access road presents the best option (and is Hillgrove's preferred option) as the others passed through residential areas in townships, which concerned the community due to potential amenity and safety impacts.</p>
<p>96 Serious consideration should be given to developing a new, dedicated route through private property to reach the Princess Highway and avoid the residential area of Kanmantoo particularly.</p> <p>Accepted.</p>	<p>See Response 95. This occurred and a new private access road is now Hillgrove's preferred option.</p>

Table 8.3 K/CCCC recommendations and Hillgrove responses (cont'd)

K/CCCC Recommendations and Hillgrove Responses		MLP Section
Traffic (cont'd)		
97	<p>Initiatives to ensure that amenity of the community is not compromised should be adopted. These include identifying appropriate restrictions on the use of exhaust brakes / engine brakes and clearly identifying standards that must be met in haulage contracts. However, strong policing of regulations under the law should be emphasised in any traffic strategy.</p> <p>Accepted.</p>	<p>9.14.2; The bypassing of Kanmantoo will significantly reduce the potential for impacts to the local community due to traffic associated with the project. Additional measures to be implemented prior to construction of the proposed private access road, upgrades to existing roads and construction of the mine commencing include:</p> <ul style="list-style-type: none"> • Provision of escort vehicles and appropriate signage for heavy haulage of construction and mining equipment to site by oversized vehicles. • Construction of temporary diversion roads for local traffic (if required). • Deployment of graders to maintain the condition of the unsealed roads that may be affected by the movement of construction and mining equipment. <p>As part of Hillgrove’s consultation program, road users will be informed of any changed road conditions prior to and during road upgrades (where required)</p> <p>9.14.2; The traffic management plan (to be developed in accordance with appropriate authorities such as Transport SA) will address road safety, amenity and environment and other aspects such as travel times.</p>
98	<p>A Traffic Management Plan (TMP) should be developed as a means of identifying good practice. The TMP should be included in the Mine Operations Plan to elevate its significance. However, the TMP should not be the sole mechanism to manage performance but rather used to support strong policing and enforcement of legal obligations.</p> <p>Accepted.</p>	<p>Refer to response 97.</p>
99	<p>The various noise standards for vehicle transport in the various areas (e.g., residential and rural living) should be published for the community in a simple guide with common examples of similar noise levels used as illustrations.</p> <p>Accepted.</p>	<p>9.5.4; The objective noise criteria for the project, provided by various EPA policies and the World Health Organisation (WHO) noise level recommendations.</p>

Table 8.3 K/CCCC recommendations and Hillgrove responses (cont'd)

K/CCCC Recommendations and Hillgrove Responses		MLP Section
Traffic (cont'd)		
100	<p>A complaints process should be established that allows timely and meaningful responses to community complaints. The complaints response should include access to a simple, do it yourself, noise monitoring regime.</p> <p>Accepted in principal with the practical solution of developing an acceptable model/regime via the K/CCCC.</p>	Refer to response 42.
101	<p>Appropriate consideration should be given when interpreting road standards for heavy vehicles, to the idiosyncrasies of the residential area of Kanmantoo such as the increased likelihood of parked cars on the roadside.</p> <p>Accepted.</p>	Refer to response 97.
102	<p>Given that circumstances like production rates may change over a 6 to 10 year period, a commitment should be made to a process to allow the community to be engaged and informed on issues like traffic, for the life of the mine.</p> <p>Accepted.</p>	9.14.5; Monitoring of traffic impacts will be a continual process and involve regular communication with the local community and prompt attention to issues raised. 8.1; Consultation has commenced with key interest groups and individuals and will continue during the remaining project planning process, the construction and operations phases, and mine closure.
103	<p>Any traffic plan should be consistent with the District Council of Mount Barker Strategic Plan for the region.</p> <p>Accepted.</p>	9.14.2 The traffic management plan will be developed in accordance with appropriate authorities such as Transport SA and will be in accordance to relevant plans and legislation.
104, 105	<p>Focus on safety strategies including additional controlled speed environments. Develop strategies to avoid traffic movements at key times, particularly road traffic at school bus pick up or other times of key family movements.</p> <p>Accepted.</p>	Refer to response 97.

Table 8.3 K/CCCC recommendations and Hillgrove responses (cont'd)

K/CCCC Recommendations and Hillgrove Responses		MLP Section
Traffic (cont'd)		
106	Provide training for workers and contractors on traffic matters. Ensure vehicle maintenance is to high safety standards. Accepted.	9.14.2; A traffic management plan will be developed in accordance with appropriate authorities such as Transport SA for the proposal of a haul route. Key aspects of this plan include road safety (e.g., speed, visibility, education of mine staff and contractors, vehicle maintenance and appropriate enforcement penalties for non-compliance).
107	Include adherence to the Traffic Management Plan as a condition of haulage contracts. Accepted.	9.14.2; Implementation of the plan will be assisted by incorporating the plan into the contracts of the concentrate transport companies.
108	Monitor performance against the Traffic Management Plan. Accepted.	9.14.5; Monitoring of traffic impacts will be a continual process and involve regular communication with the local community and prompt attention to issues raised.
109	Establish ongoing links to the community for the life of the mine. Accepted.	8.1; Emphasis on stakeholder consultation to foster and maintain good relationships through all phases of the project cycle including planning, construction, operations and closure.
110	Develop a clear and effective complaints process. Accepted.	Refer to response 42.
Integrated Waste Landform		
111	Adopting the integrated waste landform design, given that it is based on a well-established, proven design. Accepted.	6.7; Hillgrove have adopted the integrated waste landform design for the storage of processed waste rock.

Table 8.3 K/CCCC recommendations and Hillgrove responses (cont'd)

K/CCCC Recommendations and Hillgrove Responses		MLP Section
Integrated Waste Landform (cont'd)		
112	Carrying out construction monitoring by independent third parties to verify the implementation of the design through all phases of construction to closure. Accepted.	11.9; Annual construction monitoring in the form of a geotechnical and operational audit will be undertaken by an independent certified geotechnical engineer under standard Mining Lease Conditions. This report will be undertaken in conjunction with a Mining and Rehabilitation Compliance Report, an annual public document Hillgrove will submit to PIRSA.
113	The implementation of daily, routine inspections and annual engineering audits to verify the operation of the tailings storage facility in accordance with the design. Accepted.	See response 112 (annual engineering audits).
114	The continual monitoring of groundwater downstream of the facility to verify the performance of the design. (The results from any such monitoring works should be published both on-line and as permanent hard copy to selected recipients such as the K/CCCC, community environmental groups and government agencies). Accepted.	9.4.5; Groundwater monitoring will be conducted in the mine vicinity to detect seepage from the integrated waste landform (which incorporates the TSF), including wells KMB001 to KMB010. Results of the monitoring will be submitted to PIRSA on an annual basis in the form of a Mining and Rehabilitation Compliance Report. This report will be publicly available both online and in hard copy form from PIRSA.

Table 8.3 K/CCCC recommendations and Hillgrove responses (cont'd)

K/CCCC Recommendations and Hillgrove Responses		MLP Section
Integrated Waste Landform (cont'd)		
115	<p>The process of selection of vegetation cover for the rehabilitated slopes of the integrated waste landform should include consultation with stakeholders such as landowners, relevant local community members and groups. This should be done with a view to maximizing the environmental outcomes and ensuring that the integrated waste landform rehabilitation is consistent with other regional initiatives. Revegetation should consist of local native species planted in a manner designed to maximise biodiversity benefits whilst also achieving the other requirements of site rehabilitation. This process should be coordinated with the progressive rehabilitation of the site promised during the life of the mine, taking into account any SEB offset requirements imposed as part of the Mining Approvals process.</p> <p>Accepted.</p>	<p>11.7.4; Species selected for the revegetation of the rehabilitation areas (including the integrated waste landform) will be of local provenance and aggressive colonisers suited to a range of soil conditions, able to provide good cover and contribute to landscape function and are available in the quantities required to rehabilitate the MLA area. The species seed mix and planting densities for revegetation will be determined in consultation with relevant experts, the Kanmantoo-Callington Landcare Group and DWLBC.</p>
116	<p>Environmental and broader property management knowledge, technology and practices should be shared with local community members where appropriate. For example, where Hillgrove utilises technology such as HDPE for environmental purposes, a sharing of this knowledge and possible group purchasing arrangements should be explored. To facilitate this, part of the routine, on-going consultation with the community could include a sharing of this knowledge.</p> <p>Accepted.</p>	<p>9.10.4; Where possible Hillgrove will assist in community-driven development initiatives; this assistance may involve donations of employee's time, skills and knowledge.</p> <p>8.4.1; Establishing and maintaining good relationships between Hillgrove, the community (including directly affected landholders) and government through ongoing involvement in the K/CCCC and one-on-one stakeholder consultation.</p>

Table 8.3 K/CCCC recommendations and Hillgrove responses (cont'd)

K/CCCC Recommendations and Hillgrove Responses		MLP Section
Integrated Waste Landform (cont'd)		
117-118	<p>During the life of the mine, regular items should be reported to the community (via the CCC) including:</p> <p>Results of groundwater monitoring related to the performance of the integrated waste landform.</p> <p>Early notification of any extension to the mine life, especially where this may significantly increase the size or visual impact of the integrated waste landform. This is especially important in relation to any proposal to increase the height of the integrated waste landform where the increase may raise the level above the skyline when viewed from the south and the freeway.</p> <p>All accepted.</p>	<p>9.4.2; The local council and local community including landowners will be informed of any information in relation to hydrology of the region identified through water studies. Additionally, monitoring data will be publicly available within the annual Mining and Rehabilitation Compliance Report.</p> <p>8.1; Consultation has commenced with key interest groups and individuals and will continue during the remaining project planning process, the construction and operations phases, and mine closure.</p> <p>Any developments in the size of the deposit and potential extensions to the mine life would be made known within the K/CCCC at the earliest opportunity. It should be noted however that any expansion of project infrastructure will require a new phase of approvals which would include technical assessment and both informal and formal consultation periods.</p>
Mine Closure		
119	<p>Basing the Mine Closure and Rehabilitation Plan on best practice environmental management and continuing to apply these principles as the detailed mine closure plan evolved over the life of the mine.</p> <p>Accepted.</p>	<p>11.1; A key process to mine closure plan will be the progressive refinement and adaptation in light of project experience, further site information that becomes available during construction and operations and changes in regulations and stakeholder expectations, technology and knowledge and mine planning.</p>
120	<p>Committing to further work through the life of the mine to enable detailed designs to be developed.</p> <p>Accepted.</p>	<p>11.7.1; Progressive rehabilitation will be undertaken during operations to modify techniques through information gained from progressive rehabilitation. Works undertaken during operations will enable rehabilitation techniques to be trialed and refined prior to closure.</p>

Table 8.3 K/CCCC recommendations and Hillgrove responses (cont'd)

K/CCCC Recommendations and Hillgrove Responses		MLP Section
Mine Closure (cont'd)		
121	<p>Conducting landform design testing and evaluation to confirm the landform design and assist in materials selection.</p> <p>Accepted.</p>	<p>11.7; Closure objectives and criteria; trials/investigations concerning the capacity for revegetation of the TSF cover to be conducted. Strategies to include topsoil and subsoil analysis from recoverable materials, rock-armouring/topsoil/subsoil and waste materials cover trials. Progress of the trials to be reported annually, until final TSF rehabilitation treatments are proposed to PIRSA.</p>
122	<p>Refining cover design from the range of options in consultation with local community and government.</p> <p>Accepted.</p>	<p>11.7.2; Cover trials will be established to determine the most appropriate method for covering the integrated waste landform. These trials will involve physical testing of material properties in a laboratory and using this information to develop a cover design which initially can be computer modelled and then field tested.</p> <p>11.2; Hillgrove will ensure that stakeholders are included in the closure process, have their interests considered, and have the resources to participate meaningfully in the process.</p>
123	<p>Continuing to research final land use options including water storage and backfilling the main pit from satellite pits.</p> <p>Accepted.</p>	<p>11.1; The closure plan will be progressively refined and adapted in light of project experience, further site information that becomes available during construction and operation, changes to regulation, stakeholder expectations, technology, knowledge and mine planning.</p>
124	<p>Commencing collection of native seed from the mine site for use in revegetation programs and continuing research into propagation of <i>L. effusa</i> in particular.</p> <p>Accepted.</p>	<p>11.7.4; Project staff will work closely with contractors to ensure that sufficient seed is acquired and stored from the local province. Revegetation trials will focus on <i>L. effusa</i>, and will build on the results of the trials for this species currently in progress. Additionally refer to response 10.</p>
125	<p>Placing special emphasis on consultation with the local community and recognising the benefit of local knowledge in final land use design.</p> <p>Accepted.</p>	<p>11.2; Hillgrove will ensure that stakeholders are included in the closure process, have their interests considered, and have the resources to participate meaningfully in the process.</p>

Table 8.3 K/CCCC recommendations and Hillgrove responses (cont'd)

K/CCCC Recommendations and Hillgrove Responses		MLP Section
Mine Closure (cont'd)		
126	Comprehensive photographic records of the current site should be collected as a benchmark against which the improvements delivered by the Mine Closure and Rehabilitation Plan can be measured. Accepted.	9.8.4; Flora monitoring sites will be visually inspected and photographed to allow assessment of changes in abundance, composition or condition of vegetation communities through time, to base closure rehabilitation success against.
127	The principle of consulting with the community on potential future land uses after mine closure, particularly where they involve a change to existing land use that can be seen elsewhere in the district, should be strongly endorsed. Accepted.	11.3; The closure consultation process aims to keep stakeholders informed by developing and agreeing on final closure objectives and criteria, and on a process for the handover and relinquishment of the leases following closure. Additionally refer to response 125.
128	Responsive action should be taken to collect seed when and where it becomes available. This applies particularly to species such as <i>Lomandra effusa</i> which show wide variation in seed patterns as a result of environmental stress. Similarly plant propagation programs should be expedited to ensure appropriate stocks of specimens from the local gene pool. Accepted.	Refer to response 10.

9. Environmental and Social Impact Assessment

9.1 Framework

This chapter presents an impact assessment of each environmental and social aspect of the project (e.g., land use, surface water, socio-economic). For each aspect, the impact assessment is presented by first identifying and describing potential, credible, environmental and social impacts (negative and positive), the associated avoidance, mitigation or management measures are then described, followed by an assessment of the residual risk (assuming the effective implementation of the proposed control measures).

Following the impact assessment, Hillgrove's objectives in relation to each impact identified are stated; these represent the outcomes that Hillgrove is committed to. Detail is then provided for the monitoring of each aspect (e.g., land use, surface water, flora, fauna) and its assessment criteria to determine whether the environmental objective is being met.

The environmental and social objectives, assessment criteria and control measures reflect Hillgrove's commitment to meeting the project objectives within a site-specific context. Key design and site features that are reflected in project planning and design are listed in Table 9.1.

Table 9.1 Summary of key design and site features

Feature	Result
Brownfields site (i.e., the area has been previously mined and disturbed).	Project footprint can be largely located on previously disturbed land, with low consequent impact to local biodiversity conservation values.
Small mining lease application area (MLA area).	Project footprint is compact and environmental impacts are confined to a small area.
Location of existing road and rail line.	Has constrained the MLA area (see above).
Proximity to residential areas.	Has influenced siting of project components to minimise amenity impacts.
Zero discharge of process water (treated or otherwise).	Minimises downstream water quality impacts and any related adverse effects on environmental values.

The final section in this chapter (Section 9.15) is a preliminary hazard assessment which evaluates risks for the occurrence of natural hazards or accidents that may be associated with the project, rather than impacts associated with the normal operation of the project.

9.1.1 Impact Assessment

Identification of the potential impacts is based on knowledge of the existing environment, experience with similar operations elsewhere and the issues of concern raised by key stakeholders particularly those raised during meetings with the K/CCCC and government agencies (stakeholder concerns are also discussed in Chapter 8). Where relevant, impacts are described in terms of their significance at the local, regional, state or

national level. Initially, these impacts are considered without taking into consideration the measures that will be employed by Hillgrove during all stages of project development to address them.

Avoidance, mitigation and management measures are then described. These measures detail Hillgrove's commitment to environmental management for the Kanmantoo Copper Project. The measures described are technically and economically feasible within the context of the project's setting.

The final aspect of the impact assessment involves describing the level of residual risk associated with the various impacts (assuming the effective implementation of the proposed control measures). This is undertaken by examining the potential consequences (i.e., a measure of severity of environmental impact) and the likelihood¹ that those impacts will occur. The risks are qualitatively evaluated, whereby a number of categories are used to describe the consequence (severity) of each impact and the likelihood of that impact occurring. The descriptors used in the assessment (Table 9.2) are based on those given in PIRSA's MARP Guidelines Version 3.12 (PIRSA, 2006), with the following changes:

- Likelihood: 'Possible' (defined as 'may occur in some mines') replaces 'unlikely' (defined as 'not likely to occur during mine lifetime, but may occur in some mines'). 'Unlikely' (defined as 'may occur in some mines but not expected') replaces 'rare' (defined as 'may occur in some mines').
- Consequence: 'Moderate' replaces 'major'.

Table 9.2 Descriptors used to classify likelihood and consequence

Descriptor	Detail of Description
<i>Likelihood</i>	
Virtually certain	Will occur, or is of a continuous nature, or the likelihood is unknown
Likely	Likely to occur during mine lifetime
Possible	May occur in some mines
Unlikely	May occur in some mines but not expected
Virtually impossible	Has almost never occurred in similar mines but conceivably could
<i>Consequence</i>	
Negligible	Possible impacts but without noticeable consequence
Minor	Some limited consequence but no significant long-term changes, may be simply rehabilitated, not of significant concern to wider community
Moderate	Significant changes, may be rehabilitated with difficulty
Severe	Substantial and significant changes, will attract public concern, only partially able to be rehabilitated or uncertain if can be successfully rehabilitated
Disastrous	Extreme permanent changes to the environment (not able to be practically rehabilitated), major public outrage or the consequences are unknown

¹ Note that the assessment of 'likelihood' applies specifically to the resulting environmental impact. Often a final environmental impact results from a chain of events, each of which has an associated likelihood. These 'conditional likelihoods' are considered when determining the final likelihood of the environmental impact occurring.

The level of risk for each potential impact is then determined by combining consequences and likelihood using the risk matrix² shown in Table 9.3.

Table 9.3 Qualitative risk analysis matrix

		Likelihood				
		<i>Virtually impossible</i>	<i>Unlikely</i>	<i>Possible</i>	<i>Likely</i>	<i>Virtually certain</i>
Consequence	<i>Negligible</i>	Very low	Very low	Low	Low	Low
	<i>Minor</i>	Very low	Low	Low	Medium	Medium
	<i>Moderate</i>	Low	Low	Medium	Medium	High
	<i>Severe</i>	Medium	Medium	Medium	High	High
	<i>Disastrous</i>	Medium	Medium	High	High	High

The evaluation of residual risks takes into account some of the factors described above for potential impact identification, i.e., knowledge of the existing environment likely to be affected and experience at similar operations elsewhere, and also reflects the findings from specific investigations carried out in support of this MLP, plus professional judgement.

9.1.2 Environmental and Social Objectives

The environmental and social objectives that Hillgrove is committed to for the construction, operation, rehabilitation and closure of the project are presented for each environmental aspect. These objectives are based on the potential environmental impacts and residual risks identified for the project and have been given individual numeric identifiers. Each environmental and social objective is accompanied by measurable criteria that can be used by Hillgrove and others (such as external environmental auditors) to assess progress towards or compliance with the objective. Where possible, the assessment criteria are based on standards, guidelines or similar that allow numerical comparison. However, this is not always feasible hence, other criteria have been developed that relate to the implementation of specific measures that require a simple yes/no, use comparison with baseline or control site data, or use comparison with specific project features described in Chapter 6 of this document.

9.1.3 Monitoring

Following the residual risk assessment of impacts and the statement of environmental and social objectives, detail is provided on the monitoring program that will be implemented for each impact. The overall monitoring program for the project is summarised in Chapter 10.

² This matrix has been adapted from the matrix suggested in the MARP Guidelines version 3.12 to introduce additional risk categories so that the more important risks are more easily distinguished.

9.2 Land Uses

9.2.1 Potential Impacts

Potential, credible, project-related impacts to existing and potential land uses are described below. It should be noted that these do not take into consideration the proposed avoidance, mitigation and management measures that will be implemented by Hillgrove during all stages of project development (see Section 9.2.2), and that will result in the residual impacts discussed in Section 9.2.3.

Potential impacts on current and future land uses due to project development include:

- Contamination of land or water resources.
- Soil erosion.
- Decrease in available agricultural area.

These are discussed further below.

Land Use Impact Due to Contamination of Land or Water Resources

Soil contamination may occur during project activities from chemical or fuel spills, acid rock drainage, tailings and concentrate spills and dust emissions. Soil contamination may reduce pasture quality, inhibit revegetation and limit suitable future land uses.

Contaminated surface water and groundwater may restrict potential land uses, particularly for agriculture. The implications for surface water contamination are discussed in Sections 9.3 and 9.4 respectively.

Land Use Impact Due to Soil Erosion

Removal of vegetation within the MLA area may result in topsoil and subsoil erosion, with subsequent impacts on the future uses of affected land. Erosion is discussed further in Sections 9.3 and 9.5.

Decrease in Available Agricultural Area

The old Paringa pastoral station forms a large component of the MLA area (see Section 5.4). The amalgamation of the station into the MLA area has decreased the available pastoral land in the local region by approximately 248 ha. Additional reductions in agricultural area may result from the introduction of the Significant Environmental Benefit (SEB) offset areas. A proposed SEB offset area to compensate for project related native vegetation clearance is described in Section 9.8 and will involve securing additional land for long-term revegetation/conservation. Private pastoral land may be purchased, or Hillgrove may use existing properties purchased on the eastern site of Mine Road as revegetation sites. Any land utilised for the SEB offset will restrict future land use from typical agricultural pursuits.

9.2.2 Avoidance, Mitigation and Management Measures

Avoidance, mitigation and management strategies that will be used to minimise the impacts of construction and operations on the land uses are outlined below.

Land Use Impact Due to Contamination of Land or Water Resources

To limit soil contamination and any potential impacts on present or future land use, the following measures will be implemented on site (see Section 6.14):

- Using appropriate transport, storage and handling methods for fuels, lubricants and other chemicals.
- Using spill response procedures when required.
- Ensuring construction material brought to site is clean (i.e., free of weeds, hydrocarbons, metals).
- Ensuring site personnel have a high level of operator training and diligence.
- Assessing soils prior to mine closure for contamination and undertaking appropriate remediation measures where necessary.
- Ensuring adequate acid rock drainage management (further discussed in Section 9.3.2).

The measures outlined above will also reduce the risk of surface water or groundwater contamination; other measures to mitigate this impact are outlined in Sections 9.3.2 and 9.4.2 respectively.

Soil Erosion

Soil erosion will be minimised by restricting vegetation clearing to the project footprint, undertaking progressive rehabilitation, utilising erosion controls (e.g., drains, brush matting) where appropriate and controlling surface water runoff (see Section 9.3).

Decrease in Available Agricultural Area

Land that is purchased by Hillgrove and not required for project components or the SEB offset area will be leased for agricultural purposes.

9.2.3 Residual Impact Assessment

Table 9.4 provides a summary of the residual impacts associated with land use as a result of the expansion of the Kanmantoo mine. These residual impacts are discussed in detail below.

Table 9.4 Summary of land use impacts

ID	Impact	Likelihood	Consequence	Residual Risk/Benefit
I01	Land use impact due to contamination of land or water resources.	Unlikely	Minor/Moderate	Low
I02	Land use impact due to soil erosion.	Unlikely	Negligible	Very low
I03	Decrease in available agricultural area.	Virtually certain	Negligible	Low

Land Use Impact Due to Contamination of Land or Water Resources

The implementation of the control measures described in Section 9.2.2 will minimise the potential for significant soil contamination within the MLA area. Some minor contamination of soils, however, is likely to occur during operations and will require remediation.

Since no off-site soil contamination will occur and any onsite contamination will be remediated as part of the mine site rehabilitation, it is considered **unlikely** that adverse land use impacts will result from soil contamination. The consequence of soil contamination is considered to be **minor** as contamination should be localised and further remediation should restore functionality of the land, and the residual risk is therefore **low**.

Contamination of groundwater or surface water is considered unlikely (see Sections 9.3 and 9.4), therefore land use impacts due to contaminated waters are also **unlikely**. The consequence of land use impacts due to contamination is considered **moderate** as water impacts may be harder to contain and remediate. The residual risk is therefore **low**.

Land Use Impact Due to Soil Erosion

Minimising land clearance, use of soil management techniques, topsoil stripping, control of surface water and revegetation will minimise the extent of soil erosion. Impacts to land use due to soil erosion are considered to be **unlikely**. If impacts did occur, they would be localised and able to be remediated. Additionally as the end land use for areas to be cleared will not be agricultural, the consequence on the land use is therefore **negligible** and residual impact **very low**.

Decrease in Available Agricultural Area

A decrease in the area available for agriculture due to purchase of land for incorporation into the MLA area and for use in SEB offsets is **virtually certain**. The consequence of this is considered **negligible** since other agricultural land is available in the region and the area impacted is relatively small. The residual risk is therefore **low**.

The introduction of the SEB offset area can be considered a positive land use change due to its environmental benefits (see Section 9.8 for details).

9.2.4 Environmental and Social Objectives

The environmental and social objectives for land use, the assessment criteria and a summary of the control measures are listed in Table 9.5.

Table 9.5 Environmental and social objectives for land use

Impact Number	Objective	Assessment Criteria	Summary of Control Measures
I01, I02	No limitation to potential land uses (beyond mine footprint) due to contamination of land or water resources, or due to soil erosion.	Soil sample testing shows no increase in soil contamination levels. Contaminated surface water and acid rock drainage (ARD) associated with Hillgrove’s project is being successfully captured and treated on site. Monitoring of impacts to native vegetation shows soil stabilisation techniques and revegetation to be effective in reducing impact.	Implementation of waste management plan (including spill response procedures). Remediation of contaminated soil. Constructing sediment basins, bunds for surface water collection and treatment. Establishing weed management measures (see full control measures in I21). Selective placement of PAF waste materials. Ensuring areas to be disturbed are minimised and clearing complies with relevant requirements (see also other control measures for I15, I16, I17, I18). Ensuring staff and contractors have a high level of operator training.
I03	Minimal impact associated with purchase of agricultural properties.	Agricultural land not required for project is leased.	Lease agricultural land not required for project. Continued consultation with the local community to determine final land uses.

9.2.5 Monitoring

During or after significant rain, visual inspections will be conducted to assess:

- Visual evidence of erosion of stockpiles, slopes and drainage lines.
- Condition and effectiveness of drainage and sediment controls.
- Surface water monitoring (see Section 9.3.5).

If there are no significant rainfall events, inspection of drainage and sediment controls will be conducted quarterly.

9.3 Surface Water

9.3.1 Potential Impacts

Potential, credible, project-related surface water impacts are described below. It should be noted that these do not take into consideration the proposed avoidance, mitigation and management measures that will be implemented by Hillgrove during all stages of project development (see Section 9.3.2), and that will result in the residual impacts discussed in Section 9.3.3.

In terms of the protected environmental values for South Australian inland surface waters declared under the Environment Protection (Water Quality) Policy 2003 (EPA, 2003a)

(see Section 5.7.3), these potential impacts relate to the environmental value of 'maintenance of aquatic ecosystems', which generally requires the most stringent water quality of all protected environmental uses.

Adverse Effects on Aquatic Fauna due to Increased Sediment Loads in Watercourses

The proposed development has the potential to cause soil erosion due to increased flow velocities around the infrastructure footprint, resulting in delivery of increased sediment loads to downstream watercourses such as Dawesley Creek, Mount Barker Creek and the Bremer River. The integrated waste landform and the ROM pad have the potential to discharge sediment-laden water to the environment. Aquatic fauna and habitats could be potentially impacted due to:

- Changes in water quality (due to increased concentrations of total suspended solids and associated contaminants) and physical effects, e.g., blocking of gills or direct toxicity.
- Physical alteration of stream habitat (in-stream deposition).

Chemical Contamination of Watercourses

Miscellaneous Chemicals. Fuels, lubricants, explosives and process reagents will be stored and used on site and the potential exists for spillages to report to nearby creeks, thereby adversely affecting aquatic biota.

TSF Seepage. Contaminants may seep from the TSF and report to the already affected Dawesley and Mount Barker creeks (see Section 5.6.4), with associated adverse effects on aquatic fauna. If seepage is highly saline or acidic or contains elevated metal concentrations, impacts may occur on adjacent vegetation or downstream riparian vegetation along these watercourses.

Acid rock drainage (ARD). ARD (containing elevated concentrations of soluble metals) is produced when sulphide materials such as pyrite are exposed to atmospheric oxygen and water. Waste rock, tailings and ore produced by the operation have ARD-generating potential in the absence of appropriate control measures. The potential therefore exists for ARD to be produced from pyritic materials stored in the integrated waste landform or the ROM stockpile, and to report to Dawesley and Mount Barker creeks, with consequent effects on aquatic biota and riparian vegetation.

Altered Flow Regimes

The construction of major project infrastructure (such as the integrated waste landform) and the implementation of the surface water management plan (see Section 9.3.2 and Section 6.10.2), involves the capture and diversion of some runoff into alternative waterways or storages. Depending on the relative changes in the flow regimes of these waterways, riparian vegetation and aquatic fauna associated with these watercourses could be impacted.

9.3.2 Avoidance, Mitigation and Management Measures

Avoidance, mitigation and management strategies that will be used to minimise the impacts of construction and operation on the surface water resources are outlined below.

Adverse Effects on Aquatic Fauna and Habitats due to Increased Sediment Loads in Watercourses

As described in Section 6.10.2, the surface water management plan is based on the principle of diverting clean surface water runoff away from disturbed areas and intercepting turbid runoff from disturbed areas and directing it through sediment control structures prior to discharge to the downstream environment.

Clean up-gradient runoff will be diverted around the infrastructure and back into the existing drainage path using channels and bunds, thereby minimising the potential of disturbance to downstream aquatic ecosystems (Appendix 13). Any surface waters collected within the MLA area will be either treated and discharged (northern sediment basin) or reused in the mining operations (TSF return water storage and process sediment pond).

Integrated Waste Landform. Runoff from the integrated waste landform, consisting of the waste rock storage and TSF, is likely to generate sediment-laden stormwater. The integrated waste landform will be bunded around its full perimeter to contain this water and to separate it from clean runoff from the surrounding catchment. The drainage channels will direct sediment-laden runoff to either the TSF return water storage, or to the northern sediment basins located north of the TSF. The clean water will be diverted to a water storage facility, known as the Freshwater Dam (see Figure 6.7), which is designed to overflow via a diversion channel to reunite with the ephemeral Dawesley Creek tributary immediately upgradient of the railway culvert on the southern boundary of the MLA area (Appendix 12). The northern sediment basin is designed to remove sediment with overflow being discharged into the existing evaporation pond for disposal.

The quality of water in sediment basins will be routinely monitored (see Section 9.3.5). Water that is considered unsuitable for release to the environment, based on the potential for adverse impacts on downstream environmental values, will be recycled for use in the process plant. Sediment accumulated in sediment basins will be removed periodically and disposed of to the active waste rock dump site or the TSF.

ROM Pad. The ROM pad will be surrounded by bunding and small-scale sediment traps (Section 6.10.2). Overflow will be diverted into the process sediment pond located on the drainage line southeast of the main processing plant (as shown conceptually in Figure 6.7). The eastern end of the ROM pad will be raised to minimise surface water runoff flowing onto the ROM pad.

Roads. A series of interconnecting drains and culverts will allow runoff from roads and access tracks to be directed to a number of sediment traps for subsequent discharge into the pre-existing drainage paths.

Other Infrastructure. All of the infrastructure facilities, including the processing plant but excluding the water storage, will be located in low flow sheet runoff areas, and flood protection in the form of small bunds, pads or drains will be constructed to suit the individual site conditions. Where possible, roofed areas will be connected to rainwater tanks for use in garden beds and other similar purposes. Runoff from the processing plant areas, ROM pad, associated stockpiles, mine laydown areas and workshop areas will be captured for treatment and management near the source (see Section 6.10.1).

Adverse Effects on Aquatic Fauna and Habitats due to Chemical Contamination of Watercourses

Miscellaneous Chemicals. Miscellaneous chemicals will be purchased in small volumes and stored in accordance with Australian Standards i.e. within a bunded area and impervious surfaces.

TSF Seepage. As described in Section 6.8.2, the tailings slurry (containing at least 55% solids by weight) will be discharged sub-aerially from around the TSF perimeter via one or more active discharge points, which will be regularly moved to ensure even development of the tailings beach. The sloped beach will ensure that any surface water pond formed from the liberation of water from the deposited tailings is maintained around the central decant structure which has a gravity outfall to the TSF return water storage.

The TSF base and embankment will have a high degree of engineering design, with construction work supervised by a suitably qualified and experienced geotechnical engineer. The perimeter containment embankments of the TSF will comprise a starter embankment constructed with compacted clay (6 m thick) against the adjacent waste rock storage. Hillgrove will also undertake further studies as part of the detailed design phase on the permeability of the insitu material and if necessary on the fate of any seepage if it were to occur.

As described in Section 6.8.2, a key design aspect of the TSF is the TSF return water storage which has been designed to store all decant water and underdrainage for reuse in the process plant. Storage of decant water in a separate HDPE lined pond removes the majority of water from the TSF and subsequently the head required for seepage to occur.

The TSF has been designed with 750-mm-thick compacted clay liner that overlies a 1,000 mm layer of insitu clay, and an underdrainage system to capture seepage through the TSF floor. The capacity of the underdrainage system is in excess of the seepage rate through the tailing bed, therefore the compacted clay liner effectively has zero piezometric head.

In the unlikely event that fugitive seepage were to occur through the TSF base, this would be partially captured by the pit drawdown (see Section 9.4.3).

Further detail on the TSF design and operating procedures is provided in Section 6.8 and Appendix 12, Hillgrove will ensure the TSF is constructed and operated in accordance with this report.

ARD. Geochemical testwork undertaken to identify the risk of ARD from tailings and waste rock (see Section 6.7.1) indicates that, of 99 representative waste rock samples from the Main, Eastern and Emily Star zones, 60% of the samples were classified as either potentially acid forming (PAF), potential acid forming – lower capacity (PAF-LC), or uncertain expected to be PAF (UC(PAF)) (EGI, 2007).

To minimise exposure of PAF waste rock to water and oxygen, all PAF waste material will be encapsulated by non-acid forming (NAF) waste rock within the integrated waste landform (see Section 6.7.2). The encapsulation design incorporates a 2.5, 1.5 and 5 m layer of NAF material on the top, batters and base of the waste rock storage,

respectively. Current estimates are that of the 75.0 Mt of waste rock to be mined at least 23 Mt is NAF, the remaining waste rock (52.0 Mt) is still to be classified PAF or NAF (see Section 6.7.1). Based on these estimates around 30% of this remaining waste rock material needs to be NAF to ensure there is sufficient NAF material to encapsulate the PAF waste rock.

Therefore, further geochemical characterisation and modelling work, as described in Section 6.7.1 is required to refine the actual quantities of PAF and NAF material, optimise the waste placement scheduling and inform the detailed cover system design for the integrated waste landform.

Altered Flow Regimes

The project design has where possible diverted surface water flow away from project activities to limit impact on flow regimes. The construction of a diversion channel to direct flow from undisturbed areas on the west of the MLA area to join with the existing drainage lines on the southern boundary is an example of this.

9.3.3 Residual Impact Assessment

Table 9.6 summarises the residual impacts of the project on surface water, considering the likelihood and consequence of the predicted impacts after implementation of management and mitigation measures. These assessments are described in further detail below.

Table 9.6 Summary of impacts on surface water

ID	Impact (with respect to the environmental value 'maintenance of aquatic ecosystems')	Likelihood	Consequence	Residual Risk
I04	Adverse effects on aquatic fauna and habitats due to increased sediment loads.	Possible	Minor	Low
I05	Adverse effects on aquatic fauna due to chemical contamination of watercourses.	Unlikely	Minor	Low
I06	Adverse effects on aquatic fauna and riparian vegetation due to altered flow regime.	Unlikely	Negligible	Very low

Adverse Effects on Aquatic Fauna and Habitats due to Increased Sediment Loads in Watercourses

Sediment-laden runoff in the MLA area is predominately by gully discharge in defined drainage pathways. Management measures for this have been described in Section 9.3.2. It is possible that, even with management measures in place, some fugitive sediment will report to surface drainages given the nature of earth-moving activities during construction and operations. However, both the likelihood and extent to which this occurs will depend to a large degree on rainfall events during project development. If a conservative approach is adopted, the occurrence of adverse effects due to increased sediment loads on aquatic fauna and habitats is considered **possible**. As a result of Dawesley and Mount Barker creeks already being adversely modified due to Brukunga mine, Kanmantoo smelter and previous mining activities at the Kanmantoo

mine, the consequence is considered **minor**, as there would be no significant long-term changes. The residual impact is therefore **low**.

Adverse Effects on Aquatic Fauna and Habitats due to Chemical Contamination of Watercourses

Given the management and mitigation measures described in Section 9.3.2 for the integrated waste landform, ROM pad, water storage facilities, roads and infrastructure, combined with the fact that streams in the MLA area are ephemeral, it is **unlikely** that hydrocarbons or other chemicals such as process reagents will report to Dawesley Creek, Mount Barker Creek or the Bremer River. Provided adequate NAF material is available for PAF encapsulation, the formation of ARD and consequent impacts to local watercourses are also **unlikely**.

As described in Section 6.8.2 and Appendix 12, current seepage modelling (see Section 6.8.2) has indicated that it would take a minimum of 10 years for seepage to penetrate the 750-mm thick compacted clay liner once the final tailings height (and final hydraulic head) is reached. Therefore there is negligible (virtually zero) potential for seepage to occur and it will be **unlikely** that seepage will enter watercourses. Furthermore, any seepage that does occur through the TSF base will be partially captured by the groundwater drawdown cone that is created by the pit (see Section 9.4.3).

In addition, decant water and underdrainage from the TSF will drain to the TSF return water storage (which is double HDPE lined and fitted with leak detection (see Section 6.9.2)), and will be pumped back to the process plant for reuse.

Seepage from the waste rock storage will be mitigated by measures described in Section 9.3.2, which includes diverting clean water away from the structure and encapsulation of PAF material to minimise the potential for ARD generation.

As described in Section 5.7, the existing environment in Dawesley and Mount Barker creeks has been modified due to previous mining activities at the Brukunga mine, the old Kanmantoo copper smelter and the old Kanmantoo mine. In the event that further contamination of the streams in the MLA area did occur, the long-term cumulative consequences for aquatic fauna would be **minor**, particularly given that such contamination would probably be associated with high rainfall events when dilution would be greatest. The residual impact is therefore **low**.

Altered Flow Regime

Although flow diversions implemented for the project will alter flows downstream of the natural channel, the streams in the MLA area are ephemeral. In addition, any up-gradient runoff will be diverted around disturbed areas and back into the existing drainage paths, making the potential for disturbance to downstream aquatic ecosystems **unlikely**. The closest perennial watercourses are Dawesley and Mount Barker creeks, which are **unlikely** to be affected by altered flows in the MLA area.

The consequence of these altered flows on aquatic biota and riparian vegetation is likely to be **negligible** in view of the ephemeral nature of the flow, as well as the diversion of

clean upgradient water being diverted around disturbed areas. The risk due to altered flow regimes is therefore considered to be **very low**.

9.3.4 Environmental and Social Objectives

The environmental and social objectives for surface water, the assessment criteria and a summary of the control measures are listed in Table 9.7.

Table 9.7 Environmental and social objectives for surface water

ID	Objective	Assessment Criteria	Summary of Control Measures
I04, I05, I06	No long-term adverse effects on aquatic fauna and habitats due to the generation of fugitive sediment, chemical contamination, or altered flow regime.	Monitoring shows: - No project-specific changes in the health of remnant native riparian vegetation, where present, in Dawesley and Mount Barker creeks (as determined by vegetation survey). - Contaminants in bed sediments are less than twice the background concentrations in Dawesley and Mount Barker creeks (as determined by the monitoring program). - Concentrations of contaminants in Dawesley and Mount Barker creeks are consistent with background concentrations (as determined by the surface water quality monitoring).	Construction, and regular inspection, of surface water drainage/diversion system and sediment controls. Diversion of clean up-gradient runoff around infrastructure and back into the existing drainage path using channels and bunds. No off-site discharge of mine-contaminated water. Re-use or treatment of contaminated water. Integrated waste landform designed and constructed to avoid formation of ARD from waste rock (by encapsulating PAF material and implementing a cover on closure). Compacted clay liner on TSF floor and underdrainage system to collect seepage.

9.3.5 Monitoring

Discharge Monitoring

Wastewater will not be discharged to the downstream environment, except for surface water discharges from the sediment traps around the perimeter of the integrated waste landform during storm events or in extreme rainfall events (see below). These sediment trap discharges will be monitored monthly (or opportunistically following rain).

All other project-related water sources such as the TSF return water storage and process water tank will be designed and managed (by maintaining freeboard, flow monitoring and other methods) to ensure no discharges. Seepage through the tailings stack will be collected by the underdrainage system and report to the TSF return water storage. Collected seepage will be monitored monthly (or opportunistically). Tailings decant water will be recovered and returned to the process circuit, and will be monitored monthly.

Pit water will not be discharged but will be used directly for dust suppression, or reclaimed and used in the process plant. Quarterly monitoring will be conducted to determine whether ARD is occurring and, if so, to what extent. A discharge to surface waters would only occur as the result of a rainfall event so extreme that there is

insufficient capacity to retain water from the pit for use in the process plant. In this highly unlikely situation, the quality of this water and the receiving waters would be determined for variables such as turbidity and pH prior to discharge.

During discharge monitoring, field measurements of physico-chemical parameters will be collected using an appropriately calibrated field meter. All laboratory analyses will be conducted by a NATA-registered (or otherwise approved) laboratory.

While discharge monitoring should determine whether environmentally significant releases have occurred, effects on the ultimate receptors within the receiving environment can only be directly assessed by ambient surface water quality monitoring as described below.

Surface Water Quality Monitoring

Hillgrove will establish an ambient water quality monitoring program to assess the status of surface water quality for aquatic ecosystems that could potentially be affected by the project and to detect project-related changes over time. The monitoring program will consider the following key factors:

- Episodic nature of flows in the MLA area streams.
- Sampling frequency.
- Physico-chemical and biological indicators.
- Sampling site location and access.
- Procedural details, such as sampling methods, sample preservation, laboratory detection limits and the availability of appropriately experienced laboratories.

Water quality assessment procedures described in the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC/ARMCANZ, 2000) have been developed for perennial waters. These assume chronic exposure to contaminants under steady-state conditions. The monitoring approaches are therefore not likely to be suited to temporary streams which have, with variable water quality depending on the flood/drying stage of the hydrocycle (Smith et al. 2004). These streams also present difficulties in establishing water quality objectives based on reference conditions, since stream flow may occur so infrequently that percentile concentrations cannot be reliably estimated. Additionally, rainfall may result in stream flow at a potential impact site but not at the reference sites, or vice versa.

Event-based sampling of streams will be conducted following rainfall.

Surface Water Sampling Sites. Information on existing stream conditions (see Section 5.6) was provided by water sampling conducted by the EPA and DPI at the locations shown in Figure 5.15. Flow data for stream gauging stations located at some of these sites will be accessed from the DWLBC Surface Water Archive (DWLBC, 2004). Water quality monitoring will be conducted at a selection of these established sites, including sites upstream and downstream of the mine on Dawesley Creek, Mount Barker Creek and the Bremer River. These may include Dawesley Creek at Dawesley gauging station, the Bremer River at Hartley gauging station, site B050 located downstream of

the mine on Dawesley Creek, and a site on the Bremer River just above the confluence of Mount Barker Creek. Opportunistic sampling in the ephemeral creeks surrounding the MLA area will occur during high rainfall events. The final location of the monitoring sites may change due to site accessibility and suitability for achieving monitoring objectives.

Water Quality Indicators. Water quality indicators were selected based on parameters that could potentially be affected by mine activities or are significant to the receiving aquatic ecosystems, with emphasis on:

- Physical characteristics (e.g., TSS, turbidity and conductivity).
- Water chemistry (e.g., pH, sulphate, calcium, magnesium, trace metals, nutrients and dissolved organic carbon (which ameliorates metal-related toxicity)).
- Stream level.

Sediment. Chemical analysis of sediment complements water quality data. While water quality assessment provides information about the water column at the time of sampling, sediment acts as a sink for contaminants, providing an integrated picture of stream quality over time. An additional advantage of sediment monitoring in temporary streams is that sample collection can occur in the absence of surface waters.

Bed sediment samples will be sampled annually from stream water quality sampling sites. Sediment samples will be analysed for total metals and dilute acid extractable metals in the less than 2,000 µm fraction and for particle size distribution (PSD).

A summary of the ambient stream monitoring program is provided in Table 9.8.

Table 9.8 Summary of ambient stream monitoring program in the MLA area

Location	Frequency during operation	Parameters
<i>Water quality</i>		
Sites Kan01 to Kan04	Opportunistically after rainfall events	<ul style="list-style-type: none"> • pH, conductivity, turbidity, TSS. • Metals: Al, As, Cd, Cr, Cu, Fe, Mn, Hg, Ni, Pb, Zn (filtered and unfiltered). • Major ions: Ca, Mg, SO₄. • Alkalinity (selected samples). • DOC (selected samples). • Nutrients (selected samples). • Water level.
<i>Sediment quality</i>		
Sites Kan01 to Kan05	Annually	<ul style="list-style-type: none"> • Total and dilute acid extractable metals: Al, As, Cd, Cr, Cu, Fe, Mn, Hg, Ni, Pb, Zn (<2,000 µm). • Particle size distribution.

Biological Monitoring. There are inherent difficulties in the use of biological monitoring to assess the condition of systems where flows are brief, irregular and only occur after unpredictable rain has fallen. The biology and water quality of temporary systems are highly variable, hence sampling must be conducted at sufficient intensity and over large spatial scales to account for variation (Batley et al., 2003). Additionally, control sites may not be inundated at the same time as potential impact sites. Most of the recognised biological monitoring approaches remain largely untested in temporary waters (Smith et

al., 2004). The most widely used Australian biological monitoring approach, the Australian River Assessment System (AusRivAS), is designed for coarse regional scale classification of river health, rather than point source pollution impacts. Its use for monitoring of mining impacts on water quality in temporary streams warrants careful deliberation (Smith et al., 2004). Implementation of a biological monitoring program at Kanmantoo is therefore not currently proposed.

9.4 Groundwater

9.4.1 Potential Impacts

Potential, credible, project-related groundwater impacts are described below. It should be noted that these do not take into consideration the proposed avoidance, mitigation and management measures that will be implemented by Hillgrove during all stages of project development (see Section 9.4.2), and which will result in the residual impacts discussed in Section 9.4.3.

Potential project-related impacts with respect to groundwater include:

- Extraction of groundwater as part of the pit dewatering (and production wells if they are required—Hillgrove's preferred water source is treated effluent from Mount Barker District Council) affecting groundwater flows and availability for other users and/or reducing stream recharge (described in Section 5.7.2).
- Removal of groundwater from the root zone of surrounding vegetation.
- Contaminants in seepage from the tailings storage facility (TSF), waste rock storage and pit lake affecting the quality of groundwater resources.

The second issue relates to vegetation impacts and is therefore addressed in Section 9.8.

9.4.2 Avoidance, Mitigation and Management Measures

Safeguards and management strategies that will be used to minimise the impacts of project construction and operation on the groundwater regime are outlined below.

Reduced Groundwater Flows and Availability or Reduced Stream Recharge

Hillgrove does not propose to extract groundwater for use in the project. As outlined in Section 6.14.2, the preferred water source for 100% of make-up water requirements is Mount Barker District Council's Laratinga effluent treatment facility. However, should this water source not be available, or if its supply is interrupted, Hillgrove will use groundwater bores on the site to supplement the mine's water supply. This will involve:

- Obtaining (and complying with the conditions of) a water licence (or interim authorisation depending on the water allocation plan status) (see Section 4.1.2).
- Operating the bores at sustainable extraction rates.

To minimise potential impacts due to groundwater extraction for pit dewatering or use of groundwater bores, Hillgrove will:

- Undertake monitoring to establish the baseline water level in wells located on properties directly adjacent to the MLA area. Currently, 19 groundwater wells that have been installed by Hillgrove can be used for such monitoring.
- Replace or deepen existing wells if they are substantially affected (based on the establishment of sustainable levels) by dewatering activities, or provide alternative water sources for affected users.
- Only operate the bores until the normal supply of water is resumed.

The local Council and local community, including landowners, will be informed of any findings in relation to the hydrogeology of the region identified through water studies.

Deterioration in Groundwater Quality

Mitigation measures for TSF and waste rock storage (integrated waste landform) seepage are described in Section 9.3.2.

The contaminated water that is currently in the old pit will be removed, treated as required and reused in the process plant.

If contamination does occur, it will be detected early by the groundwater monitoring program and the necessary remedial measures will be put in place.

9.4.3 Residual Impact Assessment

Table 9.9 summarises the residual impacts of the project on groundwater, considering the likelihood and consequence of the predicted impacts after implementation of management and mitigation measures. These assessments are described in further detail below.

Table 9.9 Summary of impacts on groundwater

ID	Impact	Likelihood	Consequence	Residual Risk
I07	Reduced groundwater flows and availability for other users due to mine dewatering (and potentially groundwater extraction from bores).	Unlikely	Moderate	Low
I08	Reduced stream recharge from groundwater.	Unlikely	Minor	Low
I09	Deterioration in groundwater quality affecting suitability for water uses (domestic use and stock watering).	Unlikely	Severe	Medium

Reduced Groundwater Flows and Availability

To assess potential groundwater impacts of the proposed mining operations, analytical groundwater flow modelling was undertaken by Resource and Environmental Management (REM). This is reported in Appendix 4 and summarised below.

Modelling of groundwater drawdown has been undertaken on the conservative premise that three water supply wells (KMB005, KMB006 and KMB010) are operating (even though Hillgrove's base case is to use the treated effluent water rather than groundwater bores) and that pit dewatering is occurring, with the average drawdown being 0.06 m/day.

The modelling results are shown on Figure 9.1 and indicate:

- Drawdowns in excess of 10 m are mainly limited to within the MLA area, although they do extend to about 300 m beyond the southeastern project boundary.
- Drawdowns of up to 1 m (which is defined as the outer extent of significant drawdowns) in response to mine pit development, extend some 1,200 to 1,300 m beyond the eastern and southern project boundaries and around 600 to 800 m beyond the northern and western boundaries.

Figure 9.1 also displays the location of water wells, as defined by the state water well database, indicating that about 18 wells are located within the influence of the 1.0 m drawdown contour, with most of them occurring within the 1 to 4 m drawdown contour. A drawdown of this magnitude is unlikely to significantly affect the supply potential of individual wells, unless the wells are of limited depth or the pump is set at a relatively shallow depth below the watertable. It is important to note, however, that information on the state database is not entirely accurate and well sites may be non-existent, abandoned or in entirely different locations. Furthermore, as indicated above in Section 9.4.2, Hillgrove will replace or deepen existing wells or provide alternative water sources for affected users if users are substantially affected (based on the establishment of sustainable levels) by dewatering activities.

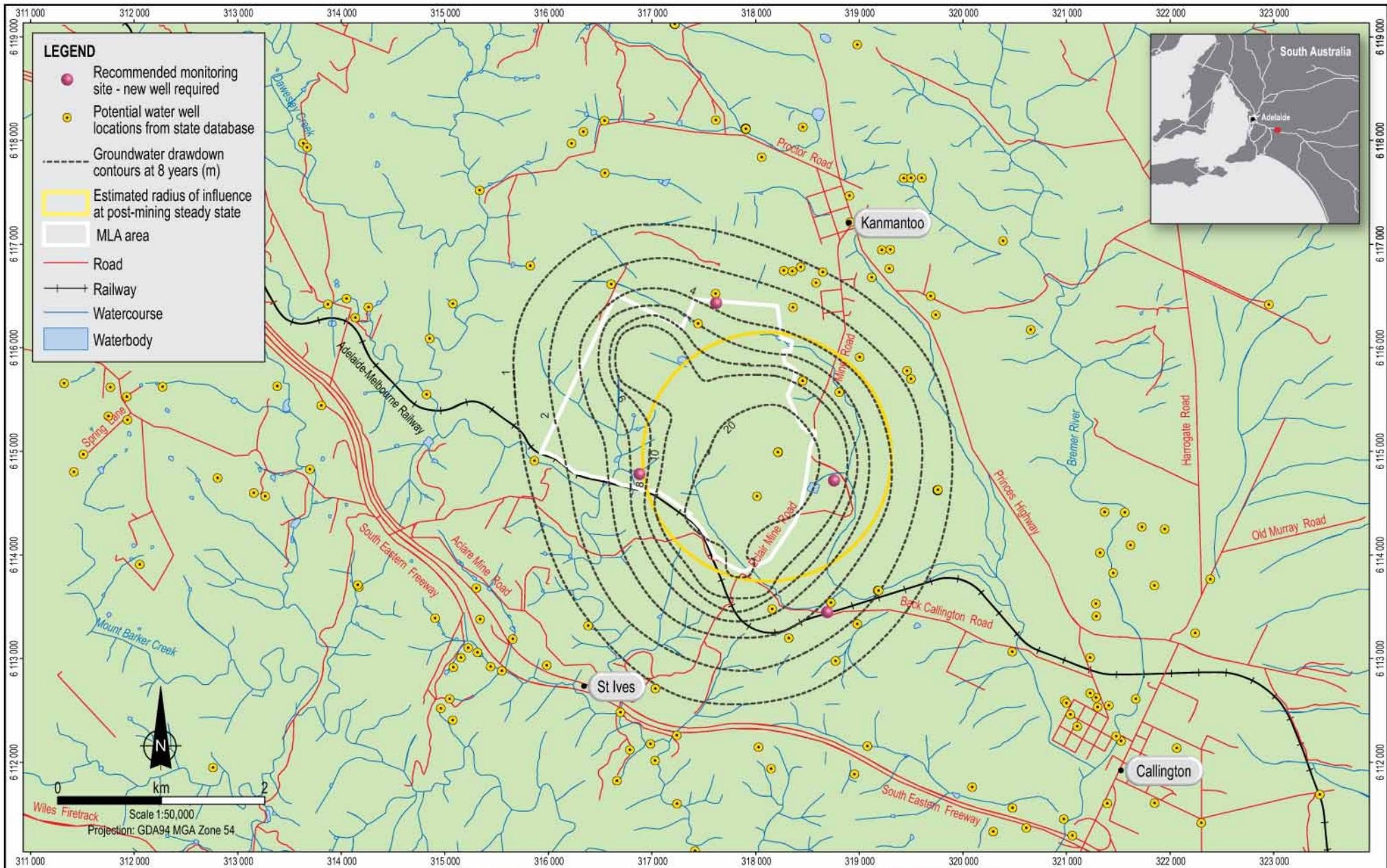
Groundwater levels are expected to start recovering immediately after conclusion of mining and processing, in response to cessation of active dewatering and pumping.

Notwithstanding these predictions, previous mining operations at Kanmantoo suggest that the predicted maximum extent of drawdown discussed above is conservatively large. The water balance completed for the old pit void suggests that the bulk hydraulic conductivity of the pit was of the order of 0.01 m/day, whereas modelling described above involved the use of an average value of 0.06 m/day. The consequence of this would be that, if the aquifer surrounding the pit behaved in the same way as the old pit (with hydraulic conductivity of 0.01 m/day), the horizontal extent of drawdown would be much less, although drawdowns close to points of extraction would be higher.

It is therefore considered **unlikely** that there will be reduced groundwater availability to other users (although the consequences are **moderate** should this occur). The resulting risk is therefore **low**.

Reduced Stream Recharge

All streams within the MLA area and immediate surrounds are ephemeral and only receive groundwater inputs when groundwater levels are significantly higher than recent levels. As discussed in Section 5.7, the streams in the MLA area and surrounds are currently acting as losing streams, which means that streams predominantly provide recharge to groundwater, rather than gaining water from groundwater. Loss of stream water to groundwater, however, is not considered an issue due to the ephemeral nature of streams in the MLA area. Groundwater drawdown as a result of pit dewatering and groundwater extraction would potentially increase groundwater recharge from a stream already acting as a losing one. It is therefore considered **unlikely** that stream recharge will be reduced due to groundwater extraction or pit inflows, and the consequence is considered to be **minor** should this occur with a residual risk assessed as **low**.




LEGEND

- Recommended monitoring site - new well required
- Potential water well locations from state database
- - - Groundwater drawdown contours at 8 years (m)
- Estimated radius of influence at post-mining steady state
- MLA area
- Road
- +— Railway
- Watercourse
- Waterbody

Source:
 Cadastre, roads, rail and drainage from DEH (optimum scale 1:25,000)
 GW monitoring wells and groundwater flows from REM
 Stock and domestic wells from 2002 PIRSA Groundwater Database


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 MKD:
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 Job No:
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 Kanmantoo Copper Project


Predicted groundwater drawdown after 8 years

Figure No:
9.1

Deterioration in Groundwater Quality

Possible pathways for project-related activities to contaminate groundwater are:

- Seepage of tailings liquor from the TSF.
- ARD generated from waste rock or tailings.
- Pit lake water.

TSF Seepage. Underdrainage and decant water from the TSF will be transferred to a double HDPE-lined dam and reused in the processing plant. The TSF incorporates a clay liner and extensive underdrainage and has been designed so that there will be virtually no seepage (modelling has indicated that it will take a minimum of 10 years for seepage to penetrate the clay liner once the final tailings height (and hydraulic head) is reached see Section 6.9.2). Furthermore, if seepage were to occur it would be partially captured by the groundwater drawdown cone that is created by the pit (see Section 9.4.2).

On closure, the tailings will dry out and will be covered with a HDPE liner and waste rock to prevent ingress of water and air to the tailings (see Chapter 12). Drainage of fluids through the tailings stack and into the underdrainage is predicted to continue for a period of up to three years following the cessation of tailings deposition. Therefore, based on current modelling predictions no adverse impacts to groundwater are expected from operation of the TSF during mining or post-closure. Further details on waste rock and tailings management are given in Sections 6.8.2 and 6.9.3, respectively.

Conservative groundwater flow and contaminant transport modelling for the old tailings dam indicates that (with respect to SA EPA (2003) fresh water aquatic ecosystem criteria) for potential future impacts down-gradient of the old tailings dam pond, metal concentrations in excess of the criteria would be confined to a zone less than 500 m downstream from the site boundary over a 100 year timeframe. If mining does proceed, it is possible that groundwater flow directions near the old seepage pond will be altered, with groundwater flow towards the Main pit during and post-mining.

Based on current modelling, the successful implementation of the control measures and proper construction and operation of the mine facilities (including the TSF), it is expected that the Environment Protection (Water Quality) policy objectives (SA EPA, 2003) will be met. However, as outlined in Section 6.8.2, Hillgrove may seek an exemption under the EPA's Environment Protection (Water Quality) policy if subsequent assessment of the model parameters indicates that residual seepage may occur. Hillgrove will undertake further studies as part of the detailed design phase on the permeability of the insitu material and if necessary on the fate of any seepage if it were to occur.

ARD Generated from the Waste Rock Storage. The groundwater in the area surrounding the old waste rock dump shows signs of contamination as a consequence of ARD (Appendix 11) due to historical placement of acid-forming waste rock. The new waste rock storage will be developed as a lift and an extension to the old waste rock dump. Progressive rehabilitation of the exposed waste rock storage slopes (including the placement of a cover system) and the successful implementation of a PAF-waste rock encapsulation strategy will mitigate potential for ARD.

The Emily Star pit will be backfilled with waste rock on completion of mining, and the groundwater level in this pit is expected to return to normal levels. Potential for ARD generation within the backfilled material will be limited by applying the same capping strategy as for the waste rock storage and shaping the backfilled pit to form a water shedding profile and to allow for settlement.

Any potential ARD seepage from the proposed waste rock storage (or backfilled Emily Star pit) that reaches the watertable will be within the zone of hydraulic containment maintained by the Main pit void.

Pit Lake Water. Elevated heavy metal concentrations, as well as acidic pH, were identified in groundwater wells closest to the Main pit (see Section 5.7.3), and the old pit lake is acidic (pH 2.8) (PB, 2006a). This suggests that historical mining activities and potential leakage from the pit lake have impacted groundwater quality in this area, albeit to a limited spatial extent.

Based on the estimated drawdown extent from pit dewatering and water supply abstraction during the eight years of planned mining (see Figure 9.1), adverse groundwater quality impacts caused by historical or proposed mining activities would be hydraulically contained by the mine pits (REM, 2007a). In addition, removal of pit water will minimise the potential for contamination impacts to groundwater from pit water. Furthermore, ongoing monitoring of existing wells and proposed wells (see Section 9.4.5) will provide an indication of changes in groundwater quality over time.

The water balances indicate the final Main pit void (unless filled to become a water storage (see Chapter 12)) will become a permanent groundwater sink in which evaporative losses will exceed rainfall and groundwater inflows. This will keep pit water levels significantly below the surrounding aquifer levels and maintain a hydraulic containment effect, with groundwater flow towards the pit. In the long-term steady state period after mine closure, groundwater inflows will be sustained by regional recharge. Consideration of these factors suggests that the radius of influence in the steady state post closure period is of the order of 1,200 m (see Figure 9.1), which would maintain hydraulic containment conditions over a large part of the MLA area. Sensitivity studies of the water balances demonstrate a high degree of confidence in the groundwater sink prediction for the Main pit.

In the unlikely event that outflows from the pit occur, the small water flux would be diluted by regional groundwater and recharge as it migrates, during which time further attenuation processes that reduce metal concentrations (e.g., complexation, precipitation and adsorption) may be expected to occur.

Conservative groundwater flow and contaminant transport modelling was undertaken for the historic mining infrastructure (including the old pit) (Appendix 4). This modelling indicates that if the pit were not acting as a groundwater sink and groundwater flowed east to southeast from the pit, consistent with the surface topography, metal concentrations in excess of the criteria (SA EPA, 2003) would be confined to a zone less than 350 to 375 m from the site boundary within a 100 year timeframe.

The likelihood of groundwater contamination affecting other water users is therefore considered **unlikely**; however, in the event it did occur, there would be a **severe**

consequence. Overall, the risk that project-related activities will contaminate groundwater is therefore assessed to be **moderate**.

9.4.4 Environmental and Social Objectives

The environmental and social objectives for groundwater, the assessment criteria and a summary of the control measures are listed in Table 9.10.

Table 9.10 Environmental and social objectives for groundwater

ID	Objective	Assessment Criteria	Summary of Control Measures
I07, I08, I09	No long-term reduced groundwater flows and availability for other users due to supply well extraction and mine dewatering, and no reduced stream recharge from groundwater. No deterioration in groundwater quality from mine components such as the TSF affecting other users.	Monitoring shows drawdown does not exceed values calculated as shown on Figure 9.1 (where these values will act as triggers for further investigations). Monitoring shows that the quality (as per EPA water quality policy objectives (SA EPA, 2003)) and quantity of groundwater available to local users is maintained throughout the project.	Continued monitoring (levels and quality) of regional and MLA area groundwater to refine models of groundwater quality and drawdown. Establishment of supply well extraction rate for sustainable use. Hillgrove to replace or deepen existing wells that become substantially affected by project-related drawdown, or provide alternative water sources for affected users.

9.4.5 Monitoring

Hillgrove will conduct groundwater monitoring to provide an increased understanding of the local hydrogeology and increase confidence in the conceptual hydrogeological model developed for the area (see Section 5.9). Monitoring will also provide information concerning groundwater transmissivity, drawdown and quality, to allow assessment of changes due to the project, including effects on regional groundwater uses. The proposed groundwater monitoring program, including sampling frequency and parameters, is set out in Table 9.11.

Ten monitoring wells (KMB001 to KMB0010) have been installed in the MLA area (Appendix 4) and initial monitoring has commenced. Hillgrove will install two new monitoring wells to better define down-gradient groundwater quality (vertical and lateral). These will comprise a well located immediately southeast of the old pit and a deep monitoring well near KMB001.

Table 9.11 Summary of groundwater monitoring program

Site	Sampling Frequency	Parameters
<i>Regional monitoring</i>		
Selected local wells on neighbouring properties.	Monthly unless steady conditions established in which case quarterly.	<ul style="list-style-type: none"> Water levels. pH, conductivity.
	Quarterly.	<ul style="list-style-type: none"> Metals: Al, As, Cd, Cr, Cu, Fe, Mn, Hg, Ni, Pb, Zn (filtered). Major ions: Ca, Mg, Na, K, Cl, SO₄, CO₃, HCO₃.

Table 9.11 Summary of groundwater monitoring program (cont'd)

Site	Sampling Frequency	Parameters
<i>MLA area (including integrated waste landform monitoring)</i>		
Wells KMB001-KMB010. Others wells as required.	Monthly until steady conditions established, then quarterly.	<ul style="list-style-type: none"> • Water levels. • pH, conductivity. • Metals: Al, As, Cd, Cr, Cu, Fe, Mn, Hg, Ni, Pb, Zn (filtered). • Major ions: Ca, Mg, Na, K, Cl, SO₄, CO₃, HCO₃. • Acidity/alkalinity.
<i>Wellfield monitoring (if or when utilised)</i>		
Each extraction well (KMB003, KMB006 and KMB010).	Continuous metering.	Volumes (rates) extracted.
Intake to process plant.	Monthly until steady conditions established, then quarterly.	<ul style="list-style-type: none"> • pH, conductivity. • Metals: Al, As, Cd, Cr, Cu, Fe, Mn, Hg, Ni, Pb, Zn (filtered). • Major ions: Ca, Mg, Na, K, Cl, SO₄, CO₃, HCO₃. • Acidity/alkalinity.

9.5 Air Quality

An air quality and odour impact assessment for the project was undertaken by Tonkin Consulting (see Appendices 1A and 1B) and is summarised below.

9.5.1 Potential Impacts

Potential, credible, project-related air quality and odour impacts are described below. It should be noted that these do not take into consideration the proposed avoidance, mitigation and management measures that will be implemented by Hillgrove during all stages of the project development (see Section 9.5.3), and that will result in the residual impacts discussed in Section 9.5.4.

The following discussion focuses on potential impacts primarily from an anthropocentric perspective. Impacts on natural values of the MLA area, e.g., flora, fauna and surface water, are addressed in the respective sections of this chapter.

Decrease in Air Quality Due to Dust Emissions

The main potential air quality issue that will result from construction and operation of the project is the liberation of particulate matter with consequent adverse impacts to human health and amenity. This is measured as total suspended particulate matter (TSP)³ and particulate matter with an equivalent aerodynamic diameter of 10 µm or less (PM₁₀)⁴. Specifically, the main sources of dust will include:

- Drilling and blasting of ore and waste rock.

³ TSP Dust Deposition: Amenity indicator for nuisance dust.

⁴ PM₁₀: Health indicator for respirable dust capable of being inhaled into the lungs.

- Loading and unloading of ore and waste rock into and out of dump trucks.
- Hauling waste rock to the waste rock storage.
- Hauling ore to the run of mine (ROM) stockpile or crusher.
- Crushing and screening of ore.
- Construction of the tailings storage facility (TSF).
- General vehicle movements over unsealed roads.
- Wind erosion from exposed surfaces (e.g., soil stockpiles, waste rock storage and TSF).

Decrease in Air Quality Due to Combustion Emissions

Emissions of combustion products such as carbon monoxide (CO), sulphur dioxide (SO₂), nitrogen dioxide (NO₂), and particulate matter from fuel combustion of fixed on-site sources (i.e., plant equipment and machinery) and vehicles will occur and has the potential to adversely impact local air quality, with subsequent adverse impacts to human health and amenity.

Greenhouse gases are addressed in Section 9.7.

Decrease in Air Quality Due to Odour

Odorous emissions may occur from the:

- Processing plant, particularly from flotation reagents used to produce concentrate.
- TSF.
- Septic tanks.

These odours have the potential to adversely impact local air quality, with subsequent adverse impacts to human health and amenity.

9.5.2 Avoidance, Mitigation and Management Measures

Avoidance, mitigation and management measures, which reflect current best practice at similar mines operating in similar environments, will be implemented to address the potential impacts discussed in Section 9.5.1 and are described below.

Separation Distances

EPA's Draft Guidelines for Separation Distances (2000) contains recommended separation distances to ensure developments are located in a way that minimises impacts caused by noise, odour or polluting air emissions. These guidelines provide a separation distance of 500 m for quarrying, processing and blasting operations, which will apply to the project.

The nearest sensitive residential receptor is approximately 230 m away from the edge of the MLA area (see Figure 5.4), 770 m away from the processing plant and at least 500 m away from any blasting operations, which are consistent with the recommended separation distances.

Decrease in Air Quality Due to Dust Emissions

Measures aimed at controlling dust levels will include:

- Using water or dust suppressants on trafficked areas (i.e., internal haul roads), exposed surfaces and similar to reduce emissions.
- Maintaining roads to minimise the build up of fine particles that are susceptible to wind erosion.
- Regular cleaning of vehicles to prevent debris falling onto roads and creating a source of dust.
- Using speed limits on roads used by mine traffic.
- Using signage and markings to ensure traffic is kept to designated roadways.
- Designing and scheduling blasting to minimise dust emissions (i.e., schedule blasting when conditions are suitable).
- Using an automatic water spray at the dump hopper and, if appropriate, partially enclosing the hopper.
- Prompt clean up of spillage around processing plant.
- Using a collector system to extract air emissions at the processing plant, if required.
- Minimising the extent of exposed areas susceptible to wind erosion.
- Where practical, limiting high dust-generating activities during adverse wind conditions or increasing the frequency of road watering.
- Storing the concentrate in a shed.
- Transport of concentrate in covered trucks.
- Progressively rehabilitating the integrated waste landform and other disturbed areas as they become available.
- Establishing a complaints register, that records the frequency of occurrence, intensity, duration, offensiveness and location of public complaints regarding dust.

Decrease in Air Quality Due to Combustion Emissions

Project equipment, machinery and vehicles will meet exhaust air quality standards and will comply with state regulations. Machinery will be fitted with the appropriate emission control equipment and will be maintained and serviced frequently.

General reviews of the mining operations will be undertaken to assess additional measures that can be implemented to minimise air quality impacts. These reviews will incorporate findings from the monitoring program (see Section 9.5.5).

Decrease in Air Quality Due to Odour

Odour emissions for the project will meet EPA targets and OHS requirements and will not add to the odours produced by the Neutrog fertiliser factory. Adherence to normal operating conditions will ensure odour emissions are kept stable and low.

Measures aimed at controlling odour levels include:

- Ensuring odour sources are enclosed, where required.
- Ensuring the storage area of reagents is adequately ventilated.
- Providing and maintaining adequate buffer distances to neighbouring residential receptors.

The need for additional specific measures will be considered in response to any complaints received, taking into account frequency of occurrence, intensity, duration, offensiveness and location. Hillgrove will undertake an odour sampling program once the project is operational to confirm the modelled results.

Adoption of best practice techniques for on-site septic tanks will minimise adverse impacts of offensive odours. Due to the small scale of these facilities, impacts to neighbouring residential receptors are not expected.

9.5.3 Residual Impact Assessment

Table 9.12 summarises the residual impacts of the project after implementation of the management and mitigation measures described above. Assessment of the residual air quality impacts has therefore been based on the comparison of modelling results with the criteria described below. Additional assumptions used in the modelling are described in Section 9.4.2 and Appendices 1A and 1B.

Table 9.12 Summary of impacts on air quality

ID	Impact	Likelihood of Consequence	Severity of Consequence	Residual Risk
I10	Decrease in air quality due to dust emissions.	Virtually certain	Negligible	Low
I11	Decrease in air quality due to combustion emissions.	Virtually certain	Negligible	Low
I12	Decrease in air quality due to odour.	Unlikely	Minor	Low

Modelling Approach

Air Quality (Dust). Atmospheric dispersion of project-related emissions has been assessed using the CALPUFF dispersion model and was based on meteorological data generated for the site using TAPM software (derived from 12 months of synthesised hourly climate data) and Bureau of Meteorology grid point datasets.

Comparisons were made between the modelled climate dataset and nine months of meteorological data (prevailing winds) collected on-site at the MacFarlane Hill weather station. Both datasets were found to be consistent, despite the MacFarlane Hill weather station being located in an exposed location and taking wind measurements at 2 m

above ground (instead of 10 m, which is the standard). Additional assumptions, such as dust emission estimations and dust source locations, are described in Appendix 1A.

The CALPUFF air dispersion model also assessed the proximity of residential areas to dust emissions to identify the activities that would result in worst-case impacts at these residences. The model accounted for significant variations in terrain and was used to compute dust impacts for PM₁₀, TSP concentration and TSP deposition.

Odour. Odour concentrations for the Kanmantoo Copper Project are dependent on such variables as wind speed, wind direction, mixing height, topography, atmospheric stability, calm conditions and cold air drainage situations. When such variables as atmospheric stability are high, wind speed and mixing height are generally low, resulting in higher odour concentrations.

An odour sampling program was conducted at a similar sized copper mine in the Cobar region of New South Wales. This mine was selected due to its similarities in flotation reagent chemistry and production volumes with the project. Sampling was undertaken during periods of optimum conditions for odour concentration, particularly in the morning when conditions were clear with calm to light winds. Conditioning tank, primary flotation and TSF odours were sampled and later analysed within 30 hours.

The odour sampling program was conducted to obtain real data on the type and strength of odours emitted from copper processing plants. This information was then fed into the atmospheric dispersion model (as described for dust generation modelling above) and used to compute odour impacts taking into consideration the proximity of residential areas.

Compliance Criteria

Air Quality (Dust). Relevant guidelines that address air quality issues in South Australia are described in EPA (2000 and 2007, as cited in Appendix 1A), and the relevant National Environmental Protection Measure (NEPM 1988 and 2003, as cited in Appendix 1A). Specific air quality criteria that apply to the project are shown in Tables 9.13 (which applies to entire airsheds) and 9.14 (which provides a basis for assessing the effects of particular emission sources with a view to ensuring that ambient air quality is maintained at a satisfactory level, and would be met at the closest residences).

Table 9.13 Environmental air quality criteria relevant to the project

Environmental Indicator	Averaging Period	Environmental Quality Objective	Goal within 10 years (of 1999) maximum allowable exceedances
PM ₁₀ (maximum concentration)	1 day	50 µg/m ³	5 days/year
TSP* daily	1 day	120 µg/m ³	Not applicable
TSP annual	1 year	90 µg/m ³	Not applicable
Carbon monoxide (maximum concentration)	8 hours	9.0 ppm	1 day/year
Sulphur dioxide (maximum concentration)	1 hour	0.20 ppm	1 day/year
	1day	0.08 ppm	1 day/year

Table 9.13 Environmental air quality criteria relevant to the project (cont'd)

Environmental Indicator	Averaging Period	Environmental Quality Objective	Goal within 10 years (of 1999) maximum allowable exceedances
Nitrogen dioxide (maximum concentration)	1 hour	0.12 ppm	Not applicable

Source: NEPC (1998) and EPA (2007) except as indicated. * Source: WHO, cited in Appendix 1A.

Table 9.14 Environmental design criteria relevant to the project

Substance	Averaging Period	Design Criterion
Carbon monoxide	1 hour	29 mg/m ³ (25 ppm)
Sulphur dioxide	1 hour	450 µg/m ³ (0.17 ppm)
Nitrogen dioxide (outside metropolitan area)	1 hour	158 µg/m ³ (0.075 ppm)

Source: EPA (2006a).

Table 9.15 classifies amenity dust deposition rates and provides a basis for assessing the impacts of nuisance dust.

Table 9.15 Classification of amenity dust deposition rates

Classification	Dust fall (water in soluble solids) mg m ⁻² day ⁻¹
Rural	13 to 65
Residential	40 to 90
Light industrial	100 to 160
Heavy industrial	200 to 350

Source: University of Adelaide (1980).

Odour. Odour criteria that apply to the Kanmantoo project are described in EPA (2000 and 2006 as cited in Appendix 1B), and the relevant Australian Standard (AS/NZS 4323.3 2001, as cited in Appendix 1B). Specific odour criteria that apply to the Kanmantoo Copper Project are shown in Tables 9.16. It should be noted that the odour criterion for the rural residential receptors surrounding the MLA area is 8 odour units (OU). Due to odour incidents and complaints arising from the Neutrog fertiliser facility, the EPA advised that a target of 2 OU should be considered.

Table 9.16 Odour guideline criteria

Number of People	Odour Units (3 minute average, 99.9%)
2000 or more	2
350 or more	4
60 or more	6
12 or more	8
Single residence (less than 12)	10

Note: 1 OU: The odour can be detected with certainty when it is presented to an olfactometer (people can not smell it). 2 OU: The odour can be smelt by some people. 6 OU: The odour is recognised by most people. 10 OU: The odour is unpleasant and may be considered offensive by most people.

Source: EPA (2006) as cited in Appendix 1B.

Decrease in Air Quality Due to Dust Emissions

Taking into account best practice emission control technology, emissions of particulate matter (as PM₁₀ and TSP), oxides of sulphur and unburnt hydrocarbons will occur,

although in negligible quantities and are not expected to have adverse impacts on surrounding air quality.

The maximum predicted ground level concentrations for PM₁₀ (see Figure 9.2) are less than the NEPM criterion of 50 µg/m³ (as cited in Table 9.13) for all sensitive receptors, and therefore do not exceed project goals. A worst-case, conservatively high background concentration of 20 µg/m³ (with the five highest concentration events excluded as the NEPM air quality goal allows for five exceedances per year) was also modelled, and the results are shown in Figure 9.2. This background concentration is considered conservative in view of NEPM Advisory Reporting Standards (2003, as cited in Appendix 1A) for PM_{2.5} (respirable particles fine enough to penetrate deep into the lungs and alveoli) which specify a limit of 25 µg/m³ averaged over a 24 hour period. The modelled air quality implications for PM₁₀ with a background concentration of 20 µg/m³ were almost identical to those predicted for maximum PM₁₀, thus confirming that no sensitive receptor will be exposed to PM₁₀ concentrations exceeding the NEPM health criteria.

Maximum predicted worst-case TSP concentration, averaged over a 24 hour period, is presented in Figure 9.3 and predicts no exceedances of the WHO TSP objective (120 µg/m³, as cited in Table 9.13) as all sensitive residential receptors are located in areas of less than 50 µg/m³ TSP. Predicted TSP deposition (see Figure 9.3) was also modelled and shows that the closest residential sensitive receptors will be exposed to very small amounts of dust fallout. The prediction of dust deposition shows negligible amenity impacts for the sensitive residential receptors with dust fall in the rural category (13 to 65 mg m⁻² day⁻¹, see Table 9.15) for the 99.9 percentile.

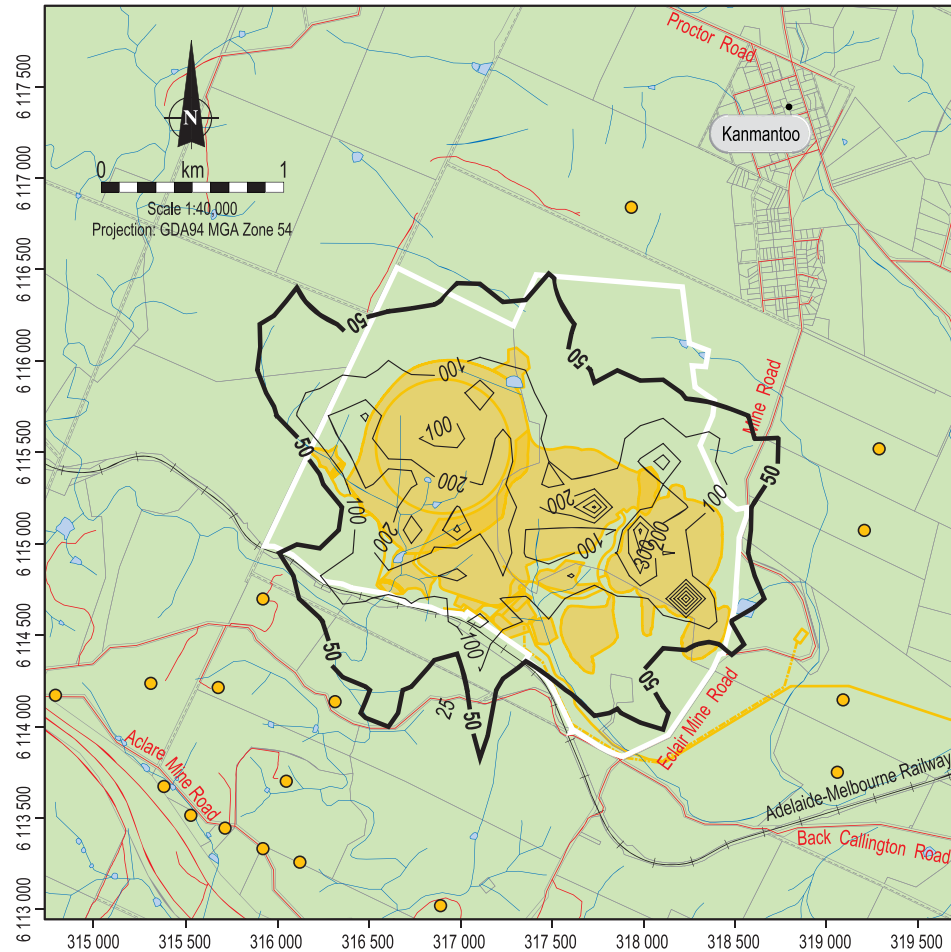
With respect to long-term criteria, the modelling results show that:

- The daily average PM₁₀ concentration is unlikely to exceed the assessment criterion of 50 µg/m³ for sensitive residential receptors in any area.
- Dust generating areas (within 200 to 300 m of haul roads within the MLA area) are likely to exceed the assessment criterion of 120 µg/m³ for TSP but will not affect any sensitive residential receptors.
- Dust deposition levels for sensitive residential receptors are unlikely to exceed any criterion, with negligible amenity impacts on all sensitive residential receptors.

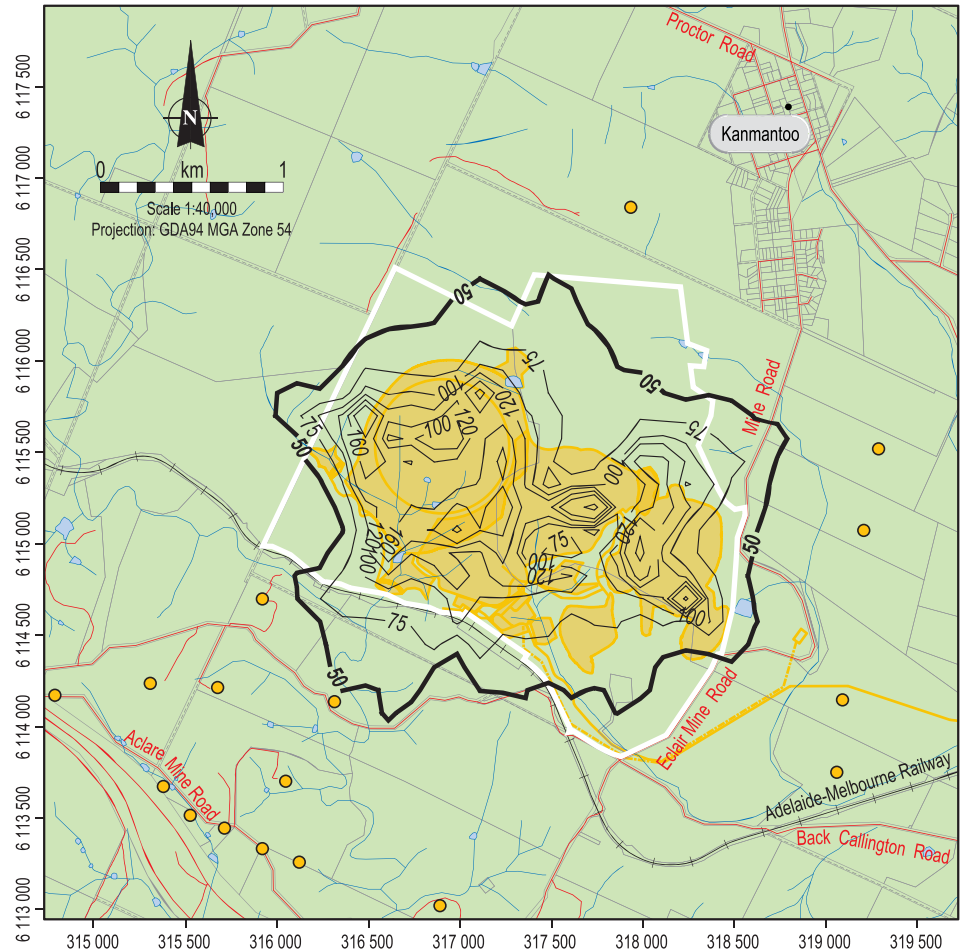
Complete dust suppression in this type of operation, and in this particular setting is not feasible hence the likelihood of a decrease in air quality due to dust emissions is **virtually certain**. However, the modelling results show that the consequences of this dust generation in terms of the various assessment criteria will be **negligible**, hence giving an overall residual risk ranking of **low**. This low residual ranking is further supported by the separation distances to the closest residential sensitive receptor (see Section 9.5.3).

Decrease in Air Quality Due to Combustion Emissions

Even in large mines, the rate of emission of sulphur dioxide, nitrogen dioxide and carbon monoxide are small compared with the emissions from traffic in an urban setting. For example, the traffic travelling on 3 km of arterial road carrying say 60,000 vehicles per



Predicted 24-hour average maximum PM₁₀ concentrations due to emissions from project - $\mu\text{g}/\text{m}^3$



Predicted 24-hour maximum PM₁₀ concentrations (including a background concentration of 20 $\mu\text{g}/\text{m}^3$ with the 5 highest concentration events excluded) due to emissions from project - $\mu\text{g}/\text{m}^3$

LEGEND

- Sensitive receptor
- Modelled contour
- Road
- Unsealed road
- +— Railway
- Cadastre
- Watercourse
- Waterbody
- MLA area
- Project layout
- Evaluation criteria:**
- NEPM



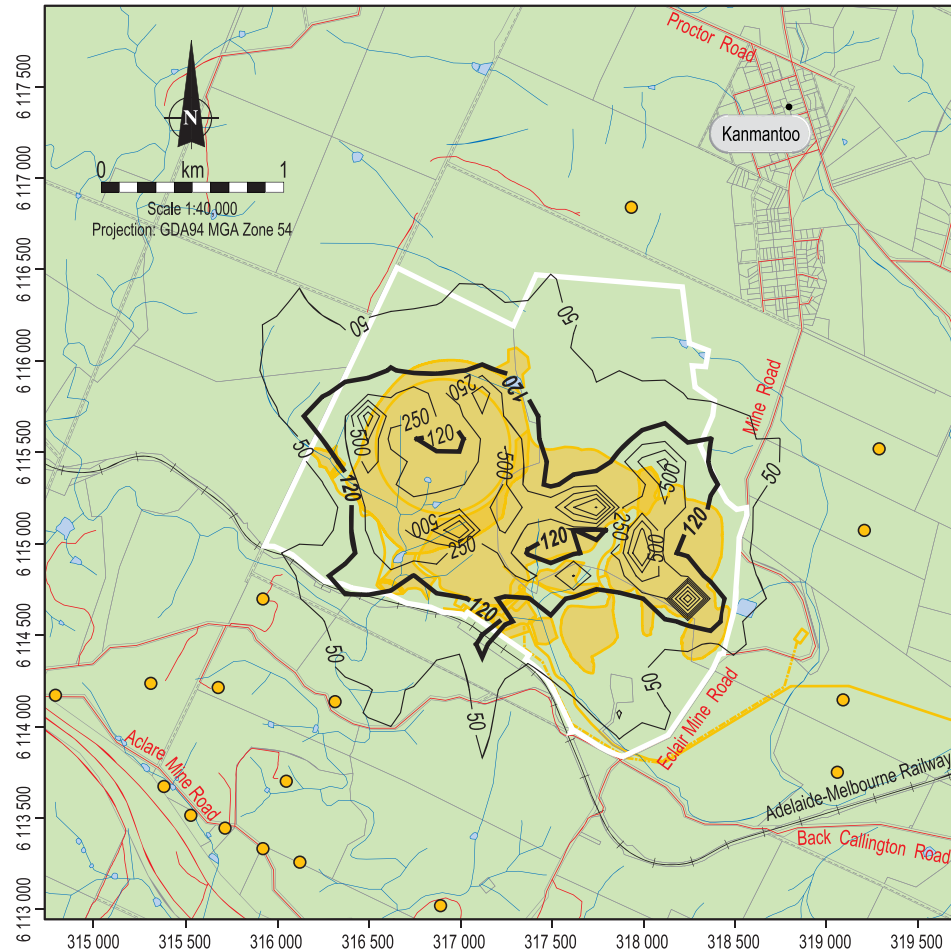
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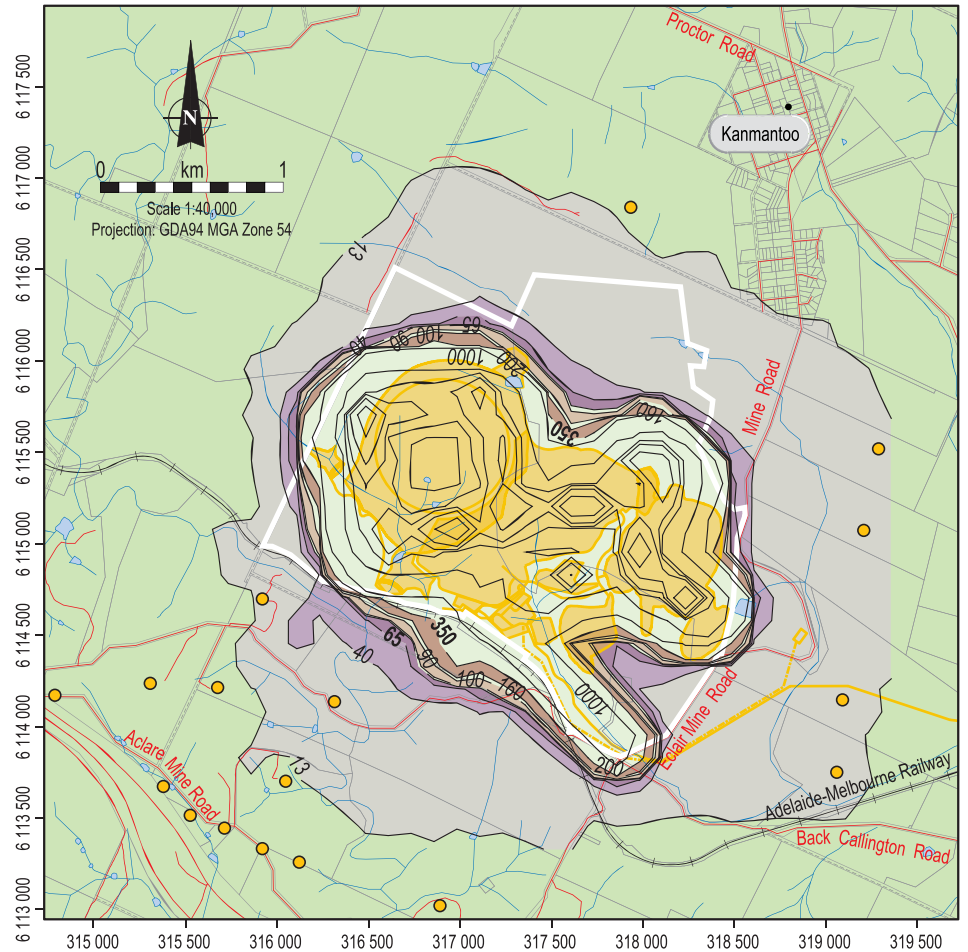


Predicted PM₁₀ concentrations

Figure No:
9.2



Predicted annual maximum 24-hour TSP concentrations due to emissions from project - $\mu\text{g}/\text{m}^3$



Predicted worst-case daily average TSP dust deposition (99.9%) due to emissions from project - $\text{mg}/\text{m}^2/\text{day}$

LEGEND

- Sensitive receptor
- Modelled contour
- Road
- Unsealed road
- +— Railway
- Cadastre
- Watercourse
- Waterbody
- MLA area
- Project layout
- Evaluation criteria:
- NEPM

TSP concentration ($\text{mg}/\text{m}^2/\text{day}$)

- | | | | | | |
|----------|---------|----------|---------------|-----------|--------------------|
| 13 - 40 | } Rural | 40 - 65* | } Residential | 100 - 160 | } Light industrial |
| 40 - 65* | | 65 - 90 | | 200 - 350 | |

* A TSP concentration of 40 - 65 $\text{mg}/\text{m}^2/\text{day}$ is applicable to both rural and residential zones.



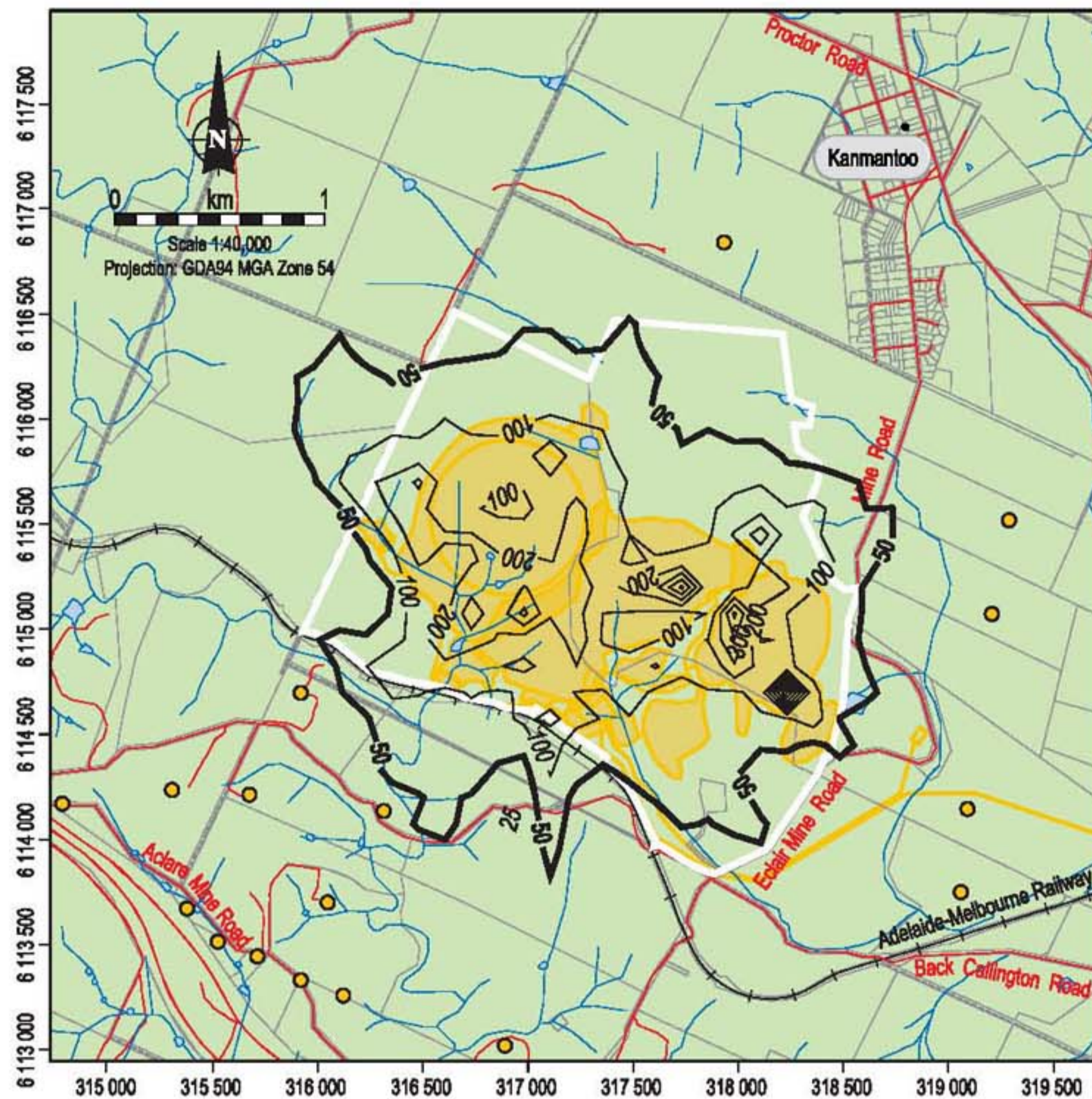
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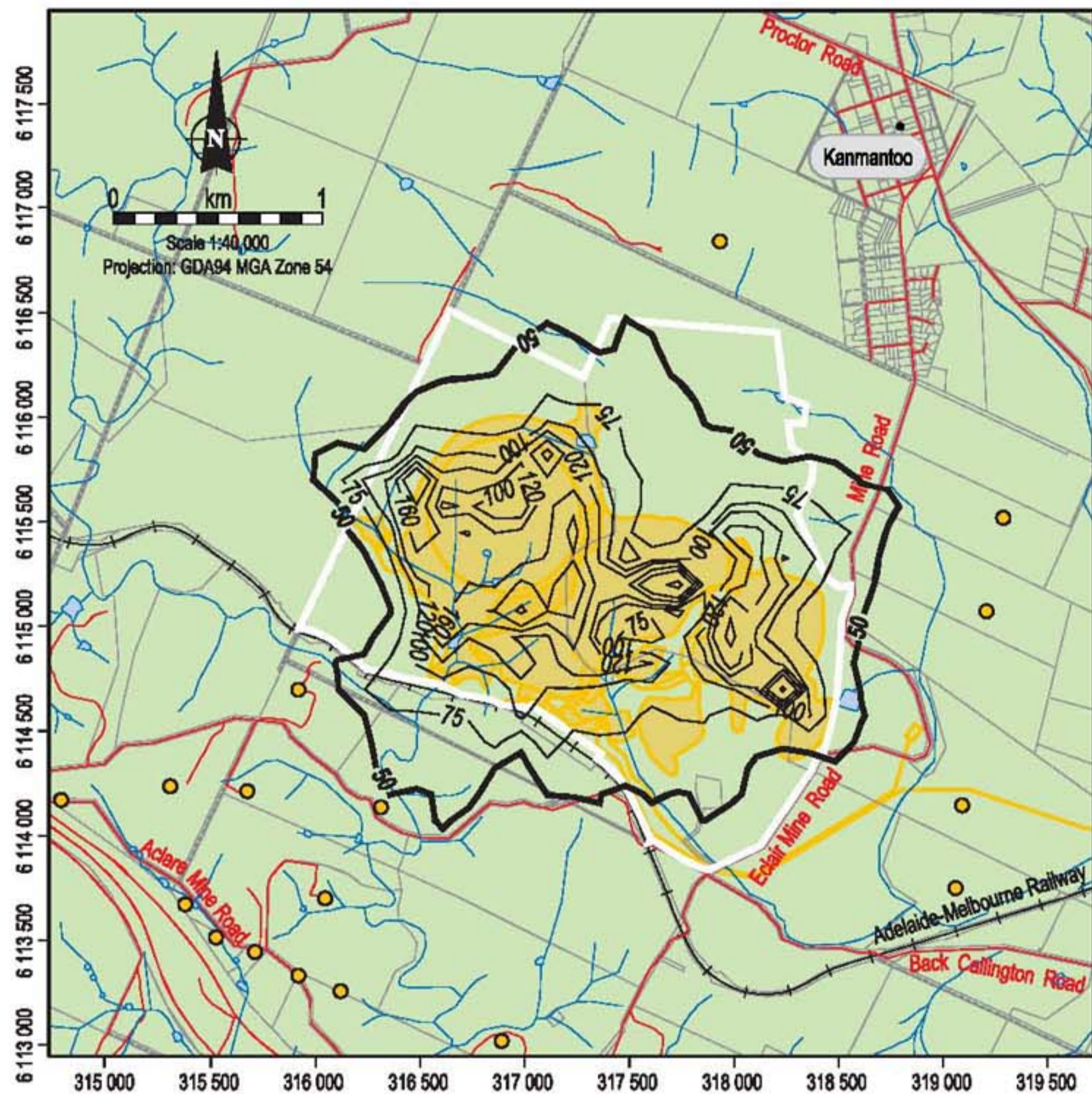


Predicted TSP concentrations

Figure No:
9.3



Predicted 24-hour average maximum PM₁₀ concentrations due to emissions from project - $\mu\text{g}/\text{m}^3$



Predicted 24-hour maximum PM₁₀ concentrations (including a background concentration of $20 \mu\text{g}/\text{m}^3$ with the 5 highest concentration events excluded) due to emissions from project - $\mu\text{g}/\text{m}^3$

LEGEND			
Sensitive receptor	Unsealed road	Watercourse	Project layout
Modelled contour	Railway	Waterbody	Evaluation criteria:
Road	Cadastre	MLA area	NEPM

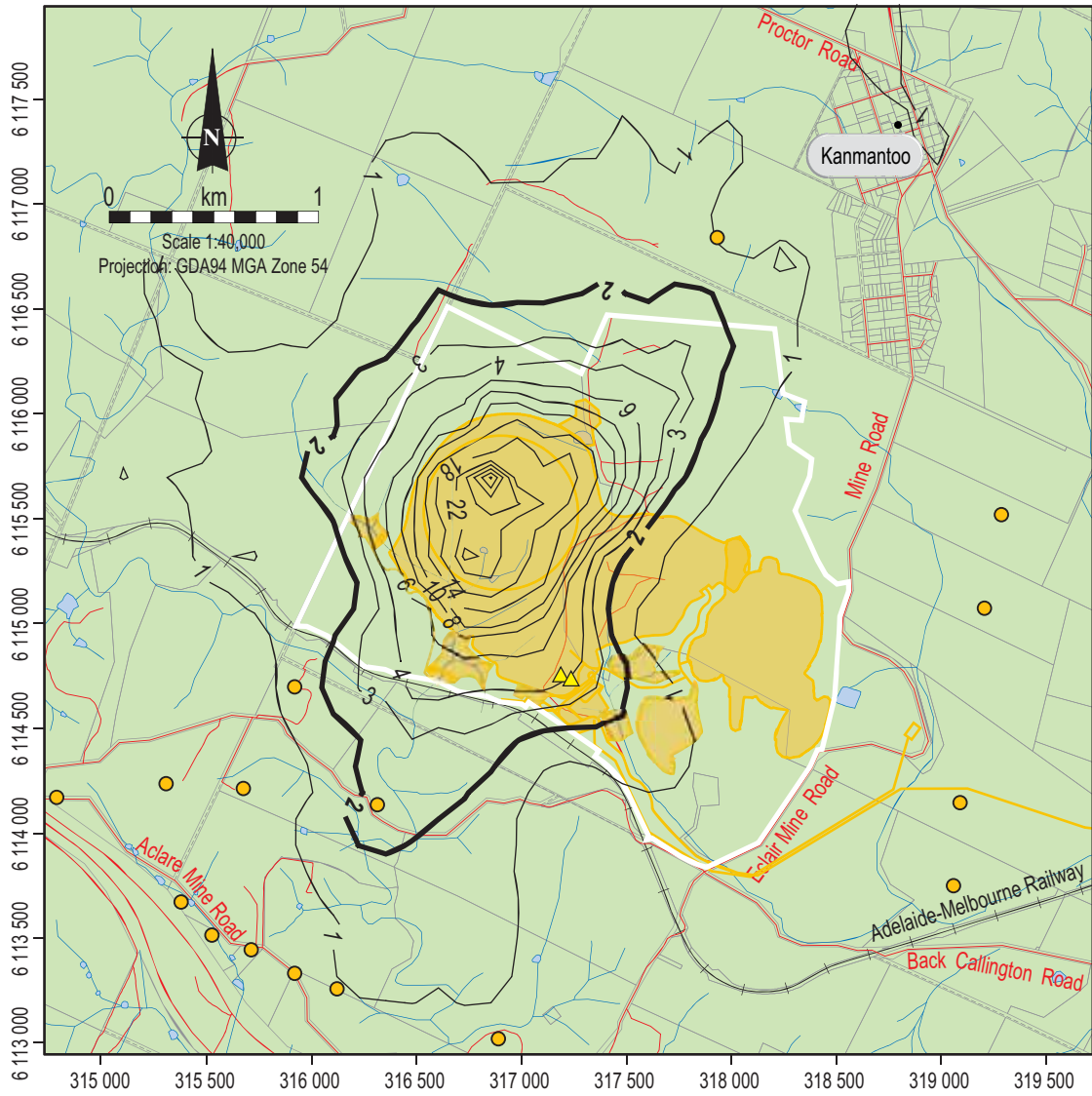

 Job No:
5000
 File No:
5000_02_F09.02_HB

Hillgrove Copper Pty Ltd
 Kanmantoo Copper Project

HILLGROVE
RESOURCES

Predicted PM₁₀ concentrations

Figure No:
9.2



Odour unit for 3 minute averages (99.9%)

LEGEND

- Sensitive receptor
- ▲ Concentrate process odour source
- Modelled contour
- Road
- - - Unsealed road
- +— Railway
- Cadastre
- Watercourse
- Waterbody
- MLA area
- Project layout

Evaluation criteria:

- EPA advised odour unit

Source: Appendix 1B.



Job No:
5000
File No:
5000_02_F09.04_HB

Hillgrove Copper Pty Ltd
Kanmantoo Copper Project



Predicted odour concentrations

Figure No:
9.4

9.5.5 Monitoring

During construction, a program will be established in consultation with the EPA to monitor dust emissions and will incorporate:

- A weather station that measures wind speed, wind direction, temperature, humidity and rainfall. The Hillgrove weather station is currently located at Macfarlane Hill but will be relocated to a clear and elevated location to the north of the open pit.
- Four to six dust deposition gauges located within (or close to) the MLA area.
- Two high-volume air samplers located in sensitive areas where there is a high potential for dust to cause an ongoing environmental nuisance. One will be located at the site office within the MLA area and the other will be located between the mine and the southern extent of the township of Kanmantoo.
- Reporting of air quality monitoring results to the public and relevant authorities quarterly during construction and annually during operations.

Monitoring of air quality with respect to the wellbeing of staff and contractors will be conducted where required as part of the project's occupational health and safety system.

Although odour modelling showed odour levels are predicted to be below EPA guidelines (Appendix 1B), odour sampling on a once-off basis will be conducted to confirm the modelling results. No further odour monitoring will be conducted, unless complaints arise.

9.6 Noise and Vibration

This section is based on a noise assessment undertaken by Sonus Pty Ltd (Sonus) and a blasting assessment undertaken by Blastech for the Kanmantoo Copper Project. The results are reported in Appendices 15 and 16 respectively and summarised below.

9.6.1 Potential Impacts

Potential, credible, project-related noise and vibration impact (disturbance to residents from noise and vibration) is described below. It should be noted that this description does not take into consideration the proposed avoidance, mitigation and management measures that will be implemented by Hillgrove during all stages of the project development (see Section 9.6.2), and that will result in the residual impacts discussed in Section 9.6.3.

The following discussion focuses on potential impacts primarily from an anthropocentric perspective. Impacts on the natural values of the MLA area, e.g., flora and fauna, are addressed in their respective sections in this chapter.

Noise and vibration from construction and operation of the project have the potential to disrupt surrounding residents. In general terms, noise nuisance is determined by the increment above background noise, with attenuation by distance, weather conditions, and local topography. Conversely, nuisance caused by vibration is determined by the increment above human comfort and personal amenity limits with attenuation by distance, depth and ground type.

The main sources of noise and/or vibration emissions are activities at the mine site during construction and operations and project-related noise from traffic on local roads. Specific noise or vibration sources include:

- Vehicles (including reversing alarms).
- Machinery (e.g., drills, loaders, haul trucks, excavators and other ancillary equipment).
- Process plant (e.g., the crusher, semi autogenous grinding (SAG) mill and ball mill).
- Blasting operations.

Disturbance due to noise generated during the construction period may be higher than during operations.

There is also the potential for flyrock (a consequence of blasting) to pose a safety risk to the public, should it extend past the boundary of the MLA area.

9.6.2 Avoidance, Mitigation and Management Measures

The initial modelling results were used to identify the main noise sources. The model was then re-run incorporating the proposed noise avoidance, mitigation and management measures described below until noise levels at sensitive receptors were at acceptable levels. This iterative modelling method was also undertaken for vibration and blasting operations. The avoidance, mitigation and management measures are discussed below.

Separation Distances

As for air quality and odour, EPA's recommended separation distances for the type of operations to be undertaken at Kanmantoo is 500 m. The MLA area currently has a buffer zone of approximately 1 km separating proposed blasting operations and approximately 585 m separating proposed noise sources (i.e., the processing plant) from the nearest residential or commercial structures.

Disturbance to Residents from Noise and Vibration

Measures aimed at controlling noise levels include:

- Servicing all plant, machinery and vehicles regularly and ensuring that their noise emissions do not exceed levels described in Appendix 15.
- Acoustic treatment and shielding techniques, including:
 - Mobile equipment fitted with 'white noise' reversing tone alarms (e.g., BBS-Tek Back Alarms), if necessary.
 - Installing physical barriers to block the line of sight between noise sources and sensitive residential receptors.
- Undertaking noise monitoring to ensure compliance with relevant noise criteria.

- Where possible, not leaving trucks standing with their engines operating when located near a sensitive residential receptor.
- Selecting and positioning site buildings, access roads, equipment and plant in a way that minimises acoustic disturbance in the locality.
- Installing standard noise abatement devices (e.g., mufflers) on machinery and vehicles.
- Establishing a complaints register and responding to complaints as appropriate, e.g., undertaking monitoring of noise levels if complaints received.

Implementation of the following measures will ensure that the effects of blasting in open pits (including flyrock) cause minimal impact:

- Ensuring ground vibration and airblast noise due to blasting operations are within Australian Standard AS2187.2 (SA, 2006 cited in Appendices 15 and 16) for sensitive sites.
- Ensuring blasting generally occurs around midday, when it is likely that no ground-based or low-level atmospheric temperature inversions are present. Blasting will occur on 365 days of the year and will be coordinated so as to not coincide with the passing of trains on the Melbourne to Adelaide rail line. No blasting will occur after daylight hours.
- Designing each blast to minimise the area affected by flyrock, including:
 - Using a graded aggregate material for stemming.
 - Selecting the length of stemming to control the maximum flyrock range.
- Setting and maintaining blast clearance distances to ensure no risk to site personnel, the public or passing traffic.
- Posting of sentries on adjacent roads to ensure no traffic enters into the designated blast zone.
- Initiating blasts using 'silent' pyrotechnic initiation systems, with delays selected so as to minimise the quantity of explosives initiated at one particular instant (i.e., single hole delaying).
- Using a suitably qualified person to design each blast, with initial blasts being conservatively designed to ensure minimal disturbance from blasting.
- Monitoring blasting to refine approach to ensure compliance.
- Establishing a complaints register. The results of monitoring will be reported to both the complainant and to PIRSA. If necessary, additional mitigation measures will be introduced.
- Preparing a brief information brochure on blasting operations and monitoring that will be undertaken, and informing local residents of the nature of the blasting impacts and the blasting program, including regular advertising of blasting times and any changes to blasting times.

Validation of Modelling

Hillgrove will conduct noise and vibration monitoring at selected sensitive noise receptors during the early stages of construction and operation of the project to validate the predictions of the noise and vibration modelling. Should results contradict the predicted noise and vibration levels (reported in Appendices 15 and 16), Hillgrove will consider additional management and mitigation measures.

If Hillgrove decides on a 10 m bench height (as was used previously at the mine), further blast modelling and validation of model parameters will be undertaken, and blast procedures will be adjusted as necessary to ensure full compliance with the Australian Standards AS 2187.2 (SA, 2006 as cited in Appendix 16).

9.6.3 Residual Impact Assessment

Table 9.18 summarises the residual impacts of the project after implementation of the avoidance, management and mitigation measures described above.

Table 9.18 Summary of noise and vibration impacts

ID	Impact	Likelihood	Consequence	Residual Risk
113	Disturbance to residents from noise and vibration.	Possible	Minor	Low

Modelling Approach

Noise Modelling. The CONCAWE noise prediction model (described in detail in Appendix 15) takes into account significant project noise sources, noise attenuation measures, terrain, locations of sensitive receptors and meteorological effects. The model has broad acceptance by Australian and international authorities.

Meteorological conditions adopted for modelling were based upon the CONCAWE weather category system which divides the range of possible meteorological conditions into six separate weather categories where:

- Category 1, 2 and 3 conditions are characterised by prevailing wind blowing from the receiver to the noise source during daytime with little or no cloud cover, resulting in the lowest noise levels at receptors.
- Category 4 conditions are characterised by no wind on an overcast day, which is typical of neutral noise propagating conditions.
- Category 5 conditions typically consist of no wind on a clear night (typical of a temperature inversion) and would be expected to propagate noise further than during Category 4 conditions.
- Category 6 conditions typically occur when prevailing wind is blowing from the noise source to the receiver on a clear night (typical of a temperature inversion), thereby causing the highest possible noise levels at receptors.

Category 6 meteorological conditions (worst-case conditions) have been used to predict noise emissions from the project for the ten closest residential receptors (see Figure 5.6).

Noise Model Inputs

The sound power levels used for the noise modelling are presented in Table 9.19. These sound power levels have been based upon noise measurements undertaken at a number of similar quarry and mining sites, including the works currently being undertaken for the construction of the Terramin mine at Strathalbyn.

Table 9.19 Noise model inputs

Equipment	Maximum Overall Sound Power Level (dB(A))
100 tonne dump truck	115
Dumping of rock (including truck and bulldozer movements)	112
160 tonne excavator	116
Front end loader	112
Rock breaker	110
Crusher	117
Drilling rig	116
Processing plant (all equipment combined)	122

Source: Appendix 15

Vibration Modelling. Potential blasting impact scenarios were modelled under average and worst case (i.e., maximum impact) scenarios. Details of the modelling is provided in Appendix 16.

Blasting will generally occur in benches between 5 and 10 m in height, with blasthole diameters in the range 89 to 165 mm. Within this range, blastholes will contain between approximately 28 and 177 kg of explosive.

Trial blasting was not considered necessary to determine site-specific parameters for use in the modelling due to the relatively large distance separating blasting operations from surrounding residences (see Section 9.6.3).

Compliance Criteria

Assessment of the residual noise and vibration impacts has been based on the comparison of modelling results with the criteria described above. Additional assumptions used in the modelling are described in Section 9.5.2 and Appendices 15 and 16.

Noise Criteria. Objective noise criteria for the project are provided by various EPA policies, which in turn refer to World Health Organisation (WHO) recommendations for noise levels. The relevant South Australian guidelines that address noise impact assessments for domestic noise, noises from machinery and industrial and other non-domestic noise are described in the EPA's Draft Environment Protection (Noise) Policy (2004) (as cited in Appendix 15). Under this Policy, the applicable noise limits for a development are based on zoning and the provisions of the relevant Development Plan. According to the District Council of Mount Barker Development Plan (consolidated on 1 March 2007), the MLA area and sensitive residential receptors 2 to 10 (see Figure 5.6) are located within a 'rural or light industrial' area while sensitive receptor 1 is located within a 'residential area'. Indicative noise factors for these areas under the Draft Environment Protection (Noise) Policy are given in Table 9.20.

Table 9.20 Indicative noise factors dB(A)

Land Use Category	Day (7 am to 10 pm)	Night (10 pm to 7 am)
Rural living	47	40
Residential	52	45
Rural or light industry	57	50
Commercial	62	55
General industry	65	55
Special industry	70	60

Source: Appendix 15

The Draft Environment Protection (Noise) Policy (EPA, 2004) also provides adjustments to the allowable noise levels in development situations, and in situations where the noise fluctuates (Appendix 15). Based upon the current land use categories and application of the requirements for development situations and fluctuating noise, the applicable noise criteria would be:

- For sensitive residential receptor 1, noise levels must not exceed 50 dB(A) during the day and 43 dB(A) at night.
- For sensitive residential receptors 2 to 10, noise levels must not exceed 47 dB(A) during the day and 40 dB(A) at night.

The policy also states for all sensitive residential receptors that a maximum instantaneous (L_{max}) noise level of 60 dB(A) should not be exceeded at night.

The Draft Environment Protection (Noise) Policy (EPA, 2004) restricts the hours of construction activity if sleep disturbance criteria would be exceeded. These restrictions include restricting the allowable hours of construction to between 9 am and 7 pm on Sundays (and on public holidays) and between 7 am and 7 pm on all other days, where the noise from activity exceeds 45 L_{Aeq} or 60 L_{Amax} .

Relevant South Australian guidelines that address noise levels due to traffic are described in the Department of Transport, Energy and Infrastructure (DTEI) Road Traffic Noise Guidelines (as cited in Appendix 15). These guidelines provide desirable noise limits for day and night periods, with a most stringent daytime limit of 55 dB(A).

Vibration Criteria. In relation to vibration, Australian Standard AS2187.2 (2006) (cited in Appendices 15 and 16) provides protection against startling effects on people. Compliance with these guidelines automatically ensures that all but the most delicate physical structures will be adequately protected. The Australian Standard specifies the following maximum limits at sensitive sites for operations lasting longer than 12 months:

- Maximum blast overpressure – 115 dBL for 95% of blasts per year (and no blast should exceed a blast overpressure of 120 dBL, unless agreement is reached with the occupier that a higher limit can apply).
- Maximum peak particle vibration velocity – 5 mm/s for 95% of blasts per year (and no blast should exceed 10 mm/s, unless agreement is reached with the occupier that a higher limit can apply).

Disturbance to Residents from Noise, Vibration, Overpressure and Flyrock

Noise. The results of the noise modelling incorporating acoustic mitigation measures and the worst-case weather conditions and equipment locations are given in Table 9.21. These predicted noise levels are considerably less than those without acoustic treatment (detailed in Appendix 15).

Table 9.21 Predicted L_{eq} noise level following acoustic treatment

Sensitive Receptor	Day (7 am to 10 pm)	Night (10 pm to 7 am)
1	47	40
2	44	37
3	42	36
4	45	39
5	44	38
6	38	35
7	44	40
8	44	40
9	42	40
10	40	34
Neutrog fertiliser facility	53	44

Source: Appendix 15

The noise modelling indicates that there is no prospect that noise levels at the closest sensitive residential receptors will be affected by noise generated by the project. Predicted noise levels:

- Do not exceed equivalent L_{eq} noise levels of 47 dB(A) during the day and 40 dB(A) during the night (see Table 9.20).
- Do not exceed noise levels in development situations and in situations where the tone of the noise fluctuates (50 dB(A) during the day and 43 dB(A) during the night for sensitive residential receptor 1 and 47 dB(A) during the day and 40 dB(A) during the night for sensitive residential receptors 2 to 10).
- Do not exceed the maximum instantaneous (L_{max}) noise levels of 60 dB(A) during the night and therefore protect against sleep disturbance.
- Are well below the level that may interfere with any industrial or commercial activity for the Neutrog fertiliser facility, and would not be expected to impair or interrupt the regular activities of any Neutrog employees (see Table 9.20).

Modelling also indicates that predicted noise levels associated with traffic movements between the MLA area and the South Eastern Freeway will be below the most stringent limits of 55 dB(A) during the day and 50 dB(A) at night. This confirms that no specific acoustic treatment is required to control heavy vehicle noise from the road to the closest residences.

Vibration, Overpressure and Flyrock. Both minimum and maximum vibration impacts for 5 m benches (Figure 9.5) at sensitive residential receptors⁵ comply with peak particle velocity criteria of 5 mm/s for 95% of blasts per year or a maximum of 10 mm/s, as specified in AS2187.2 (SA, 2006). Minimum vibration impacts for 10 m high benches (see Figure 9.5) meet peak particle velocity criteria of 5mm/s for 95% of blasts per year. However, maximum vibration impacts (165 mm holes and worst case site-specific parameters) for 10 m high benches do not meet the 10 mm/s maximum criteria at two sensitive residential locations.

Both minimum and maximum overpressure impacts for 5 m high benches (see Figure 9.5) at sensitive residential receptors meet peak sound pressure level criteria of 115 dBL for 95% of blasts per year and a maximum of 120 dBL, as specified in AS2187.2 (SA, 2006). Minimum overpressure impacts for 10 m high benches (see Figure 9.5) meet the criteria for sensitive receptors. However, maximum overpressure impacts (165 mm holes and worst case site-specific parameters) for 10 m high benches do not meet the criteria at two sensitive residential locations.

Modelling has demonstrated that blasthole diameters must be restricted to less than 165 mm to comply with standards specified in AS2187.2 (SA, 2006) for vibration and overpressure impacts. Hillgrove will ensure that blasthole diameters are restricted to less than 165 mm, or if larger blasthole diameters are required, they will undertake further modelling and parameter validation to ensure compliance (see Section 9.6.2). Hillgrove will also ensure that blasts are designed to minimise maximum flyrock range and that blast clearance distances ensure there is no risk to site personnel, the public or traffic due to flyrock.

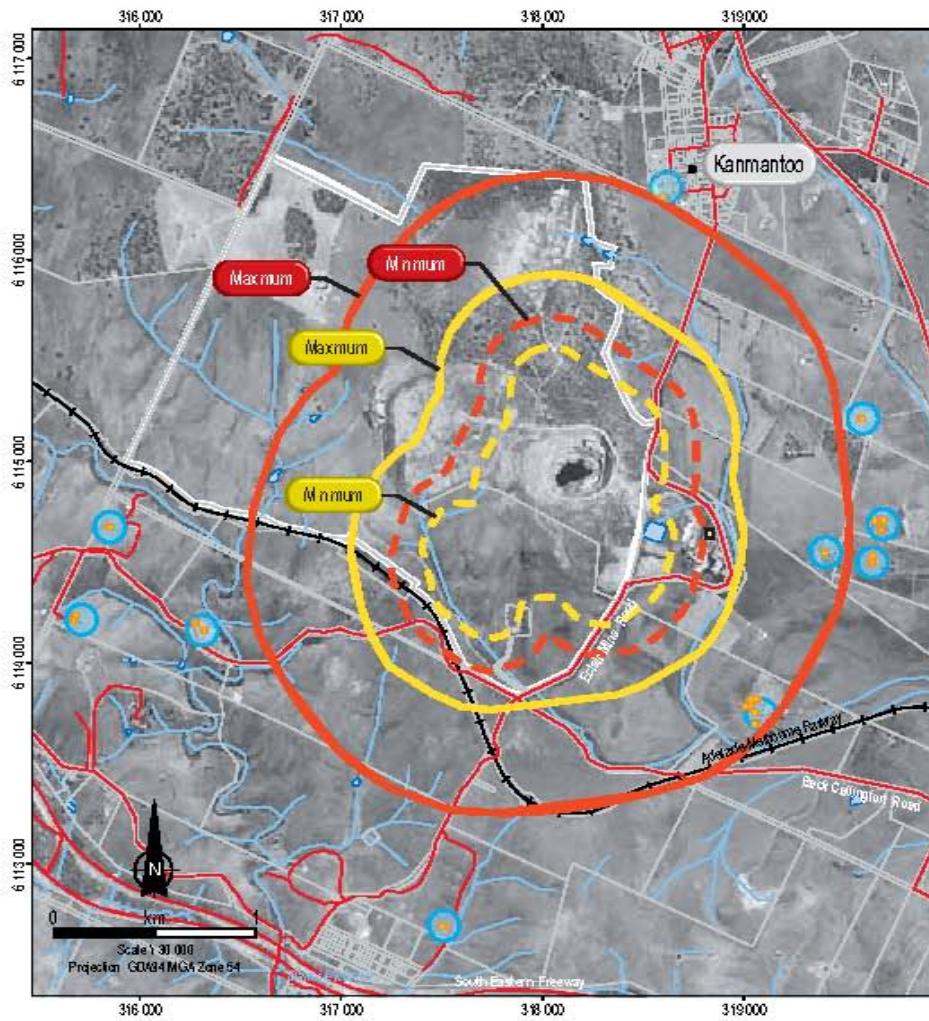
Conclusion

Noise and vibration generation from the construction and operation of the project is unavoidable, and although acoustic treatment and proper blast management, will reduce likelihood of disturbance to residents from noise, vibration, overpressure and flyrock, it is still **possible** that this may occur. The modelling results show that the consequences of noise generation and vibration will be **minor**. Therefore, the overall residual risk ranking is **low**.

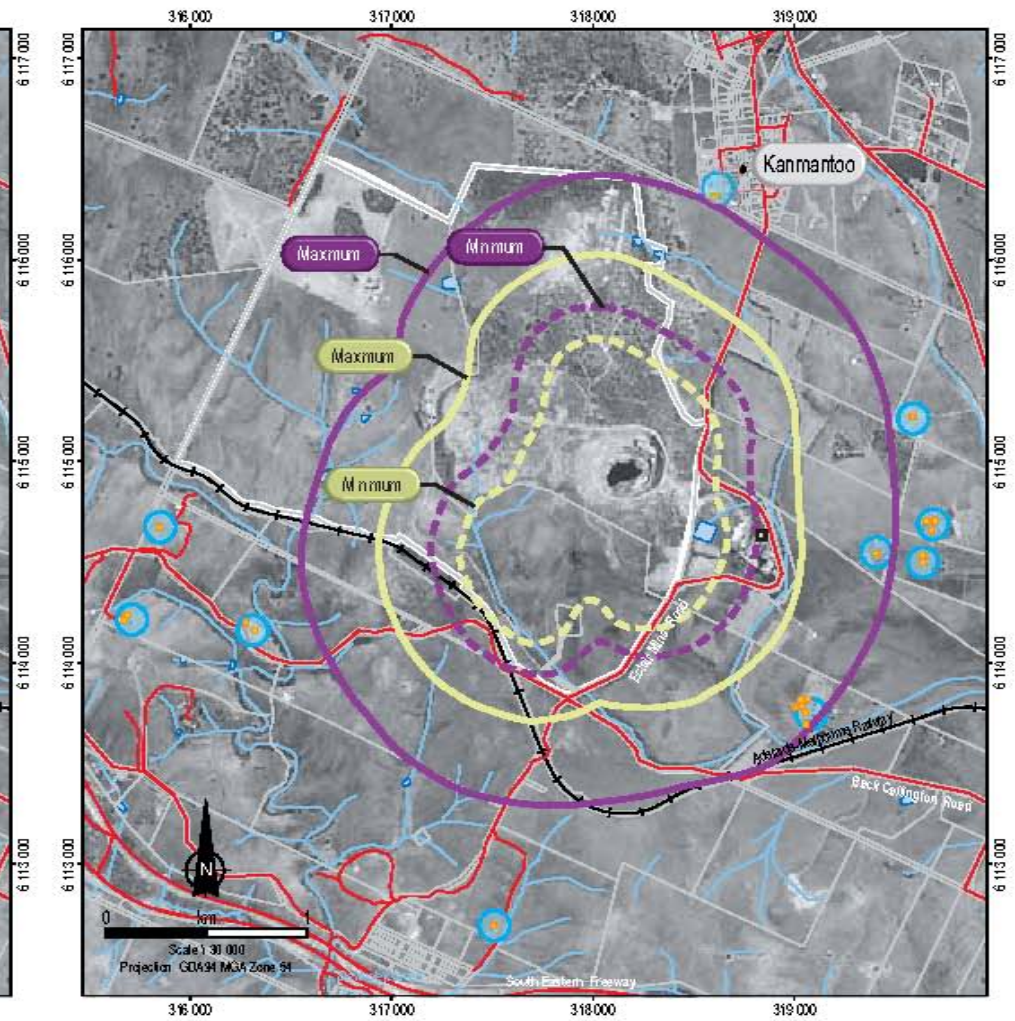
9.6.4 Environmental and Social Objectives

The environmental and social objectives for noise and vibration, the assessment criteria and a summary of the control measures are listed in Table 9.22.

⁵ The Neutrog fertiliser factory is an industrial facility, therefore does not need to comply with sensitive residential receptor criteria. This facility does, however, comply with industrial criteria of 25mm/s (McKenzie, C., pers. comm.).



Vibration impacts



Overpressure impacts

LEGEND

- | | | | | |
|--|---|--------------------------------|-------------|-----------|
| Blast vibration impact for 5-m benches (minimum) | Blast overpressure impact for 5-m benches (minimum) | Sensitive residential receptor | Road | Waterbody |
| Blast vibration impact for 5-m benches (maximum) | Blast overpressure impact for 5-m benches (maximum) | MLA area | Railway | |
| Blast vibration impact for 10-m benches (minimum) | Blast overpressure impact for 10-m benches (minimum) | Building | Watercourse | |
| Blast vibration impact for 10-m benches (maximum) ¹ | Blast overpressure impact for 10-m benches (maximum) ² | Neutrog fertiliser factory | Cadastre | |

1) Maximum blast vibration impact for 10m benches does not comply with peak component particle velocity criteria
 2) Maximum blast overpressure impact for 10m benches does not comply with peak sound pressure level criteria

Source:
 Blast impact ranges from Blast technology
 Cadastre roads rail buildings and drainage from DEH (optimum scale 1:90 000)

	Date	21.09.07
	REV	MSD
	Project/Revision/Location	Hillgrove Resources_Kanmantoo02
	JOB No	9001 02 F09.05 GIS_A

Hillgrove Copper Pty Ltd

Kanmantoo Copper Project

Expected maximum and average
 vibration and overpressure impacts
 (5 and 10 m benches)

Figure No

9.5

Table 9.22 Environmental and social objectives for noise and vibration

ID	Objective	Assessment Criteria	Summary of Control Measures
I13	No public nuisance (as defined by relevant EPA criteria) from noise and vibration (including overpressure) to nearby residents due to the project.	<p>Results of noise monitoring in workplace shows compliance with occupational health and safety noise limits.</p> <p>Results of vibration monitoring shows vibration and overpressure levels comply with AS 2187.2.</p> <p>Results of noise monitoring shows compliance with relevant EPA noise limits (as defined in the Draft Environmental Protection (Industrial Noise) Policy 2004).</p> <p>Results of noise and vibration monitoring confirm modelled results.</p> <p>Records of blasting show no disturbance due to flyrock outside predicted blast zone.</p>	<p>Establishment and maintenance of separation distances between operation and nearest receptors.</p> <p>Establishment of a noise and vibration monitoring program for early stages of construction and operation to confirm modelling predictions.</p> <p>Management of blasting operations, including timing of blasting to minimise disturbance.</p> <p>Hillgrove will regularly advertise anticipated blasting times and changes to blasting times.</p>

9.6.5 Monitoring

Noise Monitoring

A program will be established to monitor noise levels at nearby sensitive residences to confirm the noise modelling results and ensure that noise control measures are effective. The program will be established in consultation with the EPA and will include:

- Monitoring of noise levels (during the day and at night) at potentially affected residences and/or other sensitive receptors quarterly during construction.
- Monitoring of operational noise levels (during the day and at night) at potentially affected residences and/or other sensitive receptors initially and when triggered by complaint.
- Monitoring of machinery noise levels annually, as part of routine machinery maintenance.
- Checking noise monitoring equipment annually to ensure it is maintained and calibrated according to applicable standards and fitting additional noise monitoring equipment, if required.
- Comparing actual monitoring results to predicted noise levels quarterly during construction and annually during operations.
- Reporting noise monitoring results to the public and relevant authorities quarterly during construction and annually during operations.

Monitoring of staff and contractor exposure to noise will be conducted as required as part of the project’s occupational health and safety system, to ensure that the workplace complies with occupational health and safety noise limits.

A complete noise survey will be conducted within the MLA area if operating conditions change significantly.

Vibration Monitoring

A program will be established to monitor initial vibration levels due to blasting at nearby sensitive residences to confirm the modelling results and ensure blasting control measures are effective. No further monitoring will be conducted, unless complaints arise. Where complaints indicate that agreed control measures are not adequate, Hillgrove will assess whether additional mitigation measures are required.

9.7 Greenhouse Gas Emissions

A greenhouse gas characterisation and impact assessment for the project was undertaken by Tonkin Consulting (see Appendix 1C) and is summarised below.

9.7.1 Potential Impacts

The potential, credible, project-related greenhouse gas emission impact (an increase in greenhouse gas emissions) is described below. It should be noted that the description of the impact does not take into consideration the proposed avoidance, mitigation and management measures that will be implemented by Hillgrove during all stages of the project development (see Section 9.7.2) and that will result in the residual impact discussed in Section 9.7.3.

Greenhouse gases identified under the Kyoto Protocol United Nations Framework Convention on Climate Change are:

- Carbon dioxide (CO₂).
- Hydrofluorocarbons (HFCs).
- Methane (CH₄).
- Nitrous oxide (N₂O).
- Perfluorocarbons (PFCs).
- Sulphur hexafluoride (SF₆).

Of these, CO₂ and N₂O are the most significant greenhouse gases in relation to the project since they are the main products that result from the combustion of diesel when powering earthmoving equipment and when generating electrical energy (including power from the South Australian grid), both of which will occur extensively during the project. Emissions of these gases are reported on a carbon dioxide equivalent basis (CO₂-e).

Estimates of greenhouse gases have been projected over a nine-year, three-month period encompassing construction, operation and final rehabilitation. As described in Appendix 1C, the report calculates three 'scopes' of emissions from sources within the MLA area and is based on the Australian Greenhouse Office (AGO) Factors and Methods Workbook (AGO, December 2006, cited in Appendix 1C):

- Scope 1: Calculates direct greenhouse gas emissions associated with the project. This includes emissions from fuel consumption by mobile sources at the mine or used to transport concentrate to the shipping terminal.

- Scope 2: Calculates indirect greenhouse gas emissions associated with the consumption of purchased electricity produced by an external organisation. In South Australia the grid power is largely generated by coal or gas-fired power stations.
- Scope 3: Calculates all indirect greenhouse gas emissions that are a consequence of an organisation’s activities but are not from sources owned or controlled by the organisation. This includes employees commuting to and from work, emissions from the external electricity generator, and extraction production and transport of purchased fuels that are consumed at the mine.

The estimated annual electrical power consumption and total greenhouse gas emissions for the project over the total mine life are shown in Tables 9.23 and 9.24.

Table 9.23 Estimated annual consumption of electrical power

Area	Installed Power kW	Average Consumed kWh	Annual Consumption (8760 hours) MWh	Scope 2 Annual (tCO ₂ -e)	Scope 3 Annual (tCO ₂ -e)
Mine construction (1 year)	64	64	561	485	99
Office and amenities					
Mine operations (8 years)	7,000	5,122	44,876	38,303	7,942
Crushing (2,000,000 t/a)	490	209	1,835	1,587	325
Milling, excluding the SAG mill	560	322	2,822	2,441	499
SAG mill	3,600	2,892	25,337	21,917	4,485
Process plant, excluding SAG mill	1,360	857	7,505	6,492	1,328
Services	390	242	2,121	1,835	375
Others	600	600	5,256	4,546	930

Source: Emission factors obtained from AGO Factors and Methods Workbook (December 2006).

Table 9.24 Estimated greenhouse gas emissions over the total mine life

Phase	Scope 1 (tCO ₂ -e)	Scope 2 (tCO ₂ -e)	Scope 3 (tCO ₂ -e)	Total emissions (Scope 1 to 3) (tCO ₂ -e)
Mine Construction (1 year)	1,763	485	351	2599
Mine Operations (8 years)	189,786	310,543	85,015	585,344
Mine Rehabilitation (3 months)*	4,050	-	450	4500
Total				592,443

Source: Emission factors obtained from AGO Factors and Methods Workbook (December 2006).

* No electricity will be consumed during the rehabilitation phase.

During the eight years of operations, the project is estimated to liberate a total of 585,344 t CO₂-e or, 73,168 t CO₂-e per year. The total greenhouse gas emissions estimated for the project over its mine life (12 months of construction, 8 years of mining operations and 3 months final rehabilitation) is 592,443 t of CO₂-equivalent, with fuel consumption estimates provided in Appendix 1C.

9.7.2 Avoidance, Mitigation and Management Measures

Avoidance, mitigation and management strategies that will be used to minimise increase in greenhouse gas emissions from the construction and operation are outlined below

Best practice environmental measures for reducing greenhouse gas emissions that will be employed during the construction and operations phases include:

- Developing and applying policies and procedures for energy efficient mine operation.
- Minimising haul distances.
- Monitoring energy consumption (e.g., diesel and electricity) and calculating greenhouse gas emissions.
- Where practicable, establishing measurable improvement targets (e.g., participation in revegetation programs) for greenhouse gas emission.
- Considering the use of alternate fuels (e.g., compressed natural gas or aquadiesel) and technologies.
- Considering the use of efficient siting and design of power-efficient lighting.
- Ensuring that vehicles (company-owned and contractors) are well maintained and correctly sized to maximise their fuel efficiency and minimise emissions.
- Reporting greenhouse gas emissions in accordance with the State and Territory Greenhouse Gas Inventory.

Hillgrove will also participate and comply with requirements of carbon trading schemes as they are implemented at state and national levels (proposed for introduction at the end of 2010 and 2014, respectively). The company will also support and comply with, as required, greenhouse gas emission targets outlined in any new legislation introduced, such as the proposed South Australian government Climate Change and Greenhouse Emissions Reduction Bill. This bill includes a target to reduce greenhouse emissions by 2050 to 60% of the emissions in 1990, an interim target of no greater than 108% of 1990 emissions during the period 2008 to 2012, and a secondary target for 20% of all electricity consumed to be generated from renewable sources by 2014.

9.7.3 Residual Impact Assessment

Table 9.25 summarises the residual impacts of the project after implementation of the management and mitigation measures described above.

Table 9.25 Summary of impacts resulting from greenhouse gas emissions

ID	Impact	Likelihood	Consequence	Residual Risk
I14	Increase in greenhouse gas emissions.	Virtually certain	Negligible	Low

In 2005, the total estimated CO₂-e emissions for Australia were 559.1 Mt (AGO, 2007) and, of this, South Australia produced 28.1 Mt (DEWR, 2007b). Comparison with the 0.592 Mt emissions for Kanmantoo over the total mine life (0.060 Mt/a) shows that the project will represent an increase in emissions of approximately 0.011% and 0.230%

relative to Australia’s and South Australia’s total emissions, respectively. Although emission of greenhouse gases due to project development is **virtually certain** to occur, the severity of this relatively small increase is predicted to be **negligible**, and therefore the residual risk is **low**.

9.7.4 Environmental and Social Objectives

The environmental and social objectives for greenhouse gas emissions, the assessment criteria and a summary of the control measures are listed in Table 9.26.

Table 9.26 Environmental and social objectives for greenhouse gas emissions

ID	Objective	Assessment Criteria	Summary of Control Measures
114	Greenhouse gas emissions minimised.	Annual reporting to PIRSA of greenhouse gas emissions in accordance with the State and Territory Greenhouse Gas Inventory.	Inventory of electricity and fuel usage maintained. Encouragement of energy saving initiatives. Vehicles and plant regularly serviced and operated appropriately.

9.7.5 Monitoring

An inventory of electricity and fuel usage will be established and maintained to enable calculation of greenhouse gas emissions. Greenhouse gas emissions will be reported annually to PIRSA in accordance with the State and Territory Greenhouse Gas Inventory.

Consumption rates of diesel-fuelled equipment (mining unit plant, pumps, pre-process plant, wet process plant, mining fleet) will be assessed regularly to determine whether they are operating efficiently.

9.8 Flora

This section is based on a flora assessment undertaken by Ecological Associates Pty Ltd for the Kanmantoo Copper Project. The results are reported in Appendix 5 and summarised below.

9.8.1 Potential Impacts

Potential, credible, project-related impacts to flora are described below. It should be noted that these do not take into consideration the proposed avoidance, mitigation and management measures that will be implemented by Hillgrove during all stages of project development (see Section 9.8.2), and that will result in the residual impacts discussed in Section 9.8.3.

Locating some project components in areas that are currently vegetated has only been proposed where it is unavoidable. Table 9.27 provides a summary of vegetation that will be cleared to accommodate project components such as the open pit, integrated waste landform, ROM pad, processing plant and access and other site roads (Figure 9.6). Section 5.8.2 provides a description of the vegetation communities.

Table 9.27 Summary of estimated areas (ha) of disturbance

Vegetation Community	Conservation Significance	Condition (SEB ratio) ¹ (A)	Area (ha) to be Cleared (B)	Area (ha) of Total Community in MLA Area (C)	% to be Cleared (B/C x 100)
<i>E. odorata</i> low woodland	National: critically endangered. State: priority 3.	8:1	1.23	14.90	8.25
		6:1	2.02	9.70	20.82
		4:1	0.32	28.50	1.12
		2:1	0.34	1.00	34.00
<i>L. effusa</i> ± <i>H. leucopsidium</i> open tussock grassland	National: critically endangered. State: priority 1.	8:1	9.59	17.80	53.88
		4:1	2.54	3.50	72.57
<i>Austrostipa</i> sp. open tussock grassland	Regional: threatened.	8:1	0.21	11.60	1.81
		6:1	0.00	4.70	0.00
		4:1	0.61	0.70	87.14
<i>E. leucoxydon</i> woodland	Regional: threatened.	6:1	0.00	1.27	0.00
<i>Allocasuarina verticillata</i> , ± <i>Callitris gracilis</i>	Not listed	8:1	0.00	1.84	0.00
<i>E. gracilis</i> ± <i>E. oleosa</i> open mallee	Not listed	8:1	2.79	4.00	69.75
<i>Acacia pycnantha</i> low woodland	Not listed	6:1	4.26	7.70	55.32
		4:1	2.57	3.50	73.42
<i>Callitris gracilis</i> low woodland	Regional: threatened.	8:1	0.19	0.19	100.00
Scattered trees		n/a	56 trees (24 with hollows)		
Total			26.67	110.9	24.05

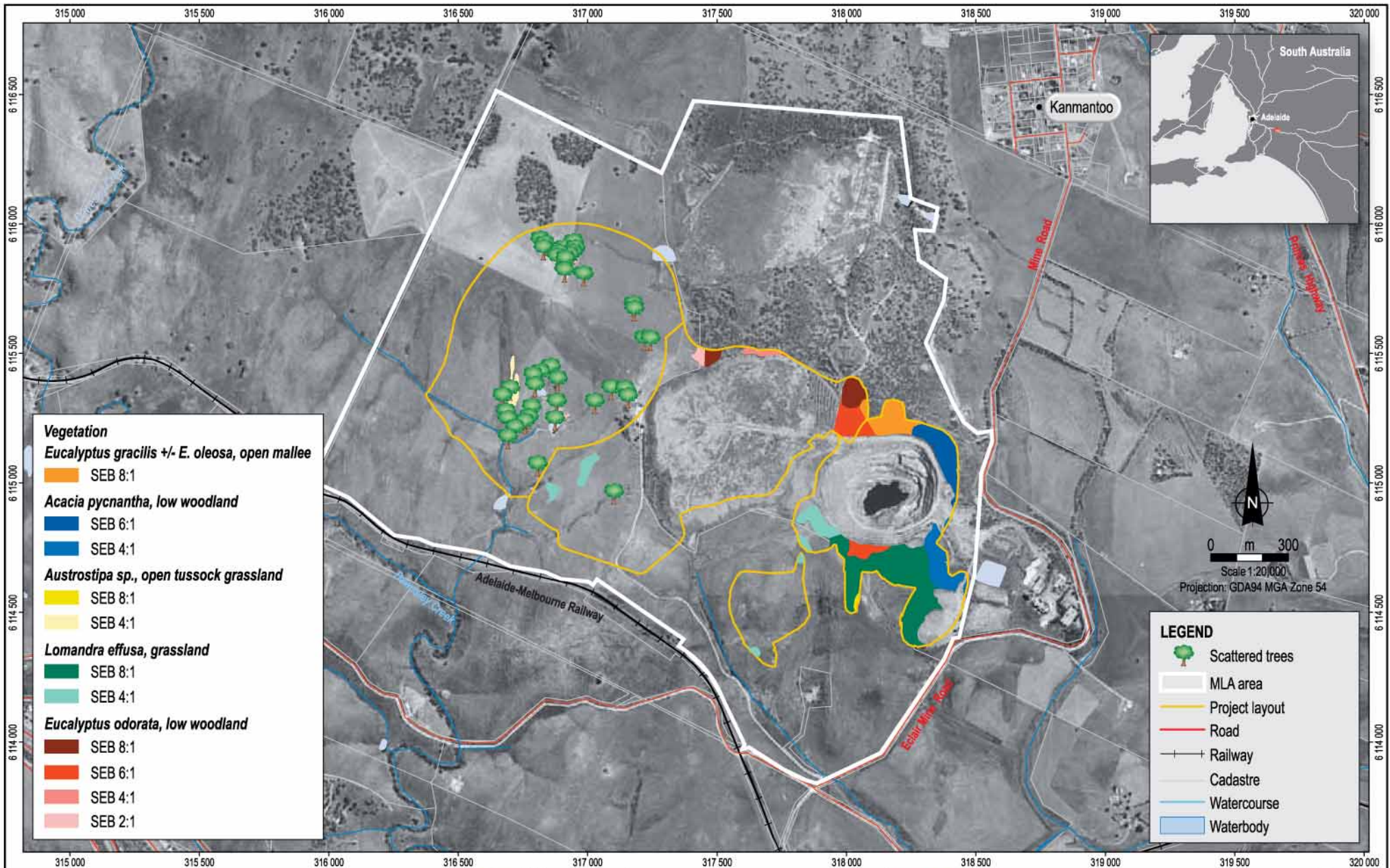
¹ The SEB ratio is based on the condition of the vegetation to be cleared. 8:1- very good condition, 6:1 - good condition, 4:1 - moderate condition, 2:1 - poor condition.

Under the *Native Vegetation Act 1991* any clearing of native vegetation for a mining operation must be undertaken in accordance with an approved native vegetation management plan that provides significant environmental benefits. The native vegetation management plan for the project is presented in Appendix 5.

Project-related potential impacts to flora that may occur in the absence of successful avoidance and management measures are described below.

Significant Impacts to Threatened Vegetation Communities

Project-related vegetation clearing may reduce the abundance of flora species within threatened vegetation communities in the MLA area and may also fragment and reduce the area of habitat available for dependent fauna species (the potential impacts of this are discussed in Section 9.9.1). Vegetation communities in very good and good condition are at the greatest risk of significant impacts from project-related disturbance.



- Vegetation**
- Eucalyptus gracilis +/- E. oleosa, open mallee*
 - SEB 8:1
 - Acacia pycnantha, low woodland*
 - SEB 6:1
 - SEB 4:1
 - Austrostipa sp., open tussock grassland*
 - SEB 8:1
 - SEB 4:1
 - Lomandra effusa, grassland*
 - SEB 8:1
 - SEB 4:1
 - Eucalyptus odorata, low woodland*
 - SEB 8:1
 - SEB 6:1
 - SEB 4:1
 - SEB 2:1

- LEGEND**
- Scattered trees
 - MLA area
 - Project layout
 - Road
 - Railway
 - Cadastre
 - Watercourse
 - Waterbody

Source:
 Place names, roads, drainage and cadastre from DEH, SA (optimum scale 1:50,000)
 Mine Layout from Hillgrove Resources
 Vegetation survey from Ecological Associates


 Date: 16.08.07
 MXD: HillgroveResources_KanmantooGIS
 Job No: 5000_02_F09.06_GIS_AI

Hillgrove Copper Pty Ltd
 Kanmantoo Copper Project



Native vegetation to be impacted by the project

Figure No: 9.6

Significant Impacts to Threatened Species

Species abundance can be measured by the density and diversity of species present (i.e., the number of individual plants in an area and the total number of species present in that area). Vegetation clearing may reduce the abundance of threatened flora species in the area of disturbance with consequent impacts to populations of threatened species at local and regional levels.

Reduced Species Abundance

Project related vegetation clearing will remove individual plants from the broader population of plants in and around areas affected by the project.

Reduced Conditions Favourable for Plant Growth

Vegetation clearing, vehicle movements and day-to-day operational activities will generate dust. This has the potential to reduce conditions favourable for plant growth (e.g., reduction in photosynthesis and respiration due to an accumulation of dust on plant surfaces or damage to plants from reactive dust particles) with subsequent reduced plant health.

Ground compaction, soil or water contamination and physical damage to vegetation in the MLA area may also reduce the ability of plants to become established, and limit the potential for regeneration and revegetation of disturbed areas.

Mine infrastructure may alter the runoff and drainage characteristics of the MLA area and have adverse affects on downstream vegetation. This may promote weed invasion, reduce plant health and degrade habitat for existing vegetation.

Groundwater drawdown caused by water extraction for processing and mine dewatering (see Section 9.4.1) has the potential to adversely impact overlying vegetation.

Introduction of New Weed Species and Increased Weed Density and Distribution

Vegetation clearing, land disturbance and vehicle movement (especially earth-moving equipment) has the potential to increase weed density and distribution by spreading propagules or creating conditions favourable for the establishment of weed species. Vehicle and equipment movement also has the potential to introduce weed species to the MLA area, via the import of seeds or vegetative matter. Track construction can fragment native vegetation, increasing the perimeter-to-area ratio, making vegetation remnants more vulnerable to weed invasion.

Provision of a Significant Environmental Benefit (SEB) – Positive Impact

To compensate for the unavoidable removal of some native vegetation by the project, Hillgrove are required to ensure that the project results in a significant environmental benefit (SEB) (see Section 4.1.2). This may have a positive impact to the flora of the MLA area, in particular the *E. odorata* woodland and *L. effusa* grassland vegetation communities and the fauna dependent on these vegetation communities for habitat and resources.

9.8.2 Avoidance, Mitigation and Management Measures

Avoidance, management and mitigation measures have been developed to reduce the risk of the potential impacts on flora described in Section 9.8.1.

The on-going implementation of site-specific management and mitigation measures will ensure that impacts to vegetation communities and threatened species are minimised. The development and implementation of the Native Vegetation Management Plan (Appendix 14) will allow the significant environmental benefit (SEB) requirements of the project to be met.

Significant Environmental Benefit Offset

Hillgrove's preferred option to meet its SEB requirements for the project is by:

- Providing for the ongoing protection and management of approximately 86 ha of remnant native vegetation within the MLA area.
- Upon project onset, commencing rehabilitation of all areas dominated by introduced pasture (approximately 100 ha to the south and west of the integrated waste landform).
- Progressively during operations and on closure, revegetating approximately 130 ha of the integrated waste landform.
- Revegetating backfilled areas of the pits (approximately 14 ha).
- Revegetating sections of the containment bund.
- Managing weeds in areas of remnant native vegetation in the MLA area, and in remnant *E. odorata* woodland in particular.
- Supporting community initiatives occurring offsite through donation of plants, equipment and funding (if necessary).

The fall-back option will be payment into the Native Vegetation Fund.

Hillgrove will work with the local community and other relevant stakeholders (e.g., Kanmantoo-Callington Landcare Group) to develop the best method to maximise the benefits of revegetation.

The rationale for the development of this SEB offset program is to:

- Protect, through improved management, all remaining vegetation within the MLA area (86 ha).
- Expand areas of *E. odorata* low woodland and *L. effusa* ± *H. leucopsidium* open tussock grassland which are of declared conservation significance at the national and state level.
- Improve existing areas of vegetation communities (*E. odorata* low woodland and *L. effusa* ± *H. leucopsidium* open tussock grassland) which provide habitat for the threatened diamond firetail and brushtail possum (listed and nominated for listing under the NPW Act).
- Replace the same habitat/vegetation types as those disturbed by the project.
- Provide links for dependent fauna by connecting vegetation remnants across the landscape.

- Improve remaining vegetation in poor, medium and good condition through weed management and exclusion of stock.
- Allow Hillgrove to manage parts of the offset area (existing vegetation and revegetated bare and degraded areas) initially as part of its operations (i.e., up until mine closure). The main advantage of this is that resources will be readily available and newly planted and demarcated areas can be closely monitored and managed.

Revegetation activities on purchased land will enable Hillgrove to closely monitor the success of plantings and use information to improve methods used for the progressive rehabilitation of areas disturbed during construction and operations within the MLA area. Specific management and monitoring measures for the offset area will be developed as part of the SEB offset area management and monitoring plan to be prepared by Hillgrove, but will include an annual survey of vegetation transects to be undertaken together with surveys of revegetated areas. A spring survey is planned for 2007.

The primary management objectives of the offset area will be the protection and enhancement (and control of threatening processes such as weed invasion, grazing and reduced conditions favourable to plant health) of the two national and state-listed vegetation communities and habitat for dependant fauna species. The management measures will include the prevention of impacts from stock grazing, weed invasion and revegetation.

The avoidance, management and mitigation measures detailed below will reduce the potential project-associated negative impacts to flora.

Vegetation Clearing

Measures to avoid, mitigate and manage the risks associated with vegetation removal include:

- Avoiding areas with vegetation communities of conservation significance. This includes *E. odorata* low woodland to the north of the old pit in good condition (7.7 ha) and patches along the northern boundary (12.5 ha) and in the northwest corner of the MLA area in moderate condition (7.0 ha), *L. effusa* ± *H. leucopsideum* open tussock grassland close to the southern boundary of the MLA area in very good and good condition (1.0 and 2.0 ha), and *Austrostipa* sp. open tussock grassland to the south of the old pit in good condition (4.7 ha).

Since project onset, by modification to the mine design, Hillgrove has reduced the area of vegetation to be cleared from 31.6 to 26.7 ha. In particular, the area of *E. odorata* low woodland to be cleared has been reduced from 8.6 ha to 3.9 ha, and the area *Austrostipa* sp. open tussock grassland to be cleared has been reduced from 3.7 to 0.8 ha.

- Minimising clearing of areas with vegetation communities of conservation value. This includes vegetation in:
 - Very good condition (*E. odorata* low woodland to the north (12.1 ha) and northwest (2.8 ha) of the old pit, *L. effusa* open tussock grassland to the immediate south of the old open pit (17.8 ha) and 11.6 ha of *Austrostipa* sp. open tussock grassland on the western slope of MacFarlane Hill). Since the

initial project layout, the requirement for the clearing of *E. odorata* low woodland in very good condition has reduced from 3.8 to 1.23 ha. This was achieved in part by relocating the TSF and designing the pit and locating the haul road to avoid disturbance to *E. odorata* low woodland.

- Good condition (4.0 ha of *E. leucoxydon* open woodland).
- Moderate condition (0.6 ha of *L. effusa* open tussock grassland).

The area of *Austrostipa* sp. open tussock grassland in very good condition to be cleared has reduced from 2.8 to 0.21 ha. This has been achieved through by reducing the size of the open pit.

- Erecting flagging tape to mark 'no-go' zones to ensure areas to be protected are clearly defined, identified and avoided and that clearing and ground disturbance is only occur within designated areas.
- Ensuring the development and implementation of vegetation clearance protocols (including an internal clearance procedure) and assessing performance against them.
- Avoiding introduction of soil pathogens to areas of remnant native vegetation by excluding soil stockpile sites from these areas and by clearly demarcating appropriate soil stockpile sites.
- Progressively rehabilitating disturbed areas and avoiding unnecessary future disturbance of these areas.
- Revegetating, using appropriate species, to link isolated vegetation remnants within the MLA area.
- Establishing a seed and cutting collection protocol and seed bank as soon as possible.
- Implementing methods to monitor and maintain progressively rehabilitated and revegetated areas as outlined in Section 9.8.4.
- Ensuring that all requirements of the Native Vegetation Management Plan are met.

Threatened Species Relocation

Hillgrove will consult with SA DEH and other qualified professionals concerning the relocation of individual threatened flora species *Diuris behrii* and *Ptilotus erubescens* (if identified) from directly impacted areas.

Weed Infestation and Introduction

Eradicating existing weeds in the MLA area will be difficult due to the well-established nature of many of these species. As a result, efforts will be concentrated on avoiding or eradicating any new populations of previously unknown weed species and on controlling the density and distribution of existing known weed infestations. Measures designed to avoid, minimise and manage the risks associated with weed infestations as a result of the project include:

- Reducing the area of vegetation to be cleared.
- Ensuring that vehicles and project equipment arrive on site free of vegetative matter, seeds and mud.
- Focusing on the control of declared weed species present in the MLA area (e.g., bridal creeper (*Asparagus asparagoides*)), and the prevention of their spread during the life of the project.
- Liaising with government agencies such as DEH, DWLBC or PIRSA, and the Kanmantoo–Callington Landcare Group on appropriate measures to eradicate or control weed outbreaks, should they occur.
- Implementing targeted weed control measures for any observed significant increase in the distribution or density of existing weeds, or new populations of weeds.
- Regularly monitoring areas with a high potential for, or susceptibility to, weed invasion, such as along roadsides, recently cleared areas and permanently wet areas such as the banks of the water storage facilities and drains, particularly following rainfall events.
- Controlling or preventing weed infestations in topsoil stockpiles to minimise the likelihood of weed introduction or increased distribution during respreading of topsoil.
- Progressive rehabilitation of disturbed areas to reduce the potential for weed species to become established.
- Ensuring all requirements of the Native Vegetation Management Plan (see Appendix 14) are met.

Dust Suppression

Measures designed to avoid, minimise and manage the risks associated with dust generation are outlined in Section 9.2.2 and Section 9.5.2.

Soil Contamination

Measures designed to avoid, minimise and manage the risks associated with acid rock drainage are outlined in Section 9.3.2.

Reduced Groundwater Availability

Measures designed to avoid, minimise and manage the risks associated with reduced groundwater availability are outlined in Section 9.4.2.

Grazing Animals

Measures designed to avoid, minimise and manage the risks associated with an increased attraction of grazing animals include:

- Maintaining perimeter fencing to prevent stock accessing the site.
- Managing revegetated areas to prevent overgrazing from native fauna (e.g., wallabies and kangaroos), introduced pest animals (e.g., rabbit and hare) and stock.

- Minimising the potential for water to pool in areas where it is applied as a dust suppressant (e.g., along unsealed haul roads) to reduce the attraction for animals.
- Implementing a pest animal management program including baiting, burrow ripping and monitoring to control rabbit and hare populations.

Surface Water Hydrology

Measures designed to avoid, minimise and manage the risks associated with changed surface water hydrology are outlined in Section 9.3.2.

9.8.3 Residual Impact Assessment

Table 9.28 summarises the residual impacts of the project to flora, considers the likelihood and consequences of the impacts (taking into account proposed management measures) and provides an overall risk rating for each potential impact. These are discussed in detail below.

Table 9.28 Summary of impacts and risks to flora

ID	Impact	Likelihood	Consequence	Residual risk
I15	Significant impacts to threatened vegetation communities: - <i>Austrostipa</i> sp. open tussock grassland. - <i>Callitris gracilis</i> low woodland. - <i>L. effusa</i> open tussock grassland/ <i>E. odorata</i> low woodland in poor to moderate condition. - <i>L. effusa</i> open tussock grassland/ <i>E. odorata</i> low woodland in good to very good condition.	Possible Unlikely Virtually certain Virtually certain	Negligible Negligible Negligible Minor	Low Very low Low Medium
I16	Significant impacts to threatened flora species.	Possible	Minor	Low
I17	Reduced species abundance (as a result of clearing).	Virtually certain	Negligible	Low
I18	Reduced species abundance (as a result of grazing).	Unlikely	Negligible	Very low
I19	Reduced conditions favourable for plant growth due to dust.	Possible	Negligible	Low
I20	Reduced conditions favourable for plant growth due to disturbance, soil or water contamination, physical damage to vegetation, changed surface water hydrology and groundwater extraction.	Unlikely	Negligible	Very low
I21	Introduction of new weed species and increased weed density and distribution.	Unlikely	Moderate	Low
I22	Introduction of a native vegetation SEB offset area, which will: - Improve the condition of <i>E. odorata</i> woodland in the MLA area. - Improve the condition of <i>L. effusa</i> grassland in the MLA area. - Provide long-term protection of the native vegetation in the MLA area.	Virtually certain	Moderate	High benefit

Significant Impacts to Threatened Vegetation Communities

Approximately 0.6 ha of *E. odorata* low woodland, 2.5 ha of *L. effusa* ± *H. leucopsideum* open tussock grassland and 0.6 ha of *Austrostipa* sp. open tussock grassland all in poor to moderate condition, will be cleared as a result of the project. It is therefore **virtually certain** that significant impacts to these threatened vegetation communities in poor to moderate condition will occur. However, the consequence of is **negligible** given that vegetation in these areas shows considerable disturbance from past clearance, as shown by access tracks, overstorey depletion, moderate understorey diversity, moderate to high weed cover and moderate to low litter and woody debris. Natural regeneration and rehabilitation will compensate for vegetation lost during clearing (although this will depend on the extent to which the same species and ecosystem function are reinstated). The residual risk is therefore **low**.

Approximately 0.2 ha of *Austrostipa* sp. open tussock grassland and 0.2 ha of *Callitris gracilis* low woodland in very good condition will be removed as a result of the project. It is therefore **unlikely** that this small area of clearance would result in a significant impact to these regionally significant vegetation communities. Given their occurrence elsewhere in the region the consequence of impacts to these communities is **negligible**. The residual risk is therefore **very low**.

Approximately 9.6 ha of very good condition *L. effusa* ± *H. leucopsideum* open tussock grassland will be removed as a result of the project. It is therefore **virtually certain** that significant impacts (i.e., clearance and fragmentation of the nationally-listed critically endangered community) to this vegetation community will occur. The consequence of this is **minor** given that occurrences of this vegetation community within the MLA area represent only a small proportion (approximately 0.4%) of the high quality remnants of the vegetation community on the eastern slopes of the Southern Mount Lofty Ranges. The residual risk is therefore **medium**.

Of the 54.1 ha of *E. odorata* low woodland occurring in the MLA area, approximately 1.2 ha in very good condition and 2.0 ha in good condition will be removed as a result of the project. It is therefore **virtually certain** that significant impacts to *E. odorata* low woodland in very good condition will occur. This vegetation community is nationally listed as critically endangered and is poorly conserved in South Australia, with most remnants small and/or degraded and atypical. *E. odorata* low woodland in the MLA area is one of the largest remnants in the eastern slopes of the Southern Mount Lofty Ranges. However, the vegetation to be removed represents less than 10% of the high quality *E. odorata* low woodland in the MLA area and only 3% of all high quality *E. odorata* low woodland in the region. The area of vegetation to be cleared is as low as reasonably practicable and is the minimum area required for construction of the Main pit and site road (3.2 ha) and at least 21.25 ha of high quality *E. odorata* low woodland (and approximately 50 ha in total) in the MLA area will be protected as part of the SEB offset. The clearing of this vegetation community is therefore expected to have a **minor** consequence. The residual risk is therefore **medium**.

Significant Impacts to Threatened Flora Species

The 26.7 ha of vegetation to be cleared to accommodate project components has been found to support two flora species that are threatened on a state scale: *Diuris behrii* (Behr's cowslip orchid) and *Ptilotus erubescens* (hairy-tails). Nineteen species of

regional significance, including four species listed as rare in the Murray botanical region, have the potential to occur in vegetation to be cleared.

It is therefore **possible** that project-related disturbance will result in significant impacts to threatened flora species. The SEB offset measures outlined in the Native Vegetation Management Plan (Appendix 14) (and summarised in Section 9.8.2) will provide compensation for any removed threatened species in the MLA area and will mitigate the likelihood of impacts to threatened species to some extent. Additionally, the relocation of individual threatened species will be investigated. The consequence of impacts to threatened species is therefore considered **minor**, and the residual risk is therefore **low**.

Reduced Species Abundance

Approximately 26.7 ha of vegetation will be removed as a result of the project. It is therefore **virtually certain** that the abundance of species present within the MLA area will reduce. The consequence of reduced species abundance (with the exception of threatened species and communities discussed above) is **negligible** given their occurrence elsewhere in the region. The residual risk is therefore **low**.

The attraction of grazing animals to the MLA area will be prevented wherever possible and undertaken in accordance with the control measures outlined above. Maintaining perimeter fencing is expected to prevent livestock from accessing areas retaining surface water and the MLA area will be monitored and management measures taken as appropriate to prevent overgrazing by native fauna (e.g., wallabies and kangaroos) and introduced pest animals (e.g., rabbits and hares). Increased grazing impacts as a result of the project are therefore expected to be **unlikely**. The consequence of reduced species abundance in these communities as a result of grazing is **negligible** given their occurrence elsewhere in the region. The residual risk is therefore **very low**.

Reduced Conditions Favourable for Plant Growth Due to Dust

Dust suppression measures such as using water or dust suppressants on trafficked areas will be used throughout the life of the project to minimise dust emissions (see Section 9.5.2). However, given the nature of construction and operations activities it is **possible** that reduced conditions favourable for plant growth will occur.

Increased dust is not likely to lead to long-term changes in flora composition, as impacts are likely to be localised in nature and able to be rehabilitated. The effect of reduced conditions favourable for plant growth due to dust is therefore **negligible** and the residual risk is **low**.

Reduced Conditions Favourable for Plant Growth Due to Disturbance, Soil Contamination, Changed Surface Water Hydrology and Reduced Groundwater Availability

Groundwater-dependant terrestrial vegetation is unlikely to occur within the MLA area (except possibly along drainage lines, and even then it is expected that the patches of riparian vegetation (which are dominated by introduced species) are dependent on perched watertables and higher soil water content rather than the regional watertable). Given the footprint of the project, the nature of construction and operation activities, and the control measures to be implemented (see Sections 9.2.2, 9.3.2, 9.8.2 and 9.10.3), it

is **unlikely** that these causes will reduce conditions favourable for plant growth beyond the immediate project footprint. The effect of reduced conditions favourable for plant growth due to these causes is **negligible** given that impacts will be localised in nature and able to be rehabilitated both progressively and following project completion. The residual risk is therefore **very low**.

Introduction of New Weed Species and Increased Weed Density and Distribution

Weed management measures outlined in Section 9.4.2, such as minimising the area of vegetation disturbed and regularly monitoring and promptly controlling any outbreaks of weed infestation, will reduce the likelihood for significant increases in the introduction, density or distribution of weeds. As a result, it is **unlikely** that the project will result in the introduction of new weed species or increased densities and distribution of weed species, and it may well result in a decrease in weed numbers across the MLA area.

Given that weeds have the potential to change the composition and abundance of native vegetation communities and that rehabilitation of areas infested by weeds can be difficult, the potential consequence is **moderate**. The residual risk is therefore **low**.

Provision of a Significant Environmental Benefit – Positive Impact

The establishment and ongoing management of the SEB offset is **virtually certain** and will provide a project-derived environmental benefit. The primary management objectives of the offset will be the protection and enhancement (and control of threatening processes such as weed invasion, grazing and reduced conditions favourable to plant health) of the two national and state-listed vegetation communities (*E. odorata* woodland and *L. effusa* grassland) and habitat for dependant fauna species such as the diamond firetail and brushtail possum. This will lead to **moderate** environmental benefits to the flora of the MLA area. Therefore, the residual benefit to flora is **high**.

9.8.4 Environmental and Social Objectives

The environmental and social objectives for flora, the assessment criteria and a summary of the control measures are listed in Table 9.29.

Table 9.29 Environmental and social objectives for flora

ID	Objective	Assessment Criteria	Summary of Control Measures
I15, I16, I17, I18, I22	No significant adverse impact on the abundance of threatened or non-threatened native flora species or communities.	<p>Native vegetation clearance in accordance with approved Native Vegetation Management Plan.</p> <p>Flora surveys (including photographic monitoring) at selected sites to detect changes in abundance, composition or condition of flora species against baseline shows no significant impact.</p> <p>Follow-up Spring survey to initial baseline flora undertaken when seasonal conditions are favourable.</p> <p>Monitoring of SEB offsets shows objectives are being achieved.</p> <p>Perimeter fencing installed and 'no go zones' clearly defined.</p>	<p>Establishment and ongoing management of SEB offset areas.</p> <p>Clear identification and documentation of areas to be protected and areas to be cleared.</p> <p>Ensuring areas to be disturbed are minimised and clearing complies with relevant requirements.</p> <p>Avoidance of threatened vegetation communities and flora species during the design phase where practicable.</p> <p>Implementation of the Native Vegetation Management Plan.</p> <p>Progressive rehabilitation.</p>

Table 9.29 Environmental and social objectives for flora (cont'd)

ID	Objective	Assessment Criteria	Summary of Control Measures
I19, I20	Avoid the reduction of conditions favourable for plant growth.	Records of disturbed areas and rehabilitated areas show that no unnecessary disturbance has occurred. See also I15, I16, I17, I18.	Implementation of dust control measures as for I10, I11 and I12. Ensuring areas to be disturbed are minimised and clearing complies with relevant requirements (see also other control measures for I15, I16, I17, I18).
I21	No significant increase in weed density or distribution and no introduction of new weeds.	Monitoring shows no increase in weed density or distribution and no introduction of new declared weeds (when compared to control sites or baseline data).	Inspection and wash down of vehicles and project equipment. Control of declared weed species. Regular monitoring for weed outbreaks and implementation of weed control measures. Minimisation of disturbance areas.

9.8.5 Monitoring

Ongoing vegetation monitoring will be conducted to allow identification of any impacts of mine construction and operations on native flora. Monitoring will be conducted in vegetation communities identified during the baseline survey (see Section 5.9.2 for locations) and any new areas as considered appropriate.

Methods and Frequency

Monitoring sites will be visually inspected and photographed to allow assessment of:

- Changes in the abundance, composition or condition of vegetation communities, particularly threatened vegetation communities.
- Ongoing impacts to flora as a result of project-related activities.
- Increases in the density and distribution of known weed infestations.
- Introduction of new weed species.

Transects will be used to allow the comparison of quantitative data on shrub numbers in the different vegetation communities, and between near-mine and control sites.

Vegetation monitoring will be timed as follows:

- During Spring 2007, to identify annual and ephemeral species not recorded during the February 2007 survey (providing conditions are more favourable for the growth of these species than occurred earlier in 2007).
- Annually thereafter during construction and operations.
- Post-closure.

Vegetation monitoring will be designed to target the identification of the presence or absence of species of conservation significance and to monitor the health of vegetation

communities in terms of vegetation structure (e.g., all strata intact), plant condition, level of disturbance (individual species or whole community), presence or absence of weeds and accumulation of litter.

Species of conservation significance targeted for identification during monitoring will include *Diuris behrii* and *Ptilotus erubescens*.

Monitoring to be conducted in the SEB offset area will be detailed in the SEB Offsets Management and Monitoring Plan, which will be submitted to PIRSA (and other relevant agencies) under separate cover.

Monitoring Sites

One quadrat (30 by 30 m) within each of the following major vegetation associations (see Figure 5.21) was surveyed to prepare detailed quadrat descriptions:

- *Austrostipa* spp. open tussock grassland.
- *Lomandra effusa* ± *Heliochrysum leucopsideum* open tussock grassland.
- *Eucalyptus odorata* low woodland.
- *Eucalyptus gracilis* ± *Eucalyptus oleosa* open mallee.

Quadrat locations and the permanent vegetation monitoring sites positions are listed in Table 9.30. These sites, or other suitably representative sites, will be established as permanent monitoring sites and monitoring will be conducted annually. Monitoring will focus on identifying the presence or absence of flora and fauna species of conservation significance at these locations and any impacts that have occurred.

Table 9.30 Location and description of permanent vegetation monitoring sites

Quadrat	Location ¹	Position	Vegetation Type	Existing Impacts	Structural Formation
1	E 318028 N 6114410	Northwest corner of quadrat	<i>Austrostipa</i> sp. open tussock grassland	None	Dominant overstorey
2	E 318139 N 6114550	Northwest corner of quadrat	<i>L. effusa</i> ± <i>Heliochrysum leucopsideum</i> open tussock grassland	Access track, gully erosion	Dominant overstorey, emergent
3	E 318106 N 6115523	Southwest corner of quadrat	<i>E. odorata</i> low woodland	Access tracks	Overstorey and understorey species

¹ Projection: GDA 94 MGA Zone 54

Pest Plant Monitoring

Hillgrove will ensure that all vehicles and plant brought to the mine or transferred between properties are visually inspected to check they are free of seeds and other plant material. Areas with a high potential for or susceptibility to invasion by pest plants, such as along roadsides, recently cleared areas and permanently wet areas (such as sewage ponds and drains), will be monitored annually or after disturbance events.

Monitoring for pest plants will include:

- Inspecting for pest plant outbreaks during Spring and Autumn and recording the number and size of infestations and the control treatment applied.

- Inspecting for pest plants after significant germination events and recording of level of pest plant invasion.

Vegetation Clearance Monitoring

All areas to be cleared for project purposes will be documented, recording the area and nature of the vegetation cleared. Each area cleared will be inspected to ensure that clearance is conducted in accordance with the conditions of the NVMP (Appendix 14).

9.9 Fauna

This section is based on a fauna assessment undertaken by Ecological Associates Pty Ltd for the project. The results are reported in Appendix 6 and summarised below.

9.9.1 Potential Impacts

Potential, credible, project-related impacts to fauna are described below. It should be noted that these do not take into consideration the proposed avoidance, mitigation and management measures that will be implemented by Hillgrove during all stages of project development (see Section 9.9.2), and that will result in the residual impacts discussed in Section 9.9.3.

Native bird, reptile and mammal species, including some species of conservation significance, may be affected by the project. Vegetation clearing and ground disturbance during construction (see Tables 9.27 and 6.2 for areas of vegetation clearance and total disturbance respectively) has the potential to reduce areas of habitat and resources within the MLA area. The potential impacts to fauna are discussed below.

Reduced Species Abundance

Species abundance can be measured by the density and diversity of species present (i.e., the number of individual animals in an area and the total number of species present in that area). There is potential for species abundance to be reduced as a result of:

- **Vegetation Clearing and Ground Disturbance.** Vegetation clearing and ground disturbance will remove fauna habitat, reduce resources for fauna species resident within the MLA area and increase inter- and intra-specific competition for food and habitat, with potential changes in the abundance of native fauna species in the MLA area.
- **Noise and Vibration.** Project construction and operations will create noise and vibration emissions, typically generated by vehicle traffic, excavations, blasting and ore processing.
- **Increased Light at Night.** Project construction and operation will result in increased light levels in an otherwise dark area that provides habitat for fauna. This light emission may result in some species being displaced from habitat near to project infrastructure in the MLA area.
- **Surface Water Contamination.** Waterbodies established as part of the project (e.g., process sediment pond and TSF return water storage) may attract waterbirds from The Coorong wetland and Alexandrina and Albert lakes, although this must be considered in the context of the very small area of waterbodies associated with the

project (approximately 6.5 ha) relative to the massive expanse of wetlands (almost 140,000 ha) located approximately 40 km south. There is the potential for adverse impacts to visiting waterbirds if these waterbodies are contaminated. Contaminated surface water also has the potential to adversely impact aquatic fauna in downstream environments such as the Bremer River.

Significant Impacts to Threatened Species

Three bird species of listed conservation significance, i.e., the diamond firetail (NPW Act), the peregrine falcon (NPW Act) and the rainbow bee-eater (EPBC Act), have been recorded in the MLA area. The diamond firetail is a resident species in the *E. odorata* low woodland in the north of the MLA area, while a pair of peregrine falcons is resident and nests annually in the face of the old open pit. The rainbow bee-eater is a seasonal migratory visitor to southern Australia that feeds and roosts in the MLA area. One mammal species nominated for listing under the NPW Act, the brushtail possum, is resident within the *E. odorata* woodland and relies on this habitat for food and shelter.

Ground disturbance (including mining) and vegetation clearing, in particular the clearing of high-quality *E. odorata* woodland, may reduce the abundance of threatened animal species in the MLA area. This may result in significant impacts to resident threatened species at a local, regional, state or national level, due to a lack of other suitable habitat surrounding the MLA area.

Increased Abundance of Introduced Species

Project construction and operations have the potential to create conditions favourable for increased abundances of introduced species such as foxes, rabbits, hares and house mice that, with the exception of house mice, are currently present in low densities across the MLA area.

The construction of waterbodies and presence of domestic waste near the administration plant facilities may provide food and shelter for these species. If not properly controlled, there is the potential for the populations of introduced species to increase as a result of these additional resources, although the nearby residences and the towns of Kanmantoo and Callington are likely to provide similar refuges for introduced species.

Increased abundance of introduced foxes and potentially feral cats is likely to increase predation pressure on native bird, reptile and mammal species, leading to a reduction in their population size. House mice are already present in the MLA area in significant numbers, although an increase in their population may further increase competition for resources with small native mammal species and dislocate them from preferred habitat.

9.9.2 Avoidance, Mitigation and Management Measures

Avoidance, management and mitigation measures have been developed to reduce the risk of the potential impacts to fauna outlined described in Section 9.9.1.

It should be noted that since Hillgrove has owned the MLA area, it has been involved in land management activities that have included the removal of grazing stock.

Significant Environmental Benefit Offset

As described in Section 4.1.2, Hillgrove is required to provide a significant environmental benefit (SEB) as a result of the project. The SEB offset outlined in Section 9.8.2 and detailed in Appendix 14 is designed to maximise the environmental value of the protected area and to provide habitat for threatened fauna species, particularly those dependent on *E. odorata* woodland habitat. This offset will significantly mitigate project-associated impacts to fauna, by improving and providing long-term protection for this habitat type.

The main activities to be conducted in the offset that are specific to fauna include:

- Protection and expansion of *E. odorata* and *L. effusa* habitat.
- Exclusion of stock.
- Control of feral animals.
- Control of weed species.
- Relocation⁶ of threatened species such as the diamond firetail and brushtail possum from directly impacted areas.

The avoidance, management and mitigation measures detailed below will further reduce the potential project-associated impacts to fauna.

Habitat Removal

The areas of vegetation to be cleared are summarised in Table 9.27. During the design phase the project footprint has been minimised and located to avoid disturbance to key habitats (i.e., high quality *E. odorata* woodland and *L. effusa* grassland habitat) where practical. Other measures to avoid, mitigate and manage the risks associated with habitat removal include (see also Section 9.8.2):

- Minimising the area of vegetation clearance in woodland vegetation.
- Consolidating areas of vegetation to be cleared for access tracks and infrastructure pathways so that large blocks of habitat, rather than small fragments, are preserved.
- Rehabilitating cleared land both progressively during the life of the project and following project completion.

Threatened Species

A threatened species management plan, which will incorporate mitigation measures such as relocation of resident species (e.g., diamond firetail and brushtail possum) from areas to be disturbed, will be developed for the MARP. An SEB offset management plan will also be prepared following a decision to proceed with the project, and will provide

⁶ Hillgrove will consult with SA DEH and other qualified professionals regarding any relocation of threatened species.

further detail for the management of threatened species in the region. This will be based on further survey work and monitoring in the MLA area and broader Mount Lofty region (see Appendix 14) and will comprise:

- Surveying the diamond firetail population in the MLA area to determine the overall population size, the number and size of diamond firetail flocks and the habitat use of the birds in the MLA area.
- Conducting a capture/mark/release program to assess population characteristics.
- Identifying and surveying high-quality habitat likely to contain diamond firetails in the broader region (i.e., Mount Lofty ranges).

This will provide information regarding the distribution and population status of the diamond firetail in the MLA area within a regional context. This information will then be used to inform the development of those aspects of the threatened species management plan specific to the diamond firetail, including options for enhancing and protecting *E. odorata* woodland habitat for the benefit of this species.

Disturbance Due to Noise and Vibration

Measures designed to avoid, mitigate and manage the risks associated with increased levels of noise and vibration are outlined in Section 9.6.2. Those measures specific to fauna include:

- Noisy infrastructure (e.g., crusher, processing plant) has been located to the west of the Main pit, minimising the potential for disturbance to fauna resident in the *E. odorata* woodland to the north.
- Where possible, vehicle and machinery access roads will be located outside high-quality *E. odorata* and *L. effusa* habitat to minimise the potential for disturbance to resident fauna.
- Limiting the number of roads constructed in the MLA area.
- Blasting will occur during the day, which will minimise the potential for disturbance to nocturnal species such as the brushtail possum which forage at night, and bird and mammal species particularly active at dawn and dusk.

Disturbance Due to Increased Light Levels at Night

Measures designed to avoid, mitigate and manage the risks associated with increased levels of light at night are outlined in Section 9.13.2. Those measures specific to fauna include:

- Restricting omni-directional exterior lighting use where possible, and preferential use of vertical beams, shields and spotlights to minimise the spill of stray light at night.
- Establishing native trees and shrubs in strategic areas to minimise the penetration of light outside these areas and into fauna habitat.

Increased Abundance of Introduced Species

Measures designed to manage and mitigate the risks associated with an increased abundance of introduced species include:

- Controlling existing feral animal populations by methods including ripping rabbit warrens and baiting foxes and feral cats.
- Targeting new populations, or significant increases in the current population, of foxes and/or feral cats.
- Ensuring that waste management procedures (see Section 6.12) are diligently followed to reduce potential resources for these species.
- Regularly monitoring areas with a high potential for, or susceptibility to, increases in abundance of introduced species (e.g., administration and plant facilities, water sources, waste storage areas and around water sources).

Potentially Contaminated Water

TSF return water storage may contain contaminants in concentrations that are toxic to wildlife, particularly wetland birds. Design and processing features that mitigate this potential impact for this project include:

- The absence of cyanide from the processing circuit. Cyanide is a major cause of bird deaths at other mine sites.
- The use of thickened tails and maximum recycling of tailings liquor, thereby minimising the amount of free-standing water present in the TSF.

Following significant rainfall during construction, surface run-off may contain sediment and metal concentrations that have the potential to be toxic to wildlife, and aquatic fauna in particular. Management and mitigation measures to address this include (see Section 9.3.2 for further detail):

- Sediment release and erosion control measures to minimise the release of sediment to receiving surface water environment.
- Rehabilitation of disturbed areas progressively during construction, where possible.
- Containment and reuse of all potentially contaminated waters in the MLA area (except during extreme rainfall events), thereby minimising the potential for discharge of contaminated water to surrounding surface water.

Other measures such as netting of the water storages or the use of passive deterrent devices may be considered if the water storages are shown to contain toxic levels of contaminants and are attracting fauna.

9.9.3 Residual Impact Assessment

Table 9.31 summarises the residual impacts of the project to fauna, considers the likelihood and consequences of the impacts (taking into account proposed management measures), and provides an overall risk rating for each potential impact. These are discussed in detail below.

Table 9.31 Summary of impacts to fauna

ID	Impact	Likelihood	Consequence	Residual Risk
I23	Reduced species abundance.	Likely/Possible*	Minor	Medium
I24	Significant impacts to threatened species.	Virtually impossible/ Possible/Unlikely#	Severe	Medium
I25	Increased abundance of introduced species.	Unlikely	Minor	Low

* Likelihood depends on cause of reduced species abundance.

Likelihood depends on the species.

Reduced Species Abundance

The project's footprint is approximately 200 ha, with some of the project components being unavoidably located in areas that currently provide habitat for a range of bird, reptile and mammal species. As a result of vegetation clearing, that habitat will be lost during the life of the project and fauna may be forced out of the area or die. Fauna may also move out of the immediate vicinity of the mine due to noise, light, dust and vibration emissions. Therefore, it is **virtually certain** that the abundance of fauna species present in the immediate footprint of the project and surrounds will be reduced.

Most of the vegetation to be removed is *E. odorata* woodland and *L. effusa* grassland of varying quality. These habitats support a high proportion of the native bird, reptile and mammal species present in the MLA area. However, most species are relatively common in the Mount Lofty ranges (apart from the threatened species discussed below).

At a community level, the loss of habitat is expected to have a **minor** effect on the abundance, diversity, geographic distribution and viability of native fauna populations. All reptile and mammal species and the majority of bird species recorded during the surveys are relatively common. Animals able to relocate prior to clearing will not be significantly affected by project activities, and none of the project infrastructure will encircle habitats and prevent fauna from moving between habitat patches.

The location of project infrastructure away from key areas of high quality habitat will minimise the potential for impacts to fauna due to disturbance, although some disturbance is inevitable. Noise, vibration, light and dust due to vehicle traffic, blasting, excavations and ore processing in the MLA area are **likely** to disturb fauna. The louder and longer the duration of the noise and vibration, the greater the impact on species present will be. Species sensitive to disturbance by noise, vibration and light are likely to relocate to other suitable habitat in the MLA area, particularly the high quality *E. odorata* woodland in the northeast of the MLA area. The location of the processing plant to the west of the open pit will maximise the distance between the processing plant and this key habitat, thereby minimising the likely noise disturbance levels to fauna. Impacts are likely to be more pronounced in social species such as the diamond firetail whose calls may be masked by project noise, or nocturnal species sensitive to light such as the brushtail possum. There is the potential that in time, fauna in the MLA area may become tolerant to disturbance and re-colonise habitat previously vacated. This is likely to occur after construction of the project is complete. Should this occur, the residual risk to fauna may decrease.

Impacts to aquatic fauna are **possible**. Controls will be implemented to prevent contaminated site water entering the environment (see Section 9.3.2), although increased sediment load and metal concentrations are possible in surrounding streams during periods of ephemeral flow (see Section 9.3.3 for further detail), with impacts to the abundance of aquatic fauna species. Given the significantly modified nature of the aquatic environment in the Dawesley and Mount Barker creeks due to the Brukunga mine and previous mining and smelting activities at Kanmantoo, the consequence of these impacts is considered **minor**.

Water contained in the pit post-closure is not likely to pose a risk to waterbirds. There has been no evidence of bird trauma associated with the acidic water in the current pit.

The consequence of reduced species abundance in the MLA area is **minor**. Impacts are not expected to result in significant long-term changes to fauna composition in the region. Natural regeneration of vegetation, and ultimately rehabilitation, will at least partially compensate for habitat removed during clearing (see Chapter 11 for rehabilitation details). The provision of the SEB for the project will also assist in the mitigation of impacts associated with native vegetation clearing. The regeneration of this habitat will allow for the re-colonisation of disturbed areas by native fauna species following project closure. It is expected that, if carefully managed over time, the rehabilitated areas (outside the mine pit) will provide similar habitat to that present prior to clearing. This has been demonstrated by the recovery of areas impacted by previous activities at the site.

Given the **virtually certain** likelihood that this impact will occur within the immediate MLA area, yet the **minor** consequence of such an impact, the residual risk is **medium**.

Significant Impacts to Threatened Species

The project is highly unlikely to have a significant impact to EPBC Act-listed fauna species. However, one migratory EPBC Act-listed species (the rainbow bee-eater) is a seasonal visitor to the MLA area.

Approximately 3.25 ha of high quality (good and very good condition) vegetation will be cleared in the *E. odorata* woodland. This habitat currently supports populations of the NPW Act listed diamond firetail and the brushtail possum, which is currently nominated for listing. As a result, reduced abundance of threatened species in the MLA area is likely to occur. The implications of this reduced abundance are discussed below for each species. The clearance of *L. effusa* grassland is not expected to result in significant impacts to threatened species, as this habitat was not found to support significant species in the MLA area.

Following project closure, control of introduced species and rehabilitation of habitat is likely to significantly reduce the impacts of introduced species on native fauna.

Rainbow bee-eater (EPBC Act Listed). The migratory rainbow bee-eater (*Merops ornatus*) is listed under the EPBC Act under the provisions of the Japan-Australia Migratory Bird Agreement (JAMBA). As such, it is not a listed threatened species. For the project to have a significant impact to this species, it would have to (DEH, 2006):

- Substantially modify, destroy or isolate an area of important habitat for the species.

- Result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the species.
- Seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of the species.

Several flocks of this species were recorded during the field survey. At a local level, there may be small-scale impacts to the species presence and habitat use in the MLA area. However, the MLA area is not considered important habitat to the species, it will not result in an invasive species harmful to the rainbow bee-eater becoming established and it will not seriously disrupt an ecologically significant proportion of the population of this species. In the context of the widespread distribution of the bird across southern Australia during summer-autumn months, it is **virtually impossible** that the project will result in a significant impact to this species at the regional, state or national level.

Diamond firetail (NPW Act Listed). The diamond firetail (*Stagonopleura guttata*) is found across a range of Eucalyptus-dominated vegetation communities that have a grassy understorey, including woodland, forest and mallee (Antos and Bennett, 2006 and Higgins et al., 2006, cited in Appendix 6). The resident nature of the species within its range, and its reliance on a home range of 2 to 20 ha (Paton et al., 2004, cited in Appendix 6), makes it susceptible to the impacts of vegetation clearing and disturbance associated with the project. The masking of diamond firetail calls by project-related noise is likely to disturb the activity of the species in the MLA area. The project will clear approximately 3.25 ha of high quality *E. odorata* woodland. Approximately 21.35 ha of this vegetation will remain in the MLA area, which is just larger than the minimum patch size of 20 ha thought to be necessary to support populations of the species in plains grassy woodland habitat. As a result, based on available information, the likelihood that the project will result in a significant impact to the diamond firetail is **possible**. Impacts, should they occur, are likely to be significant at the local and regional level. However, further research into the abundance and distribution of the diamond firetail (undertaken as part of the establishment and management of the SEB offset area) will refine this impact assessment.

Peregrine falcon (NPW Act Listed). The peregrine falcon (*Falco peregrinus*) is naturally found in low densities throughout its distribution. The species is known to have a tolerance to mining activity (Appendix 6), and the single pair of birds nesting in the face of the old pit are likely to relocate within the pit or to another suitable location nearby when disturbance levels increase during construction and mining. As a result, it is **unlikely** that the project will have a significant impact to this species at the regional, state or national level.

No mammals of listed conservation significance are present within the MLA area. However, the **brushtail possum** (*Trichosurus vulpecula*) has been nominated for listing under the NPW Act. This species has experienced a significant decline in the area of favoured habitat, and a resultant increase in the level of competition among those species that require similar habitat resources (Kahrimanis et al., 2004, cited in Appendix 6). High predation pressures from introduced species such as foxes and feral cats have further pushed the decline of the species in South Australia. The project will result in the loss of a small area of high quality *E. odorata* woodland habitat for this species, and increased levels of light in the MLA area may disturb it. *E. odorata*

woodland habitat is poorly represented in the Mount Lofty Ranges region, and the population present in the MLA area is likely to be significant at the local and regional level. However, minimising the area of high quality *E. odorata* woodland habitat to be cleared in the MLA area and measures to minimise light disturbance will minimise the potential for significant impacts to the brushtail possum. In addition, the establishment and management of the SEB offset areas will protect and enhance habitat favoured by this species. As a result, it is **possible** that the project will contribute to the decline of the species in the short-term, with impacts will at the local and regional level. It is **unlikely** that impacts will be significant at the state or national level.

Other Threatened Bird Species. The project is **unlikely** to have a significant impact on other EPBC Act-and NPW Act-listed species such as migratory and wetland species due to their wide ranging distribution and transient nature. If project-related surface waters such as the TSF decant pond are highly contaminated (see Section 9.3.2) and attract waterbirds, some active management of these areas would be required to ensure impacts to these species are minimised. The nearest Ramsar-listed wetland, The Coorong and Lakes Alexandrina and Albert Wetland, is located approximately 40 km south of the MLA area. Although the Bremer River, located approximately 3 km east of the MLA area, discharges to this Ramsar wetland, the potential for impacts to this area is **unlikely** as the project is designed not to discharge contaminated water off site.

There is little potential for significant impacts to EPBC Act-listed species due to their absence (and unlikely presence) in the MLA area. However, the consequence of significant impacts to threatened species at the state level (i.e., NPW Act-listed species) is considered **severe**. Impacts may result in a significant change to the known distribution of species, which may result in the loss of local populations of these species. Natural regeneration of habitat and the protection and enhancement of habitat in the SEB offset areas will compensate for the temporary loss of habitat for threatened species. The relocation of resident individuals prior to clearing is expected to minimise impacts to directly disturbed populations, although the survival rate of translocated species is unknown.

Although the likelihood of significant impacts to the rainbow bee-eater is virtually impossible, given the **severe** consequence and **possible** occurrence of significant impacts to the diamond firetail, the residual risk is **medium**.

Increased Abundance of Introduced Species

Introduced species are already present in the MLA area in relatively low densities. The rabbit, fox and cat are listed as key threatening processes under Section 3 of the EPBC Act, with the impact to bird, reptile and mammal species as a result of predation by foxes and cats being of particular concern. Management and mitigation measures outlined in Section 9.9.2 will provide for the control of introduced species and it is **unlikely** that the density and distribution of these species in the MLA area will increase as a result of project activities.

The consequence of an increased abundance of introduced species, and in particular foxes and cats, is **minor** given the proximity of the MLA area to Kanmantoo and refuges currently available to introduced species in these areas. As a result of this, and the possible likelihood of it occurring, the residual risk is **low**.

A point to note is that the strict implementation of control measures outlined in Section 9.9.2 during operation of the project may lower populations of introduced animals in the MLA area.

9.9.4 Environmental and Social Objectives

The environmental and social objectives for fauna, the assessment criteria and a summary of the control measures are listed in Table 9.32.

Table 9.32 Environmental and social objectives for fauna

ID	Objective	Assessment Criteria	Summary of Control Measures
I23, I24	No significant adverse impact to the abundance and diversity of threatened or non-threatened native fauna species.	<p>Native vegetation clearance to be in accordance with approved Native Vegetation Management Plan.</p> <p>Regular surveying at selected sites to detect changes in abundance, composition or condition of fauna species from baseline shows no significant adverse impact.</p> <p>Regular checking of site water bodies to detect potential adverse impacts on migratory wetland bird species shows no adverse impacts to these species.</p> <p>SEB offset areas established and monitored to demonstrate objectives are being achieved.</p>	<p>Establishment and ongoing management of SEB offset areas (including the implementation of a threatened species management plan).</p> <p>Project infrastructure located outside areas of very good quality <i>E. odorata</i> low woodland where possible.</p> <p>Clearly identifying and documenting areas to be protected and areas to be cleared.</p> <p>Minimising the area of direct land clearing.</p> <p>Progressively rehabilitating cleared land.</p> <p>Additional surveying of diamond firetail populations.</p> <p>Introduction of bird-repellent measures if migratory waterbird species regularly visit permanent water bodies in the MLA area during operations.</p> <p>See also control measures for I15 to I21.</p>
I25	No significant increase in introduced fauna species.	No change in abundance of pest (feral) species (when compared to control sites and/or baseline data).	<p>Prohibition of pets and feeding of animals.</p> <p>Controlled extermination of introduced fauna species.</p> <p>Internal and external auditing to assess housekeeping standards (in particular litter control).</p>

9.9.5 Monitoring

Fauna monitoring will be conducted to allow identification of potential impacts of mining operations to fauna. Fauna monitoring sites will be located in areas of remnant *Eucalyptus odorata* woodland and *Lomandra effusa* and *Austrostipa* spp. grassland in areas remote from project activity. The exact number and location of survey sites will be determined following finalisation of the project footprint and will be selected in consultation with relevant fauna survey experts.

Methods and Frequency

Fauna monitoring will involve fauna surveys and targeted counts for threatened species at selected sites to allow assessment of:

- Changes in the abundance, composition or condition of fauna species, particularly threatened species.
- Ongoing impacts to fauna as a result of project-related activities.
- Success of rehabilitation and/or relocation activities for threatened species.
- Increases in the density and distribution of pest animal infestations.
- Introduction of new pest animal species.
- Diversity and health of waterbird populations at permanent waterbodies.

Survey methods may include visual observations, spotlighting, bird census transects, trapping and active searching.

Fauna monitoring will include:

- Preparing an inventory of fauna species for each of the three key habitat types (*Eucalyptus odorata* woodland, *Lomandra effusa* grassland and *Austrostipa* spp. grassland).
- Conducting a survey of other *E. odorata* woodland habitat in the Kanmantoo region during Spring 2008 to assess the distribution and abundance of diamond firetail.
- Conducting an annual survey each Spring for the presence of diamond firetail, brushtail possum and other selected species.
- Inspecting waterbodies located within the MLA area weekly (e.g., TSF decant, process water dam) for wetland bird species.
- Recording animal deaths that occur as a direct result of project activities.
- Monitoring the success of control techniques in reducing environmental impacts due to pest animals in the MLA area.

Monitoring will be conducted prior to, during and following disturbance. The number of sites to be sampled during monitoring will be calculated to allow for valid statistical comparisons between control and impact sites.

9.10 Socio-economic

This section summarises the findings of a socio-economic assessment and economic assessment that was undertaken for the project (see Appendix 7).

Distinction is made between 'local', 'peripheral and 'other' (state and national) communities (as defined in Section 8.2) since the potential impacts to these stakeholders vary.

9.10.1 Potential Impacts—Negative

Potential, credible, project-related negative socio-economic impacts are described below. These potential impacts do not take into consideration the proposed avoidance, mitigation and management measures that will be implemented by Hillgrove during all stages of project development (see Section 9.10.3), and which will result in the residual impacts discussed in Section 9.10.5.

Note: increased traffic was a concern raised during stakeholder consultation, and this impact is discussed in Section 9.14 (Infrastructure and Transport).

Changed Value of Rural Properties

Rural property prices for land immediately adjacent to the mine have the potential to increase if Hillgrove pays premium prices for this land. Land immediately adjacent to the project that is not purchased by Hillgrove but is perceived to be impacted by the mine through reduced amenity or air quality, or increased noise may reduce in value.

Increased Pressure on Police Resources

In addition to existing population growth, an increase in the local and peripheral population as a result of the project has the potential to place additional pressure on police resources until adequate resources can be provided.

Competition for Skilled Labour

Regional development boards reported that existing businesses experience difficulties finding skilled employees to work in the region. This difficulty may be exacerbated if the mine is perceived as a more appealing workplace. The project may also increase competition for skilled labour at the state and national level.

Increased Scarcity of Temporary Accommodation

During construction, the contractors' employees will be accommodated in temporary accommodation throughout the region. This has the potential to place additional pressure on already scarce temporary accommodation, reducing its availability for people seeking to live in local and peripheral communities.

9.10.2 Potential Impacts—Positive (Benefits)

Benefits to the South Australian and Australian Economies

Potential economic benefits to state and national economies may result from:

- Direct financial contributions through the payment of taxes and royalties.
- Increased gross state product (and gross domestic product) from sales revenue.
- Indirect financial contributions through the payment of taxes by people employed directly and indirectly, and also by companies that service the project directly or indirectly.
- Decreased unemployment levels.

Economic Benefits to Communities

Economic benefits to the local, peripheral and other communities may result from the project through:

- Population growth.
- Diversification of the current industrial and economic base of the region.
- Purchase of goods and services (economic multipliers) in both local and peripheral communities.
- Increased revenues associated with mining compared to agricultural production.
- Tourism.

Training and Education

Training and education opportunities provided by the project may increase the skills capacity of existing and potential employees.

Increased Employment Opportunities

The project may increase the number and variety of employment opportunities (both directly and indirectly).

Increased Support to Communities

Through additional sponsorship, donations and involvement in community events, Hillgrove may increase existing support to communities. Population growth has the potential to increase volunteer recruitment and participation in community initiatives such as the Country Fire Service (CFS) and sporting teams.

Increased Industry Diversity

Project development has the potential to increase the diversity of industries at both a local and state level, with associated benefits such as increased economic robustness and choice of employment.

Increased Skills Base

The skills capacity of spouses of existing and potential employees may increase the skills base in the region.

Increased Demand for Temporary and Rental Accommodation and Increased Residential Property Value

Increased occupancy and demand for temporary and rental accommodation has the potential to increase revenue for investors, developers and hotel/motel owners in local and peripheral communities.

Improved Service Provision

Enrolments in educational facilities in local and peripheral communities including childcare facilities, kindergartens and primary and secondary schools may increase as a

result of the project. Increased funding as a result of additional enrolments will improve service provision within educational facilities.

9.10.3 Avoidance, Mitigation and Management Measures

Changed Value of Rural Property

The value of rural properties in close proximity to the mine may change. To address the potential change in value of rural properties in close proximity to the mine, Hillgrove will implement management and mitigation measures to minimise negative impacts on amenity.

Changes to Local Employment Market

In consultation with relevant regional development boards, Hillgrove will discuss training and skill requirements with the local registered training organisations including the Training and Further Education (TAFE), and Vocational Education and Training (VET) providers. In addition, Hillgrove will hold supplier briefings so that local businesses can diversify to accommodate the needs of the mine.

Increased Competition for Skilled Labour

The majority of the workforce will be sourced from Adelaide and other regional centres, or state capitals. Approximately 20% will come from the local and peripheral communities, specifically Mount Barker and Murray Bridge. To reduce skills shortages in these communities, Hillgrove will encourage skilled personnel to move back to South Australia to work at the mine. In addition, Hillgrove will consider involvement in pre-employment skills training.

Increased Pressure on Police Resources

Hillgrove will liaise with the Hills Murray Local Service Area police regarding where the project's workforce resides so that additional resources may be allocated to towns within the study area, if necessary.

9.10.4 Optimisation Measures

To optimise the socio-economic benefits of the project, Hillgrove will:

- Preferentially source people, goods and services from within South Australia.
- Develop the project as quickly as possible.
- Seek premium prices for the sale of mine products.
- Continue to liaise with the Adelaide Hills and Murraylands regional development boards on strategies to increase the size of the workforce available to the mine. Such strategies include:
 - Community capacity building by working with schools to develop curricula and pathways to employment in the resource sector.
 - Promotion of pre-employment programs, licence assistance programs and potential skills and trade training based on cadetships and scholarships.

- Place a high emphasis on stakeholder consultation to foster and maintain good relationships and continue to consult with the community through all phases of the project cycle, including:
 - Planning (including preparation of this Mining Lease Proposal).
 - Construction.
 - Operations.
 - Closure.
- Invest in training and education programs for employees and potential employees.
- Allocate a percentage of the project’s budget for sponsorship contributions and donations towards communities, particularly local communities. These contributions will focus on projects that provide long-term community benefits that will remain after mine closure. Through various forms of sponsorship, Hillgrove currently provides support to the Callington Primary School, Callington Football Club, Callington Little Athletics, Callington cricket and netball clubs, Bushfire Watch and Kanmantoo Rural Watch.
- Where possible, assist in community-driven development initiatives; this assistance may involve donation of people’s time, skills and knowledge.
- Through the K/CCCC and other forms of stakeholder consultation, involve the community in maximising social benefits and mitigating impacts by encouraging feedback and acting on information when it is received.

9.10.5 Residual Impact Assessment – Negative

Table 9.33 summarises the residual negative social and economic impacts (residual positive impacts are described in Section 9.10.6) of the project, considering the likelihood and consequence of the predicted impacts after the successful implementation of management and mitigation measures.

Social and economic impacts should be considered within the context of an already rapidly changing social and economic environment as a result of rapid population growth (see Section 5.10.2).

These assessments are described in further detail below.

Table 9.33 Summary of negative impacts on socio-economic state

ID	Impact	Likelihood	Consequence	Residual Risk
I26	Negative change in value of rural property.	Unlikely	Minor	Low
I27	Increased pressure on police resources.	Possible	Negligible	Low
I28	Increased scarcity of rental accommodation.	Possible	Minor	Low
I29	Competition for skilled labour.	Possible	Negligible	Low

Changed Value of Rural Property

Negative impacts on rural properties prices are **unlikely**, considering that the project is developing an existing mine site and impacts to amenity will be minimised through implementation of management and mitigation measures. Potential for reduced rural property prices is also expected to be offset by the potential for increased demand for residential properties due to both the mine workforce and supporting industries. If property prices were to be negatively impacted the effect is likely to be confined to properties immediately adjacent to the mine and the impacts are likely to be limited to the mine life. The negative impact on rural property prices is therefore **minor** and the residual risk **low**.

Increased Pressure on Police Resources

It is **possible** that a small population increase in some towns may place a short term, increase in the pressure on police resources. Given that only a small number of mine employees and contractors are likely to be accommodated in any one town within the study area, and that a majority are likely to be accommodated with their families, short term pressure on police resources as a result of the mine will be **negligible** for local and peripheral communities. The residual risk is therefore **low**.

Increased Scarcity of Temporary Accommodation

Given that there is already a paucity of rental accommodation in the Adelaide Hills region, which is likely to extend into local and peripheral communities, it is **possible** that the project will add to the existing scarcity of rental accommodation. The consequence of any project-related increase is considered **minor** in the context of the existing regional trends (of increasing rental scarcity). The residual risk is therefore **low**.

Increased Competition for Skilled Labour

The project will directly employ approximately 150 people during operations. It is **possible** that this will increase competition for skilled labour at some levels (particularly for the employee pool of highly skilled people with previous mining experience). Within the region, Hillgrove involvement in pre-employment skills training will build skill capacity to enable previously unskilled people to work at the mine, and this will mitigate the local impacts of labour competition to some extent. The consequence of significant labour competition occurring is **negligible** given that labour shortages are being experienced elsewhere in the region and will be balanced by the positive benefits to potential employees associated with a more competitive market. Overall, the residual risk is considered to be **low**.

9.10.6 Residual Impact Assessment – Positive (Benefits)

The risk matrix described at the start of this chapter has been modified slightly to enable its application to assessment of residual benefits (Table 9.34). While the terms and definitions used to assess likelihood are the same, those used for assessing severity of consequence are as follows:

- Negligible – Possible socio-economic impact but without noticeable consequence.
- Minor – Some limited consequence but not of significant impact or enhancement to the wellbeing of communities or economies.

- Moderate – Significant contributions producing noticeable changes to wellbeing of communities or economies.
- Substantial – Significant contributions producing significant changes to wellbeing of communities or economies.
- Extreme – Extreme permanent benefits to wellbeing of communities or economies.

Table 9.34 Qualitative benefit analysis matrix

		Likelihood				
		<i>Virtually impossible</i>	<i>Unlikely</i>	<i>Possible</i>	<i>Likely</i>	<i>Virtually certain</i>
Consequence	<i>Negligible</i>	Very low	Very low	Low	Low	Low
	<i>Minor</i>	Very low	Low	Low	Medium	Medium
	<i>Moderate</i>	Low	Low	Medium	Medium	High
	<i>Substantial</i>	Medium	Medium	Medium	High	High
	<i>Extreme</i>	Medium	Medium	High	High	High

Table 9.35 summarises the residual positive socio-economic impacts of the project, considering the likelihood and consequence of the predicted impacts after the successful implementation of management and optimisation measures. These assessments are described in further detail below.

Table 9.35 Summary of positive impacts on socio-economic state

ID	Impact	Likelihood	Consequence	Residual Benefit
I30	Benefits to the South Australian and Australian economies	Virtually certain	Minor	Medium
I31	Economic benefits to communities	Virtually certain	Moderate	High
I32	Training and education	Virtually certain	Minor	Medium
I33	Increased employment opportunities	Virtually certain	Minor	Medium
I34	Increased support to communities	Virtually certain	Minor	Medium
I35	Increased industry diversity	Virtually certain	Minor	Medium
I36	Increased skills base	Possible	Minor	Low
I37	Increased demand for temporary and rental accommodation	Likely	Minor	Medium
I38	Increased residential property value	Likely	Minor	Medium
I39	Improved service provision	Possible	Minor	Low

Benefits to the South Australian and Australian Economies

The benefits to the South Australian and Australian economies from the project are **virtually certain** and, based on current economic predictions, will involve:

- Total investment expenditure (e.g., project expenditure and investment in additional infrastructure) of about \$100 million over 8 years.
- Total, unescalated revenues (note these do not take into account cost of production) of about \$650 million.
- Annual operating expenditure of about \$55 million.

- Annual Government royalties of approximately \$1.3 million for the first five years then approximately \$3.5 million for the remaining three years (\$14.4 million in total or \$1.8 million per year on average over the life of the mine).
- Annual salaries for Hillgrove staff and contractors of approximately \$4.8 million per annum (excluding on-costs) and \$7.0 million, respectively.
- Increased incomes for people elsewhere in the region, including local and peripheral communities, of approximately \$20 million per annum.
- Direct employment of up to about 150 people during operations (approximately 65 Hillgrove staff and 85 contractors).
- Indirect employment of around 300 people during operations (using an employment multiplier of 2.2 (i.e., for every directly employed person an additional 2.2 people will be indirectly employed).
- A direct contribution to the gross state product (GSP⁷) of approximately \$0.3 billion (in present value terms) over a nine year period (one year of construction investment and eight years of operation (calculated at 2007 prices)).

These economic benefits will result in a noticeable change to the South Australian economy and produce a **minor** effect. The overall benefit associated with this impact is **medium**.

Economic Benefits to Communities

The economic benefits outlined above will also be experienced at the local and peripheral community level. The local communities, i.e., the residents of Callington and Kanmantoo, will receive indirect benefits through corporate support of sporting teams, community activities and spending in local businesses. All local and peripheral communities will also experience economic benefits associated with direct and indirect employment of local residents, spending in businesses and general increased levels of economic activity. The likelihood of economic benefits to communities is therefore **virtually certain**. The consequence of the benefits will vary depending on the community concerned, with those communities that house mine employees most likely to experience significant benefits. The overall consequence is considered to be **moderate** with the resultant benefit being **high**.

Training and Education

Training and education of Hillgrove employees and contractors and potential employees is **virtually certain**. The consequence of this will be significant for those who are trained as it will have a lasting effect (skills and knowledge can be applied elsewhere once the project is completed). However, it will be highly localised (will only benefit employees

⁷ Kanmantoo Copper Project GSP includes annual capital investment, annual operating expenditure, annual Government royalties and annual salaries for Hillgrove staff and contractors.

who receive training). The overall consequence will therefore be **minor**. The residual benefit of training and education is therefore **medium**.

Increased Employment Opportunities

The project will increase the number and variety of employment opportunities (i.e., this is **virtually certain**) at local, peripheral, state and even national levels. The size of this effect is such that it is likely to be imperceptible at state and national levels. Job opportunities are increasing elsewhere in the region as a result of other developments (e.g., Terramin's Angas Zinc mine, Mobilong prison redevelopment) and skills shortages are already apparent. This will lessen the positive effects of increased employment opportunities for peripheral communities. Benefits for the local community will be determined by the "employability" of people living in Callington and Kanmantoo. The overall consequence of increased employment opportunities is therefore considered **minor** and the resulting benefit **medium**.

Increased Support to Communities

The project will result in increased support to communities (i.e., this is **virtually certain**), most of which will be centred on peripheral communities where mine employees live (i.e., the larger towns of Strathalbyn, Mount Barker and Murray Bridge) and local communities (i.e., those closest to the mine) which will benefit from sponsorship of local sporting clubs and grants for the local school (e.g., Callington and Kanmantoo). Sponsorships and donations will also be made to peripheral communities. The consequence of this support is considered to be **minor** at the local community level (i.e., Callington and Kanmantoo) because, although it is positive, it is not expected to have a significant impact on the wellbeing of communities or economies. Increased support to communities is likely to be imperceptible in peripheral communities. The residual benefit is therefore **medium**.

Increased Industry Diversity

The project will result in increased industry diversity (i.e., this is **virtually certain**). The overall consequence of this as a result of the project is expected to be **minor** for local and peripheral communities and the residual benefit is therefore **medium**.

Increased Skills Base

It is **possible** that spouses of mine employees that move into the area will be skilled workers. The consequence of a slight increase in the overall number of skilled people (e.g., health practitioners and teachers etc) is expected to be **minor** for local and peripheral communities, and the residual benefit is therefore **low**.

Increased Demand for Temporary and Rental Accommodation

Increased demand for temporary (hotels, motels and caravan parks) and rental accommodation as a result of Hillgrove staff and contractors living in the area is **likely**. The overall benefit of this is expected to be **minor** for local and peripheral communities as temporary and rental accommodation is already in demand. The residual benefit is therefore **medium**.

Increased Residential Property Value

Hillgrove staff and contractors seeking to live in the area and increased salaries and incomes for residents of local and peripheral communities are **likely** to result in a slight

increase in property values in both local and peripheral communities. The overall consequence of this is expected to be **minor** for local and peripheral communities as property values are already increasing. The residual benefit is therefore **medium**.

Improved Service Provision

Improved service provision is **possible** for local and peripheral communities as a result of increased enrolment in educational facilities. In addition to existing population growth, this has the potential to result in additional funding for schools (e.g., extra teachers and classrooms) that are already in demand. The overall consequence of this is expected to be **minor** at a local and peripheral community level, and the residual benefit is therefore **low**.

9.10.7 Environmental and Social Objectives

The environmental and social objectives for socio-economic impacts, the assessment criteria and a summary of the control measures are listed in Table 9.36.

Table 9.36 Environmental and social objectives for socio-economic impacts

ID	Objective	Assessment Criteria	Summary of Control Measures
I26	Negative impacts on rural property value minimised.	Complaints register to show no reasonable complaints from surrounding property owners as a result of reduced amenity.	Amelioration of impacts during the design phase where possible and enforcement of high housekeeping standards (see I48 to I50). Minimisation of dust emissions (see I10 to I12). Establishment and maintenance of separation distances between operation and nearest residents to mitigate noise (see I13).
I27, I28	No significant increase in pressure on existing community resources and services in local and peripheral communities.	Records of community consultation and complaints register to show no significant increase in pressure on community resources due to the project.	Information provision to Hills Murray Local Service Area police and real estate agents.
I29	Minimise negative impacts to local and peripheral community as a result of increased competition for skilled labour.	Records of employment show successful recruitment of skilled people from local region, Adelaide, the rest of South Australia and Australia.	Active, Australia-wide recruitment. Involvement in training and education to build levels of skilled labour and to train employees for the project.
I30, I31, I32, I33, I35, I36, I37, I38, I39	Maximise economic and employment benefits and increased skill base.	Records of training and education provision to Hillgrove staff. Records kept of the number of Hillgrove employees that live in local region.	Standard project management procedures, fostering of high performance culture. Maximise mine life.

**Table 9.36 Environmental and social objectives for socio-economic impacts
(cont'd)**

ID	Objective	Assessment Criteria	Summary of Control Measures
I34	Increase level of support to local and peripheral communities as a result of the project.	<p>Program for community support designed and implemented.</p> <p>Records of Hillgrove participation in community initiatives and sporting teams in local and peripheral communities.</p>	<p>Sponsorship, donations and in-kind support.</p> <p>Provision of information about volunteer initiatives such as the CFS and sporting teams on Hillgrove notice boards.</p>

9.10.8 Monitoring

The proposed socio-economic monitoring program will involve ongoing monitoring of the following indicators (see also Chapter 12):

- Workforce statistics, including:
 - Gender and age.
 - The number of 'local' and South Australian people employed by the project.
 - Specific training provided by Hillgrove.
- Service and goods supply statistics. These will include details regarding:
 - Type and quantity of goods/service.
 - Value.
 - Location of supplier.
- Contributions made by Hillgrove to local communities, such as sponsorship of local events.

9.11 Indigenous Cultural Heritage

9.11.1 Potential Impacts

As no Indigenous sites or objects were identified during the survey work, potential impacts associated with project-related activities are only discussed based on their potential for discovery. This discussion does not take into account any proposed avoidance, mitigation and management measures that will be implemented by Hillgrove if Indigenous sites are identified, and which will result in the residual impacts discussed in Section 9.11.3.

Disturbance to Potential Indigenous Historic and Cultural Heritage Sites

A low potential exists for the discovery of Indigenous artefacts and or remains of scientific and Indigenous significance within the MLA area during construction and excavation activities. While no objects or artefacts were identified during the Indigenous survey (Appendix 8), one creek flat on the southern boundary of the project site and three creek flats within the proposed site access corridor, have been identified as potential burial sites and/or archaeological sources (see Figure 5.23). The southern creek flat (7,668 m²) has been identified as a potential source of clay for project infrastructure, while the southwestern creek flats may potentially be excavated during access road construction.

Other sites within the project footprint, such as the open pit, integrated waste landform, processing plant and ROM pad have undergone a high degree of landscape modification during historic mining activities and are unlikely to contain Indigenous sites or objects.

The significance of potential sites can be assessed based on scientific significance and/or traditional significance. Scientific significance takes into account site integrity, site structure, site contents and representativeness of the site and is assigned by a suitably qualified archaeologist. Traditional significance is based on an assessment by the local Indigenous representatives, the Peramangk.

9.11.2 Avoidance, Mitigation and Management Measures

In order to avoid and mitigate disturbance to Indigenous sites and objects that may be discovered within the MLA area, Hillgrove will develop and implement an Indigenous cultural heritage management plan. This plan will:

- Incorporate Indigenous site and object recognition training into the site inductions, ensuring employees and contractors are aware of their obligations under the *Aboriginal Heritage Act 1988*, especially with respect to the discovery of burial sites or objects.
- Require clearance/disturbance forms to be completed for any ground disturbance within the MLA area. This will enable any future proposed disturbance of the southern and or southwestern creek flat (see Figure 5.23) to be monitored by Peramangk representatives, or trained Hillgrove staff members.
- Reproduce the boundaries of the southern and southwestern creek flats (see Figure 5.23) on project base maps. This will allow the sensitivity associated with this zone to be identified during all site works, thereby reducing the likelihood of damage to any undiscovered sites.
- Establish a specific protocol to be followed in the event that a suspected Indigenous site, object or burial is discovered, that will fulfil requirements under the *Aboriginal Heritage Act 1988*. The response to such a discovery will require the following steps:
 - Cease work immediately, and then contact police (in the case of the discovery of human remains), South Australian Aboriginal Affairs and Reconciliation Division (AARD) and Peramangk representatives.
 - In the case of a discovered burial, where the remains are confirmed to be Aboriginal by the coroner, an archaeologist will then assess the burial site and work in conjunction with Peramangk representatives to establish management measures (if different from those outlined in the cultural heritage management plan).
 - After an adequate assessment has been undertaken, work with machinery can recommence a specific distance away from affected areas as long as monitors are in attendance and specified distances are adhered to. These specified distances will be negotiated with stakeholders as part of a consent-to-disturb agreement.

9.11.3 Residual Impact Assessment

Residual impacts of the project on Indigenous cultural heritage are summarised in Table 9.37 and discussed below.

Table 9.37 Summary of the impacts on Indigenous cultural heritage

ID	Impact	Likelihood	Consequence	Residual Risk
I40	Disturbance to potential Indigenous sites of moderate (or higher) scientific/Indigenous significance (without prior approval).	Virtually impossible	Moderate	Low
I41	Disturbance to potential Indigenous sites of limited scientific/Indigenous significance.	Virtually impossible	Minor	Very low

Disturbance to Potential Indigenous Sites of Moderate (or Higher) Scientific/Indigenous Significance

It is **virtually impossible** that Indigenous sites or objects will be disturbed within the MLA area. In the event that an object or site of moderate to high scientific or Indigenous significance is encountered, unauthorised disturbance of the site is also unlikely due to the implementation of the mitigation measures. The potential consequences of disturbance of Indigenous sites is **moderate** depending on site or object and or the method of disturbance. The residual risk is therefore considered to be **low**.

Disturbance to Potential Indigenous Sites of Limited Scientific/Indigenous Significance.

It is **virtually impossible** that Indigenous sites or objects will be disturbed within the MLA area. In the event that an object or site of moderate to limited scientific or Indigenous significance is encountered, unauthorised disturbance of the site is also unlikely due to the implementation of the mitigation measures. Due to the limited scientific significance of these sites, the consequence of disturbance is **minor**. The residual risk associated is considered to be **very low**.

9.11.4 Environmental and Social Objectives

The environmental and social objectives for Indigenous cultural heritage, the assessment criteria and a summary of the control measures are listed in Table 9.38.

Table 9.38 Environmental and social objectives for Indigenous cultural heritage

ID	Objective	Assessment Criteria	Summary of Control Measures
I40, I41	No Indigenous sites disturbed during project operations (note: no known sites exist within the MLA area).	Excavations monitored and recorded and show no disturbance to sites. Excavation activities in the zone of low potential Indigenous sensitivity undertaken in accordance with the Indigenous cultural heritage management plan.	Implementation of the Indigenous cultural heritage management plan (including identification of the zone of potential sensitivity on all base maps of the MLA area, use of an appropriate Indigenous/trained monitor during excavation within the potentially sensitive zone, the cessation of activities at location if a significant site is discovered, employee training on importance of identifying and protecting these sites).

9.11.5 Monitoring

If Indigenous cultural sites are identified, they will be inspected quarterly to assess the preservation and integrity of structures (if present) and the effectiveness of current management techniques.

9.12 Non-Indigenous Cultural Heritage

9.12.1 Potential Impacts

Potential credible, project related impacts on non-Indigenous cultural heritage are described below. This discussion does not take into account the proposed avoidance, mitigation and management measures to be implemented by Hillgrove during the project development and operation (see Section 9.12.2), and that will result in the residual impacts discussed in Section 9.12.3.

Disturbance to Known Non-Indigenous Historic and Cultural Heritage Sites

Recent survey work identified four non-Indigenous sites within the MLA area with varying degrees of regional heritage significance. These sites included: the Paringa smelter engine house; the Paringa smelter creeping chimney and stone stack; the remains of the stone settling tank; and the Paringa homestead (see Figure 5.23). These sites are not listed on any national, state or regional register and have no formally assigned heritage value under the *Heritage Places Act 1993* (see Section 5.13.2).

Three other sites of limited heritage significance are also located in the MLA area: a ruin rumoured to be the mine manager's residence; a ruin adjacent to the supposed mine manager's residence; and a ruin near the Paringa smelter engine house.

Non-Indigenous heritage site disturbance associated with the project may occur through:

- Development of the integrated waste landform, requiring the removal of the Paringa homestead, which lies within the integrated waste landform footprint.
- Blasting and resultant vibration, particularly with respect to the dilapidated structures such as the Paringa creeping chimney and stone stack and the Paringa smelter engine house.
- Contact with site machinery and haulage vehicles.
- Interference due to increased human presence.
- Increased exposure through removal of adjacent vegetation.

Disturbance to Potential Non-Indigenous Historic and Cultural Heritage Sites

There is low potential for project operations to reveal and disturb new non-Indigenous cultural heritage sites.

9.12.2 Avoidance, Mitigation and Management Measures

In order to avoid, mitigate and manage disturbance of non-Indigenous sites within the MLA area. Hillgrove will develop and implement a cultural heritage management plan that will address potential undiscovered non-Indigenous sites (although unlikely), and known sites within the MLA area of regional significance. This plan will involve:

Site Protection

- During site inductions contractors and subcontractors will be made aware of the existing non-Indigenous heritage sites and access requirements.
- Vehicle access will be restricted to existing tracks and proposed site roads, to prevent inadvertent damage to sites (both known and unknown).
- The Paringa Creeping Chimney and Stone Stack, the Paringa Engine House and the stone setting tank will be fenced or existing fences maintained to protect unauthorised access and damage. As the Paringa Smelter is in a very advanced state of decay, warning signs will be erected.
- In the event that non-Indigenous cultural heritage sites are uncovered during site development, work will be ceased within 50 m of the site until a cultural heritage consultant has been contacted to undertake an assessment of the site and determine appropriate management measures.
- A non-Indigenous site inventory will be established to identify and monitor site preservation and integrity. These assessments will be undertaken quarterly during the first year of operations, then on an annual basis. Reports will be made available to the local community.

Further Site Documentation

To provide historical documentation of the Paringa homestead and particularly the vulnerable structures such as the Paringa creeping chimney and stone stack, the sites will be documented (by sketches and photos) prior to project commencement.

In order to mitigate impacts associated with the removal of the Paringa homestead, Hillgrove will make available all raw building materials from the homestead to the local community for use in historical restorations.

9.12.3 Residual Impact Assessment

Table 9.39 summarises the residual impacts on non-Indigenous cultural heritage, considering the likelihood and consequence of the predicted impacts after the successful implementation of management and mitigation measures. These assessments are described in further detail below.

Table 9.39 Summary of impacts on non-Indigenous cultural heritage

ID	Impact	Likelihood	Consequence	Residual Risk
I42	Disturbance to the Paringa smelter creeping chimney and stone stack.	Likely	Moderate	Medium
I43	Disturbance to the Paringa smelter engine house.	Possible	Moderate	Medium
I44	Disturbance to the stone settling tank.	Unlikely	Minor	Low
I45	Disturbance to the Paringa homestead.	Virtually certain	Minor	Medium

Table 9.39 Summary of impacts on non-Indigenous cultural heritage (cont'd)

ID	Impact	Likelihood	Consequence	Residual Risk
I46	Disturbance to the three ruins of limited significance.	Unlikely	Negligible	Very low
I47	Disturbance to potential non-Indigenous historic and cultural heritage sites.	Virtually impossible	Negligible	Very low

Disturbance to the Paringa Smelter Creeping Chimney and Stone Stack

Although direct disturbance is unlikely during construction and operational phases (see Figure 9.5), indirect impacts derived from blasting and vibration are **likely** to cause instability to the chimney and stack. The creeping chimney and stone stack have not been formally listed under any national, state or regional register; however, a degree of significance has been informally assigned to these structures by local communities. The consequence of disturbance due to project-related activities is therefore determined to be **moderate**, providing a **medium** residual risk.

Disturbance to the Paringa Smelter Engine House

The project footprint will avoid the Paringa Smelter engine house (see Figure 9.5). Structures such as the Paringa Smelter that currently are in a poor state of preservation will **possibly** undergo further deterioration as a direct result of project operations. Implementation of the mitigation measures described above will make accidental disturbance to this site unlikely; however, vibration and blasting may disturb this stone structure. The consequence of disturbance is determined to be **moderate** due to the degree of significance informally assigned by local communities. The results of avoidance and mitigation measures will provide a **medium** level of residual risk.

Disturbance to the Stone Settling Tank

The stone settling tank will not be disturbed by project construction and operations as it sits outside the proposed project footprint (see Figure 5.23). The structure is currently stable and in a reasonable state of preservation, and with the implementation of the mitigation and management measures it is **unlikely** that disturbance to the site will occur. As the structure is not listed under any local regional or state register, the consequence of inadvertent disturbance would be **minor**, with a **low** residual risk.

Disturbance to the Paringa Homestead

It is **virtually certain** that the Paringa Homestead will be disturbed by the project. The homestead is situated next to the old waste rock dump, and will be removed during the construction of the integrated waste landform (see Figure 5.23). The consequence of this impact is **minor** due to the limited regional significance of the homestead and the ability to salvage suitable materials for reuse in restoration activities. The residual risk of this impact is therefore **medium**.

Disturbance to the Three Ruins of Limited Significance

The potential for disturbance of the three ruins is considered **unlikely** due to their location outside of the proposed mine footprint on the southern side of the MLA area. Although these ruins are in a very poor state of preservation, fencing and signage will prevent unauthorised and unnecessary access. Due to their low significance, the

consequence of disturbance is considered to be **negligible** and the residual risk is **very low**.

Disturbance to Potential Non-Indigenous Historic and Cultural Heritage Sites

The potential for discovery of new sites of non-Indigenous historic or cultural significance in the MLA area during construction and operations is extremely low, as an extensive site survey has been undertaken (Appendix 8). Should new sites be discovered the mitigation measures will limit likelihood of disturbance. The overall likelihood of disturbance to new sites is considered **virtually impossible**, with disturbance to these sites being **negligible**. The risk associated with this impact is therefore considered to be **very low**.

9.12.4 Environmental and Social Objectives

The environmental and social objectives for non-Indigenous cultural heritage, the assessment criteria and a summary of the control measures are listed in Table 9.40.

Table 9.40 Environmental and social objectives for non-Indigenous cultural heritage

ID	Objective	Assessment Criteria	Summary of Control Measures
I42, I43, I44, I45, I46, I47	No unauthorised disturbance to non-Indigenous heritage sites within the MLA area.	No disturbance to any non-Indigenous heritage site without prior authorisation. Structures fenced as per cultural heritage management plan. Salvage materials from Paringa homestead removed in accordance with cultural heritage management plan. Monitoring records of structures to show no project-related deterioration.	Implementation of the Non-Indigenous cultural heritage management plan (including restricting unauthorised access, fencing and other means of securing the sites).

9.12.5 Monitoring

In accordance with the non-Indigenous cultural heritage management plan, quarterly inspections of heritage sites will be conducted during the first year of project development, with annual inspections thereafter. These inspections will assess the preservation and integrity of structures and the effectiveness of current management techniques.

9.13 Landscape and Visual Amenity

9.13.1 Potential Impacts

The only potential credible, project related impact on landscape and visual amenity is decreased, or in fact improved, visual amenity. The impact to existing visual amenity will vary with viewer sensitivity (i.e., the degree to which change is perceived or experienced by an individual), the viewer’s distance from the MLA area (i.e., local, sub-regional or regional) and the phase of the mine cycle (i.e., construction, operation or closure).

It should be noted that any reduction in visual amenity, as described below, does not take into consideration the proposed avoidance, mitigation and management measures

that will be implemented by Hillgrove during all stages of project development (see Section 9.13.2) and that will result in the residual impacts discussed in Section 9.13.3.

Reduced Visual Amenity during Construction and Operations

Potential causes of reduced visual amenity during construction and operations include:

- Size and form of new project components (i.e., processing plant, integrated waste landform, offices, staff amenities and roads within the MLA area) in the landscape.
- Colour of project components in contrast to the existing environment.
- Permanent changes to landforms within the MLA area (i.e., partial removal of MacFarlane Hill during the extension of the open pit increasing the view of project components within the landscape).
- Light emissions highlighting night operations and changes to the existing landscape (i.e., new infrastructure, processing plant).
- Dust emissions due to ground excavation, construction works, haulage and processing.
- Vegetation removal, altering existing landscape and allowing views of the project components.
- Presence of additional vehicles and project machinery, haulage routes of trucks along local roadways.
- Untidy areas and litter at the mine site.

Reduced Visual Amenity Post Closure (Potential Benefit)

Potential causes of reduced visual amenity post closure include:

- Size and form of permanent project components (i.e., integrated waste landform) in the landscape.
- Permanent changes to landforms within the MLA area.

Alternatively, the visual amenity of the site might be improved upon closure due to the improved contouring of the integrated waste landform and revegetation of the site.

9.13.2 Avoidance, Mitigation and Management Measures

To minimise the potential for significant visual impacts, the integrated waste landform will be sited on the western side of the MLA area, away from the main residential areas (and the viewshed) of Kanmantoo. A range of mitigation and management measures to limit the visual impacts of the project is currently being incorporated by Hillgrove in its final project design. These measures are based on potential impacts identified in Section 9.13.1 and are discussed in detail below.

Reduced Visual Amenity during Construction and Operations

Management and mitigation measures to minimise the visual impact during construction and operations include:

- Restricting omni-directional exterior lighting use where possible, and preferential use of vertical beams, shields and spotlights to minimise the spill of stray light that may increase viewer sensitivity at night.
- Reducing dust generation by the implementation of dust management program, detailed in Section 9.5.2.
- Establishing native trees and shrubs:
 - Around project boundaries to shield the operation from sensitive vantage points.
 - Surrounding the processing plant and administration buildings to incorporate the buildings with the surrounding landscape.
 - Surrounding the western and northern edges of the project site, thereby assisting to integrate the integrated waste landform into the surrounding landscape.
 - Along access routes to visually close out sensitive vantage points.
- Undertaking progressive rehabilitation (see Section 13.7.1) wherever possible within the MLA area during operation.
- Undertaking waste management as outlined in Section 6.12.

Reduced Visual Amenity Post Closure

Management and mitigation measures to minimise the visual impact of the project post closure will include:

- Removing buildings and infrastructure (subject to stakeholder agreement).
- Contouring the base of the integrated waste landform to a concave form. The upper slopes and top of the integrated waste landform will be modified from the angle of repose to a more concave shape, creating a natural weathered profile.
- Superficial contouring of the integrated waste landform base to provide valleys and gullies as refuges for vegetation and fauna habitat.
- Rehabilitating the integrated waste landform by extensive tree and shrub plantings along the base of the structure and benches.
- Rehabilitating disturbed surfaces.
- Planting trees and shrubs along the northern and western edges of the MLA area to integrate the integrated waste landform into the surrounding landscape.

9.13.3 Residual Impact Assessment

Table 9.41 summarises the residual impacts of the project on landscape and visual amenity, considering the likelihood and consequence of the predicted impacts after the successful implementation of the aforementioned management and mitigation measures. These assessments are described in further detail below.

Table 9.41 Summary of impacts on landscape and visual amenity

ID	Impact	Likelihood	Consequence	Residual Risk
148	Reduced visual amenity during construction and operations.	Unlikely to Likely*	Negligible to Moderate*	Very low to Medium*
149	Reduced visual amenity post closure.	Virtually Impossible	Negligible	Very low
150	Improved visual amenity post closure.	Virtually Certain	Minor	Medium benefit

* Dependent on distance from MLA area.

Visual Assessment Method

The assessment of the visual impacts of the project is based on the report by Wax Design (in association with Brett Grimm) (Appendix 2). The quantitative assessment of the visual impact has been undertaken using the GrimKe Matrix in conjunction with photomontage production.

The GrimKe Matrix utilises a two-tiered assessment method, assessing the existing landscape character and the degree of visual impact generated from both the historic and proposed mining operations. Four viewpoints were identified within the local and sub-regional area as being typical to worst-case representations of the development in the landscape. Photomontages were produced for each of these viewpoints, digitally inserting the proposed mine infrastructure into the surrounding landscape (see Figure 5.8). A statistical quantification of the degree of visual impact was then produced for each of these viewpoints.

For further details on the method of this assessment refer to Appendix 2.

Reduced Visual Amenity during Construction and Operations

Modification of the existing landscape during the construction and operation is **likely** to reduce the visual amenity within the local area. Local residents will experience the greatest level of change to the landscape, due to their close proximity to project components and awareness of the existing landscape. Perceived reductions in visual amenity will, however, be limited, due to the presence of existing historic mine workings and associated infrastructure. Local residents will experience a limited degree of visual change on the northwest, west, south and southwest of the MLA area. The integrated waste landform and some additional infrastructure will be visible from Eclair Mine Road and certain sections of Back Callington Road (see Figure 5.8). From local properties, views of the mine expansion will be limited to specific ridges. The consequence of the reduced visual amenity is considered to be **moderate** and resultant risk is therefore **medium**.

Within the sub-regional area visual impacts will generally be restricted to distances less than 10 km from the MLA area. While impacts are **likely**, the complex ridge and valley structure of the Kanmantoo landscape suggests that any visual impacts will be restricted to certain elevated localities in the northwest, west, south and southwest of the MLA area (see Figure 5.8). The western sub-regional area will experience the greatest visual effect, due to the siting of the integrated waste landform in this viewshed. The consequence of the reduced visual amenity is considered to be **moderate** and the resultant risk is **medium**.

At distances greater than 15 km, the proposed project infrastructure will be shielded to a large degree by a complex set of ridge and valleys (see Figure 5.8). Visitors to the area will experience little to no change in perceived visual amenity, as the project will expand mining components already present within the regional landscape. Any additional visual impact is **unlikely**. The consequence is considered to be **negligible** and the resultant risk is therefore **very low**.

Reduced Visual Amenity Post Closure

On a local level, extensive revegetation and screening works will enable permanent project components such as the integrated waste landform and pit void to be incorporated within the existing environment. As the existing landscape is highly modified and contains un-rehabilitated mine components, long term impacts on visual amenity are **virtually impossible**. Rehabilitation and incorporation of the old waste rock dump into the proposed integrated waste landform will reduce the current impacts on visual amenity from historic workings at Kanmantoo. The consequence is therefore **negligible** and the risk is **very low**.

Within the sub-region, proposed rehabilitation and revegetation of the MLA area will mitigate sensitive vantage points from the MLA area. Contouring and revegetation of the integrated waste landform will incorporate this structure within the general topography form of the region. Any reduction in sub-regional visual amenity is therefore **virtually impossible** after mine closure. The consequence of this impact is therefore **negligible**, with a **very low** risk.

As the project components will not typically be distinguishable on a regional scale post closure, the likelihood of visual impacts will be **virtually impossible**, the consequence **negligible**, and the risk therefore **very low**.

In fact, it is **virtually certain** that the visual amenity would be improved post closure. The consequence of an overall improvement to the existing landscape is **minor**, and the residual benefit is therefore **medium**.

9.13.4 Environmental and Social Objectives

The environmental and social objectives for landscape and visual amenity, the assessment criteria and a summary of the control measures are listed in Table 9.42.

Table 9.42 Environmental and social objectives for landscape and visual amenity

ID	Objective	Assessment Criteria	Summary of Control Measures
148, 149, 150	Site maintained and closed in a manner such that visual impacts are minimised.	Records of disturbed areas and rehabilitated areas to demonstrate that no unnecessary disturbance has occurred. Monitoring of dust emissions (in line with routine air quality assessment) shows no significant dust nuisance as a result of the project. MLA area kept free of litter. Rehabilitation of site to approved closure plan.	Amelioration of impacts during the design phase where possible. Implementation of a progressive rehabilitation plan. Enforcement of high housekeeping standards. Minimise dust emissions (see I10 to I12).

9.13.5 Monitoring

The effectiveness of mitigation measures in minimising visual impacts will form the basis for monitoring visual amenity. No formal monitoring of visual amenity is proposed, except by complaint. Where complaints indicate that agreed mitigation measures are not adequate, Hillgrove will assess whether additional mitigation measures are required.

9.14 Infrastructure and Transport

9.14.1 Potential Impacts

Potential, credible, project-related impacts to infrastructure and transport are described below. It should be noted that these do not take into consideration the proposed avoidance, mitigation and management measures that will be implemented by Hillgrove during all stages of project development (see Section 9.14.2) and that will result in the residual impacts discussed in Section 9.14.3.

Road and Traffic Disruption during Construction

Project construction may alter local and regional traffic volumes and traffic type, with consequent safety and amenity issues and possible impacts on road maintenance requirements. Possible disruption of traffic during construction of the cross road intersection (where the new access road meets Mine Road and then continues into the mine area) and the T-junction intersection with the Princes Highway may also occur.

Road and Traffic Disruption during Operations

Potential increases to local and regional traffic volumes and traffic type during operations may occur, with consequent safety and amenity issues, and possible impacts on road maintenance requirements.

Adverse Effects on South Australia's Power Supplies

The use of grid power for the project may have adverse impacts (such as causing supply interruptions) on South Australia's power supplies.

Adverse Effects on Local and Regional Water Supplies

The use of groundwater and water extracted from the River Murray may have adverse impacts on local and regional water supplies. Such impacts may include a reduction in availability for other users.

Adverse Effects on Other Infrastructure

The project may potentially affect other infrastructure components of the including large-scale infrastructure such as the airport and airport facilities, as well as small-scale infrastructure such as local fences.

9.14.2 Avoidance, Mitigation and Management Measures

Roads and Traffic

Avoidance (Route Selection). In planning the route for traffic movements associated with the construction and operation of the project, Hillgrove initially considered two road options (see Chapter 7):

1. Back Callington Road, Callington Road, Princes Highway, East Terrace; or
2. Mine Road, Princes Highway, East Terrace.

The assessment of potential impacts to road traffic, safety and condition along each of the routes (Appendix 10) identified that, while each route was feasible, the use of these routes would either require significant road upgrading and loss of native vegetation (Option 1), or raised community concern over amenity and safety impacts (Option 2).

In response to concerns raised during the K/C/CCC presentation of the traffic assessment (regarding the potential safety and amenity impacts of project-related traffic travelling through Kanmantoo and/or Callington), Hillgrove investigated the feasibility of constructing a private access road (Option 3). This third option minimises the potential impact of project-related traffic, and heavy vehicles, in particular, to the Kanmantoo community.

Hillgrove's proposed route is therefore Option 3 (this option was also preferred by the K/C/CCC).

Consideration was also given to using rail to transport the concentrate as discussed in Chapter 7.

Management. As the proposed concentrate transport route will utilise a number of roads that are not designated as gazetted Restricted Access Vehicle (RAV) routes, applications will be lodged with the Department for Transport, Energy and Infrastructure (DTEI) to seek approval for the proposed haul route to be gazetted (with the exception of East Terrace, which is already a gazetted road). DTEI will consult with the relevant road authorities for the roads forming the haul route (i.e., District Council of Mount Barker or Department of Transport Energy and Infrastructure, Rural City of Murray Bridge), and will consider aspects such as the frequency of traffic movements, geometric design standard of the route, structural strength of the road pavement and its ability to withstand the loads applied by RAVs. Impacts on local communities affected by the RAVs (which may include road safety and environmental impacts such as noise, vibration and dust), will also be considered (Appendix 10), with appropriate management measures documented.

A traffic management plan for the concentrate transport route will be developed in accordance with appropriate authorities such as Transport SA, and in consultation with the local community. Key aspects of the plan will include:

- Road safety (e.g., speed, visibility, education of mine staff and contractors, vehicle maintenance, and appropriate enforcement penalties for non-compliance).
- Amenity and environment (e.g., impacts of mine traffic on the local community amenity and natural environment, including noise, vibration, dust, and vehicle splash and spray and other key concerns that were raised by the K/C/CCC).

The traffic management plan will also address other aspects such as travel times (e.g., to avoid school bus times) and use of exhaust brakes. Implementation of the plan will be assisted by incorporating the plan into the contracts of the concentrate transport companies.

Mitigation. The bypassing of Kanmantoo will significantly reduce the potential for impacts to the local community due to traffic associated with the project. However, mitigation measures will still be implemented prior to construction of the proposed private access road, upgrades to existing roads and construction of the mine commencing, and will include:

- Provision of measures such as escort vehicles and appropriate signage for heavy haulage of construction and mining equipment to site.
- Construction of temporary diversion roads for local traffic (if required).
- Deployment of graders to maintain the condition of the unsealed roads that may be affected by the movement of construction and mining equipment.

As part of Hillgrove's consultation program (see Chapter 8), road users and local residents will be informed of any changed road conditions prior to and during road upgrades (where required).

Other Infrastructure

The only other aspects of the local, regional or state infrastructure that require specific consideration concern the state's electricity supply and local/regional water supplies.

The average electrical power load during operations is estimated to be 5.9 MW, with the total annual energy consumption estimated to be about 52 GWh (see Section 6.10.1). The new power infrastructure to be built (i.e., a transmission line extension of the existing 132 kV line into the site, and a switchyard to convert the 132 kV to 11 kV) will be of sufficient capacity to support the mine's power requirements.

During the peak of construction between 30 to 100 kL per day of water will be required, this will be sourced from either the old pit or, if this water is not suitable, from the water main along Mine Road (see Section 6.10.2). For the operation phase, the opportunities to harvest water, capture pit ingress water and recycle process water on site have been maximised. Hillgrove's preferred water supply option if viable for raw water requirements is treated water from the Laratinga Effluent Treatment Facility and Hillgrove have a Memorandum of Understanding with the Mount Barker District Council regarding the use of this resource. Should this water source not be available, or if its supply is interrupted, Hillgrove will use groundwater bores on the site to supplement the mine's water supply.

9.14.3 Residual Impact Assessment

A summary of the residual impact assessment for the impacts associated with roads, traffic and other infrastructure, is shown in Table 9.43.

Table 9.43 Summary of impacts associated with infrastructure and transport

ID	Impact	Likelihood	Consequence	Residual Risk
I51	Road and traffic disruption during construction.	Possible	Minor	Low
I52	Disruption to local traffic during operations.	Likely	Minor	Medium
I53	Adverse effects on South Australia's power supplies.	Virtually impossible	Moderate	Low

**Table 9.43 Summary of impacts associated with infrastructure and transport
(cont'd)**

ID	Impact	Likelihood	Consequence	Residual Risk
154	Adverse effects on local and regional water supplies.	Unlikely	Moderate	Low
155	Adverse effects on other infrastructure.	Unlikely	Negligible	Very low

Road and Traffic Disruption During Construction

Traffic modelling to estimate the number and type of vehicles during the construction phase of the project indicates that the volume varies depending on the construction stage with the last quarter of the construction year having the most traffic. The estimated construction traffic volumes are between 84 and 256 vehicle movements per day, with over 90% of the traffic expected to be light vehicles and a maximum of 24 heavy vehicles per day (see Section 6.9.4 and Appendix 10).

It is **possible** that the movement of vehicles to site will affect motorists using the proposed traffic routes. However, the use of the private access road by project-related traffic will significantly reduce the extent of the disruptions, particularly to the Kanmantoo community. The consequence of this impact is **minor** due to the implementation of appropriate management measures such as the traffic management plan, the limited number of heavy and light vehicles involved, and the restricted time period during which construction will occur. The residual risk is therefore **low**.

Disruption to Local Traffic During Operations

Traffic modelling to estimate the number and type of vehicles during the operations phase for a typical year indicates that the volume of project-related vehicle movements per day is between 202 and 210. More than 87% of the traffic is expected to be light vehicles, and there will be between 20 and 28 heavy vehicle movements per day, depending on the type of vehicle used (i.e., B-doubles or Semi-trailers) (see Section 6.9.4 and Appendix 10).

Traffic volume increase during operations is **virtually certain**. As a result, it is **likely** that some disruption to local traffic will occur. However, with the implementation of appropriate management and mitigation strategies such as the traffic management plan, the level of disruption caused by this traffic increase is considered to be **minor**. While there will be some additional traffic associated with the mine travelling through Kanmantoo, this will be mainly light vehicles only. Therefore, the potential for, and significance of, impacts to road safety and the community have been significantly reduced by Hillgrove's decision to construct and use the private access road. All heavy vehicles will use this road, unless conditions make this bypass unsafe to access. In such cases heavy vehicles will use Mine Road and Princes Highway, subject to consultation with the community and compliance with the traffic management plan. However, there will still be some increase in traffic volume in the local area during operation and this may lead to minor disruptions, so the residual risk of this impact is therefore **medium**.

Adverse Effects on South Australia's Power Supplies

It is **virtually impossible** that supply interruptions would occur due to the project's power demand as the Kanmantoo mine will be drawing relatively small quantities of power from the state network and will therefore not be a significant user. It is therefore not anticipated that this use of power would cause supply interruptions. The consequence is considered to be **moderate**. The residual risk of an adverse effect on South Australia's grid capability is **low**.

Adverse Effects on Local and Regional Water Supplies

It is considered **unlikely** that adverse effects on local and regional water supplies will occur because of the project's use of water from the River Murray or groundwater, due to the preferential use of water from other sources (i.e., Laratinga Effluent Treatment Facility and on-site water harvesting). Further detail regarding the significant of impacts to water supplies is provided in Section 9.3.3. The consequence is, however, **moderate**, with a corresponding residual risk rating of **low**.

Adverse Effects on Other Infrastructure

The likelihood of adverse impacts occurring on other local, regional or state infrastructure is **unlikely**, with the corresponding severity of consequence being **negligible**. It is anticipated that due to the size of the port facilities, the use of this infrastructure would have a minimal impact. Similarly, there will not be a significant increase in demand on the Adelaide airport facilities, as the mine will not be operating as fly-in-fly-out. The resulting residual risk is therefore **very low**.

9.14.4 Environmental and Social Objectives

The environmental and social objectives for infrastructure and transport, the assessment criteria and a summary of the control measures are listed in Table 9.44.

Table 9.44 Environmental and social objectives for infrastructure and transport

ID	Objective	Assessment Criteria	Summary of Control Measures
I51, I52, I53, I55	No significant impacts to public roads or traffic as a result of traffic to/from the mine. No impact to power supplies or other local infrastructure as a result of the project.	Records demonstrate that consultation has occurred with the appropriate agencies (e.g., District Council of Mount Barker, Murray Bridge Council, DTEI and Transport SA). All accidents and near-misses appropriately investigated and investigation shows that accident was not substantially caused by project-related traffic. Site security record shows compliance with agreed hours of traffic movement. Complaints register (containing records of relevant complaints and actions/responses taken) to show no reasonable complaint unaddressed.	Implementation of the Traffic Management Plan. Liaison with appropriate agencies (e.g., District Council of Mount Barker, Murray Bridge Council, DTEI and Transport SA) regarding infrastructure. Haul route designated as gazetted Restricted Access Vehicle route where required. Implementation of Hillgrove's consultation program to inform road users of any changed road conditions.

**Table 9.44 Environmental and social objectives for infrastructure and transport
(cont'd)**

ID	Objective	Assessment Criteria	Summary of Control Measures
154	No significant impacts on local and regional water supplies as a result of the project.	No reduction in availability of water supplies for local and regional users.	Maximisation of recycled water processed on site during operations. Monitoring of groundwater (levels and quality) near the mine and at selected bores of existing users.

9.14.5 Monitoring

Quarterly traffic counts will be conducted to assess if traffic volumes are as predicted. Monitoring of traffic impacts will be a continual process and will involve regular communication with the local community. The traffic management plan will serve as a tool for ensuring that the impacts of heavy vehicles on other road users and adjacent lands owners are minimised (Appendix 10). No other monitoring of infrastructure and transport is proposed, other than recording the number of complaints related to these issues in the complaints register.

9.15 Preliminary Hazard Analysis

9.15.1 General

The probability of accidents associated with the development and operation of the project is low, given that the design, operating and control measures adopted by Hillgrove will have the specific aim of preventing their occurrence. Similarly, natural events of sufficient magnitude to cause significant damage have a very low probability of occurrence.

General safeguards that will be adopted by Hillgrove include:

- Implementation of emergency response plans (including spill contingency) and procedures for accidents and hazardous events.
- Induction training and periodic refresher training for all employees and contractors on all aspects of safety and site-specific regulations concerning safety.
- Attention to government statutory compliance, notification and liaison procedures.
- Liaison with emergency service organisations with regard to visiting the site and becoming familiar with the operation and emergency response plans.

Nevertheless, a preliminary hazard assessment has been undertaken to identify and assess the key risks of each major component of the project to people (both project-related and the general public), the mining operation and the environment.

As part of the detailed design phase, hazard identification and hazard operations workshops will be undertaken to refine the preliminary assessment and further controls incorporated into final design as necessary.

9.15.2 Hazard Identification

The hazard identification and preliminary assessment has been based on experience gained by the project team in the development and operation of similar projects in similar environmental and social settings.

The assessment process resulted in the identification and evaluation of 17 hazards. These are listed in Table 9.45, which also includes mitigation and preventative controls. The risk assessment undertaken differs from that used in the rest of this chapter because it:

- Evaluates risks for the occurrence of natural hazards or accidents rather than normal operating procedures (which is the premise of the assessment in earlier sections).
- It uses the Standards Australia (2006) risk matrix in which risks are categorised as extreme, high, moderate or low.

Table 9.45 Risk matrix for preliminary hazard assessment

		Consequence				
		<i>Catastrophic</i>	<i>Major</i>	<i>Moderate</i>	<i>Minor</i>	<i>Insignificant</i>
Likelihood	<i>Almost certain</i>	Extreme	Extreme	Extreme	High	High
	<i>Likely</i>	Extreme	Extreme	High	High	Moderate
	<i>Possible</i>	Extreme	Extreme	High	Moderate	Low
	<i>Unlikely</i>	Extreme	High	Moderate	Low	Low
	<i>Rare</i>	High	High	Moderate	Low	Low

No risks were identified in the extreme risk category.

Three risks were identified in the high-risk category (one relating to TSF failure, one to ARD from the waste rock storage and the other to fire/explosions), with another six falling in the moderate-risk category and eight in the low-risk category. The high risks are discussed below.

TSF Failure

The project is located in an area that has an earthquake hazard risk as measured by the acceleration coefficient of 0.05 to 0.1 (GA, 2000c) (see Figure 5.14). This means that, in any 50-year period, there is a 90% chance that the peak ground acceleration⁸ will not exceed 0.05 to 0.1. This value may be compared to some more seismically active areas of Australia where acceleration coefficients greater than 0.1 apply⁹. Therefore, seismic activity (within the Australian context) in the area, and the associated risk, is considered to be moderate.

⁸ Peak ground acceleration is a dimensionless coefficient of acceleration that is used by civil engineers to estimate forces on structures.

⁹ The higher the value of the coefficient, the higher the risk of earthquake occurrence.

No known major active faults, which control the location and occurrence of earthquakes, occur at the project site (PIRSA, 2002) and the nearest recorded earthquakes to the MLA area are (GA, 2000b):

- Micro-earthquakes (less than 2.0 Richter magnitude) within 15 km.
- Very minor earthquakes (2.0–2.9 Richter magnitude) within 15 km.
- One 4.7 Richter magnitude earthquake approximately 26 km away.

The design of embankment structures to accommodate earthquake loads will be based on ANCOLD Guidelines for Design of Dams for Earthquake, and specific minimum requirements will be met concerning flood requirements, stability under seismic conditions, monitoring and surveillance of performance. The appropriate design earthquake acceleration for the TSF is an annual exceedance probability of around 1 in 1000.

If an earthquake of sufficient magnitude were to occur during operations, the inner slope of the embankment may fail and slide into the TSF. However, this failure is unlikely to extend to the embankment crest and tailings would probably not be released. As the tailings level rises and buttresses the inner embankment slopes, the potential for failure decreases since the tailings provides increased support. Once the TSF is full, failure of inner slopes cannot occur.

The TSF containment embankment is formed by compacted earthworks. Mine waste is then placed around the outer edge of this containment embankment such that a void is formed inside the waste rock storage. This void allows for further controlled, compacted, earthworks around the circumference of the void to form a perimeter containment boundary between the tailings and the waste rock. One of the advantages of this structure is that continued staged construction is in the downstream direction, that is, each lift is laid back against the surrounding mine waste rock storage and is placed over previously placed mine waste. Construction of future embankment lifts does not rely on the strength of the deposited tailings and, as such, the rate of rise and strength of the tailings do not impact on construction considerations. This type of structure is relatively resistant to deformations in seismic events and is the most stable form of TSF design.

It should be further noted that, at maximum height, the TSF will be surrounded by the waste rock storage, which will stand well above the TSF crest level in some areas. The probability of embankment failure during the life of the tailings disposal has been assessed as being low, provided the construction and operation guidelines are adhered to (Appendix 12).

If the embankment was breached and the tailings also breached the surrounding waste rock storage, and this failure was accompanied by significant rainfall, it is possible that tailings solids and decant water could be washed downstream with consequent adverse impacts on water quality due to both solids and, possibly, metals.

Safeguard against TSF failure include overall method of embankment construction (i.e., downstream construction), design and construction of the embankments to be stable up to the design event, supervision of TSF construction by appropriately qualified personnel, TSF structural inspections, and other measures as summarised in Table 9.46 and detailed in Appendix 12.

Generation of ARD from the Waste Rock Storage

As indicated in Section 6.7.1, approximately 60% of the waste rock samples assayed by EGI were PAF, PAF–lower capacity, or the PAF nature of the material was uncertain (EGI, 2007). The remaining 40% of the waste rock samples were NAF. This may lead to ARD from the integrated waste landform if the PAF rock is not managed and or characterised correctly.

Management and mitigation measures that have or will be implemented to manage this risk include:

- Preparation of a sulphur distribution model based on the existing data from the geological database and application of the nominal 0.2% sulphur cut off to produce a preliminary acid rock drainage distribution model.
- Identification of data gaps in the sulphur distribution model and infill testing, as required.
- Validation of the sulphur cut-off criteria with additional testing of selected samples across the various deposits
- Geochemical characterisation of materials close to the expected pit shells to assess the acid rock drainage potential of final voids.
- Leach column testing of waste rock materials to determine rates of reaction and likely leachate compositions to assist finalising collection and treatment requirements.
- Preliminary investigations into waste rock storage cover design requirements and potential sources of cover materials.

Successful implementation of the above, and the management measures described in Section 6.7.2, e.g., selective handling and encapsulation of PAF waste rock, will result in a low likelihood of significant volumes of ARD being generated. However, the consequences of ARD (should this occur to a significant extent), particularly as the time period involved could extend beyond mine closure, have resulted in an overall classification of this risk as 'high' (taking into account the already degraded nature of the receiving environment). Management of PAF waste rock will therefore be an ongoing, high-priority focus during project planning, construction, operations and closure.

Fire and Explosion

Mining and ore processing operations, including the storage and handling of flammable or combustible substances (i.e., diesel for the mining fleet) and explosives, can lead to the generation of potentially explosive and/or flammable gas emissions. Potential environmental impacts may include breakout of fire into surrounding vegetation, release of significant quantities of air emissions and contaminated runoff from fire-fighting water. Other impacts include damage to property and injury, as well as possible plant shutdown.

Detailed project design will address specific plant and facility design criteria for fire prevention, detection, control and personnel safety requirements. Other measures to reduce this risk include:

- Appropriate induction and training of personnel.
- Procurement of fire equipment adequate for the level of risk identified for the project and regularly maintained and tested to ensure good working order.
- Storage and handling of all substances, including waste and explosives, under conditions that minimise the risk of fire, explosion or toxic emissions.
- Implementation of specific procedures for high-risk tasks such as ‘hot work’ (e.g., welding) and working from heights.
- Liaison (e.g., Country Fire Service) and monitoring (e.g., fire danger ratings).

Table 9.46 Preliminary hazard analysis

Hazard	Potential Consequence/Impacts	Mitigation and Prevention Measures	Qualitative Risk
TSF embankment failure due to seismic activity, overtopping embankment	Increased potential for ARD. Tailings solids and/or tailings decant water enters watercourse or groundwater.	Adoption of integrated waste landform design. Supervision by qualified engineer during construction. Development and implementation of detailed TSF operating procedures (see Appendix 12). Emergency response plan. Engineered capping on closure. Annual dam safety inspections by external party.	High (E2) Potential offsite impact
ARD formation from the waste rock storage	Seepage of ARD into watercourses and groundwater.	Geochemical characterisation. Implementation of waste rock management plan, including waste scheduling and encapsulation. Surface water drainage management.	High (D2) Potential offsite impact
Fire and/or explosion	Loss of native vegetation. Release of air emissions. Contaminated runoff from fire-fighting water enters watercourse. Injury/fatality.	Compliance with standards for the storage and handling of explosives and flammable material. Regular maintenance and testing of fire equipment. Development and implementation of fire management plan and emergency response plan.	High (C3) Potential offsite impact
Tailings pipeline failure due to seismic activity, structural failure or heavy equipment damage.	Release of tailings slurry to vegetation. Release of tailings slurry to watercourse.	Bunding. Monitoring pipeline flow. Development of contingency plans. Visual inspection of tailings lines.	Moderate (D3) Potential offsite impact

Table 9.46 Preliminary hazard analysis (cont'd)

Hazard	Potential Consequence/Impacts	Mitigation and Prevention Measures	Qualitative Risk
ARD formation from the TSF	Seepage of ARD into surface water courses and groundwater.	Engineered capping on closure. Monitoring. TSF underdrainage. HDPE liner as part of cover. Extraction of decant water.	Moderate (D3) Potential offsite impact
Failure of waste rock storage due to seismic activity or changed material properties.	Smothering of vegetation. Surface water contamination. Injury/fatality.	Location of storage. Appropriate dumping practices. Drainage control. Development of recovery plan.	Moderate (D3) Potential offsite impact
Failure of TSF decant pond due to seismic activity, structural failure, overtopping of embankments.	Release of contaminated water into watercourses and into groundwater through seepage.	Engineered design. Water volume into pond is controllable. Pumps to pump water into process sediment pond. HDPE lined pond.	Moderate (D3) Potential offsite impact
Vehicle collision or roll-over	Release of product, hydrocarbons or chemicals to the environment. Fire or explosion. Injury/fatality.	Compliance with appropriate statutory standards for the transport of materials. Adherence to speed limits and road rules. Develop emergency response plan (including spill contingency). Maintenance schedule for all vehicles.	Moderate (D4) Potential offsite impact
ARD formation in the pit	Contaminated pit water injures wildlife. Contaminated pit water impacts groundwater aquifer.	Geochemical characterisation. Pumping pit water for use in the process plant. Pit acts as groundwater sink. Groundwater monitoring.	Moderate (D3) Potential offsite impact
Mobile mining equipment collisions or rollover	Injury/fatality.	Operator induction and training. Flashing lights. Night lighting.	Low (D4)
Post-closure pit wall failure	Pit wall instability. Further rehabilitation work required. Exposure of fresh PAF material.	Pit wall and berm design. Post-closure monitoring. Abandonment bund outside area of potential instability.	Low (D4)
Tank or pipeline rupture or breach at process plant	Release of process water, hydrocarbons or other chemical. Surface/groundwater contamination. Fire or explosion.	Bundling. Monitoring pipeline flow. Monitoring tank levels. Development of contingency plans. Auditing and inspections.	Low (E4) Potential offsite impact

Table 9.46 Preliminary hazard analysis (cont'd)

Hazard	Potential Consequence/Impacts	Mitigation and Prevention Measures	Qualitative Risk
Pit wall failure due to seismic activity, geotechnical instability or groundwater pressure.	Injury/fatality. Disruption to operations.	Material constrained to the confines of the pit. Design of pits slopes, bench heights and berms. Artificial reinforcement of walls (e.g., rock bolts). Stability monitoring, e.g., pins, ongoing geotechnical and hydrological review. Dewatering, i.e., control of water behind pit walls.	Low (E2)
Pit flooding as a result of extreme rainfall or flood event, excessive groundwater inflows or failure of dewatering system.	Disruption to operations. Large volume of water requiring disposal. Potentially contaminated pit water requires disposal. Potential for release of pit water into environment. Pit wall instability.	Weather monitoring. Groundwater level monitoring. Pit water level monitoring. Maintenance of pumps.	Low (E2) Potential offsite impact
Irrespirable atmosphere in confined spaces	Injury/fatality. Plant shut-down.	Standard procedures for operating in confined spaces. Design of plant to avoid confined space areas.	Low (D4)
Fuel leakage/spillage	Fire and explosion. Soil contamination. Surface water contamination. Groundwater contamination.	Regular inspection of tanks, pipes, connections and bunds. Soil and groundwater monitoring. Spill response training and spill response kits maintained and located in appropriate areas. Development of waste management plan. Development of emergency response plan (including spill contingency).	Low (D4) Potential offsite impact
Chemical leakage/spillage	Release of chemical resulting in surface water and ground contamination. Release of gases.	Storage that prevents possible mixing of acidic and alkaline materials. Bunding with washdown and runoff collection systems. Use of appropriate protective clothing during handling. Operator training for mixing and use of chemicals. Spill response training. Following the MSDS. Development of waste management plan. Development of emergency response plan (including spill contingency).	Low (D4) Potential offsite impact

9.15.3 Leading Indicator Criteria

For each hazard identified in Table 9.46 where there is a high consequence event that relies significantly on a control strategy to reduce the risk, leading indicator criteria have been developed. These will, if monitored, provide early warning that the control measure is failing and are summarised below. Further detail for the monitoring of these aspects is provided in the preceding sections.

TSF Failure

- Stability monitoring shows deterioration in TSF embankment stability.
- Ongoing geotechnical and hydrological review shows unpredicted change in geotechnical and hydrological conditions.

Generation of ARD from the Waste Rock Storage

- Groundwater/surface water monitoring indicates decrease in pH from background.
- Rehabilitated areas show signs of impact from acid rock drainage, i.e., presence of salts, acid drainage.
- Monitoring of cover system is at variance with model predictions.
- Actual volumes of PAF/NAF waste are at variance with the waste characterisation model/ waste management plan and there is a higher percentage of PAF waste.
- Audit of waste rock material handling procedures show the waste management plan is not being implemented.

Fire and Explosion

- Audit of emergency response procedures and equipment shows inadequate emergency response for fire.
- Audit of storage facilities shows storage protocols are not being observed.

10. Monitoring and Reporting

Hillgrove will implement a comprehensive monitoring and reporting program for the project. The primary objectives of the environmental and social monitoring program are to:

- Provide information that will determine the adequacy of environmental and social management practices and allow improved practices and procedures to be developed.
- Detect and measure trends or environmental/social changes, and enable analysis of their causes.
- Confirm environmental and social impacts of particular activities and identify unforeseen effects and the need for additional management measures.

The proposed monitoring program will include monitoring of:

- General mine operations.
- Discharges and emissions from the mine site.
- Potential environmental impacts associated with the project.
- Potential social impacts associated with the project.

Monitoring of the MLA area following closure of the mine is detailed in Appendix 17.

10.1 Monitoring Program

Details of the proposed monitoring for each of the impacts identified are contained in Chapter 9. Additional monitoring that will be undertaken as part of the site's environmental management and stakeholder engagement program are set out below. The overall monitoring program is summarised in Section 10.2.

10.1.1 Non-mine Waste Monitoring

All waste storage areas within the MLA area will be inspected monthly to visually assess if waste materials are appropriately stored and check if they are presenting a potential risk to human health or the environment.

In addition, the records will be kept concerning:

- Spills of hazardous materials (including fuel, oil and other hazardous chemicals) and cleanup.
- Disposal of hazardous waste, including contaminated soil resulting from fuel, oil or chemical spills.

10.1.2 Stakeholder Consultation Monitoring

Hillgrove will establish a complaints register for recording all complaints, and will aim to resolve complaints received from stakeholders as soon as practicable. The nature of the complaint will determine the timeframe and actions to be taken.

Monitoring of stakeholder consultation will include ongoing monitoring of:

- Records of attendance at public events and community meetings to gauge the success of stakeholder consultation and to improve ongoing stakeholder consultation.
- Records of feedback including the person's name and contact details, method of consultation, information communicated, responses and outcomes of the consultation in the stakeholder database.
- Articles that appear in the media, particularly letters to the editor.
- Number and nature of complaints documented in the Complaints Register, including the person's name and contact details, communication, action taken to resolve the complaint, outcomes and feedback from complainant.

10.2 Monitoring Program Summary

The environmental and social monitoring program is summarised in Table 10.1.

Table 10.1 Summary of environmental and social monitoring program

Location	Frequency during operation	Parameters
Landform and land use		
MLA area	During/after significant rain	Visual evidence of erosion of stockpiles, slopes and drainage lines. Condition and effectiveness of controls.
Surface water - water quality		
Sites Kan01 to Kan04	Opportunistically after significant rainfall event	<ul style="list-style-type: none"> • pH, conductivity, turbidity, TSS. • Metals - Al, As, Cd, Cr, Cu, Fe, Mn, Hg, Ni, Pb, Zn (filtered and unfiltered). • Major ions - Ca, Mg, SO₄. • Alkalinity (selected samples). • Dissolved oxygen (selected samples). • Nutrients (selected samples). • Water level.
Sediment traps	Monthly (or opportunistically should monthly sampling not be feasible)	<ul style="list-style-type: none"> • Field pH, conductivity, turbidity. • Acidity/alkalinity. • TSS, TDS. • Metals - Al, As, Cd, Cr, Cu, Fe, Mn, Hg, Ni, Pb, Zn (filtered and unfiltered).
TSF return water storage	Monthly	<ul style="list-style-type: none"> • Major ions - Ca, Mg, SO₄.
Pit water	Quarterly	
Surface water – stream sediment quality		
Sites Kan01 to Kan05	Annually	<ul style="list-style-type: none"> • Total and dilute acid extractable metals - Al, As, Cd, Cr, Cu, Fe, Mn, Hg, Ni, Pb, Zn (<2000 µm). • Particle size distribution.

Table 10.1 Summary of environmental and social monitoring program (cont'd)

Location	Frequency during operation	Parameters
Groundwater - regional		
Selected local wells on neighbouring properties	Monthly until steady conditions established, in which case quarterly	<ul style="list-style-type: none"> Water levels. pH, conductivity.
	Quarterly	<ul style="list-style-type: none"> Metals - Al, As, Cd, Cr, Cu, Fe, Mn, Hg, Ni, Pb, Zn (filtered). Major ions - Ca, Mg, Na, K, Cl, SO₄, CO₃, HCO₃.
Groundwater – MLA area		
Wells KMB001-KMB010 Others wells as required	Monthly until steady conditions established, then quarterly	<ul style="list-style-type: none"> Water levels. pH, conductivity. Metals - Al, As, Cd, Cr, Cu, Fe, Mn, Hg, Ni, Pb, Zn (filtered). Major ions - Ca, Mg, Na, K, Cl, SO₄, CO₃, HCO₃. Acidity/alkalinity.
Groundwater – wellfield (if or when utilised)		
Each extraction well (KMB003, KMB006, KMB010)	Continuous metering	Volumes (rates) extracted.
Intake to process plant	Monthly until steady conditions established, then quarterly	<ul style="list-style-type: none"> pH, conductivity. Metals - Al, As, Cd, Cr, Cu, Fe, Mn, Hg, Ni, Pb, Zn (filtered). Major ions - Ca, Mg, Na, K, Cl, SO₄, CO₃, HCO₃. Acidity/alkalinity.
Air quality		
One at the site office and another between the mine and the southern extent of the township of Kanmantoo	Ongoing	High volume air sampling for PM ₁₀ (to be established in consultation with EPA).
Areas with high potential for dust to cause an ongoing environmental nuisance, within (or close to) the MLA area	Monthly	Dust deposition monitoring by four to six deposition gauges (to be established in consultation with EPA).
MLA area and sensitive receptors a required	On complaint	Odour levels.
Noise		
Occupied residences and other sensitive receptors	Quarterly (during construction)	Construction noise levels (day and night measurements), with monitoring results compared to predicted noise levels.

Table 10.1 Summary of environmental and social monitoring program (cont'd)

Location	Frequency during operation	Parameters
Noise (cont'd)		
Occupied residences and other sensitive receptors	Initially and on complaint	Operational noise levels (day and night measurements) with monitoring results compared to predicted noise levels.
Machinery used in MLA area	On arrival to site and annually, as part of routine maintenance	Machinery noise levels.
MLA area	Annually, as part of routine maintenance	Maintenance and calibration of noise monitoring equipment, according to applicable standard.
Vibration and Flyrock		
MLA area and sensitive receptors as required	Initially and on complaint	Vibration and overpressure levels and flyrock.
Greenhouse gas emissions		
MLA area	Ongoing	Annual electricity use.
		Annual use of fuel, oil and grease.
		Diesel consumption rates for diesel powered equipment (mining unit plant, pumps, pre-concentrator plant, wet concentrator plant, and mining fleet).
Flora		
Established flora monitoring quadrats	Spring 2007, then annually	Species abundance, composition and condition.
MLA area, selected sites	Annually in spring	Presence of <i>Diuris behrii</i> (Behr's cowslip orchid) and <i>Ptilotus erubescens</i> (hairy-tails).
MLA area, selected sites	Annually	Health of vegetation community in terms of structure, disturbance, weeds and litter of <i>Eucalyptus odorata</i> low woodland and <i>Lomandra effusa</i> ± <i>Heliochrysum leucopsideum</i> open tussock grassland.
Flora - Vegetation clearance		
Areas to be cleared for project	As required, when vegetation is cleared	Area and nature of cleared vegetation, records demonstrating conditions of the NVMP are met.
Flora - Pest plants		
MLA area	As required	Records of vehicle and plant inspections for pest plant control.
MLA area	Spring/autumn or after significant germination events	Pest plant outbreaks (including size and number of infestations) and pest plant control treatment.
Fauna		
MLA area	Spring 2007	Fauna species in each of the three key habitat types (<i>Eucalyptus odorata</i> woodland, <i>Lomandra effusa</i> grassland and <i>Austrostipa</i> spp. grassland).
	As required	Record of all animal deaths as a result of project activities.
	Quarterly	Pest animals and pest animal control success.

Table 10.1 Summary of environmental and social monitoring program (cont'd)

Location	Frequency during operation	Parameters
Fauna (cont'd)		
MLA area and surrounds	Spring 2008	Regional distribution and abundance of diamond firetail (Section 9.9.2).
Areas of key habitat within the MLA area	Annually in spring	Presence of diamond firetail, brushtail possum and other selected species.
Project waterbodies (e.g., TSF and TSF return water storage)	Weekly	Visual evidence of fauna visiting waterbodies.
Socio-economic		
MLA area	Ongoing	Mine workforce statistics including: - Gender and age. - Number of 'local' and South Australian people employed. - Specific training provided by Hillgrove.
		Service and goods supply statistics, including: - Type and quantity of goods/service. - Value. - Location of supplier.
Local community	Ongoing	Contributions made by Hillgrove to local communities, such as sponsorship of local events.
Indigenous cultural heritage		
Potential Indigenous sites in MLA area	During ground disturbance (if required)	Evidence of cultural heritage artefacts or sites, by appropriate monitor.
MLA area	As required	Records of all new indigenous cultural heritage material discovered and reporting to DAARE and Peramangk representatives.
Identified indigenous sites within MLA area, if found	Quarterly (if found)	Preservation and integrity of identified cultural heritage material.
Non-Indigenous cultural heritage		
Identified non-indigenous cultural heritage sites	Quarterly during construction, then annually	Preservation and integrity of identified cultural heritage sites.
MLA area	As required	Records of all non-indigenous cultural heritage material discovered and reporting to DEH Heritage Branch.
Infrastructure and transport		
Local roads used by mine traffic	Quarterly	Volume of vehicle traffic.
MLA area and surrounds	Ongoing	Records of documents relating to vehicles, traffic and roads.
Non-mine waste		
MLA area	Ongoing	Waste production and recycling rates.
MLA area	Monthly	Visual evidence that wastes are appropriately stored and not presenting an environmental or health risk.

Table 10.1 Summary of environmental and social monitoring program (cont'd)

Location	Frequency during operation	Parameters
Non-mine waste (cont'd)		
MLA area	As required	Records documenting spills of hazardous materials (including fuel, oil and other hazardous chemicals) and cleanup.
		Records documenting disposal of hazardous waste, including contaminated soil resulting from fuel, oil or chemical spills.
Stakeholder consultation		
Local community	Ongoing	Records of attendance at public events and community meetings.
Not applicable	Ongoing	Records of feedback including the person's name and contact details, method of consultation, information communicated, responses and outcomes of the consultation.
		Stories that appear in the media.
		Number and nature of complaints documented in the Complaints Register, including the person's name, contact details, action taken to resolve the complaint, communication, outcomes and feedback.

10.3 Reporting

Hillgrove will maintain comprehensive records for cost control, technical efficiency and safety reasons, as well as for environmental purposes.

Reporting will be conducted according to the ML conditions, state agency licence requirements and Hillgrove's internal requirements. In particular, Hillgrove will provide annual mining and rehabilitation compliance reports to PIRSA, documenting performance of the Kanmantoo Copper Project against environmental, economic and social indicators.

Any non-compliance with licence conditions will be reported to relevant government agencies as soon as practicable. Environmental incidents that occur either as a result of an emergency, accident or equipment malfunction and which cause or threaten serious or material environmental harm will be reported within 24 to 48 hours of the event. Incidents can include (but are not limited to):

- Fire outbreak from the MLA area.
- Motor vehicle accident.
- Hydrocarbon or reagent spill.
- Contamination of a waterway.

Reporting requirements for discharge monitoring will be determined during detailed design and will be incorporated into the final monitoring program to meet the requirements of the National Pollution Inventory. Results will be regularly reported to the appropriate government authority.

Internal reporting of environmental and social performance to Hillgrove's senior management team will be conducted on a monthly basis. A summary of this report, including details of non-compliance reports, corrective actions and major issues arising from daily supervision and inspection and compliance audits, will be included in the monthly site report to the Managing Director. Relevant matters from these reports will be forwarded to PIRSA as required by legislation.

11. Mine Closure and Rehabilitation

11.1 Introduction

This chapter presents a summary of the conceptual mine closure and rehabilitation plan (MCRP) for the Kanmantoo Copper Project (Appendix 17).

Mine closure planning is a continuous process which starts prior to project development. Closure plans are progressively refined and adapted in light of project experience, further site information that becomes available during construction and operations, and changes in regulations, stakeholder expectations, technology, knowledge and mine planning. A key aspect to mine closure is the progressive rehabilitation of the site during operations, where this enables rehabilitation techniques to be trialled and refined prior to closure. Progressive rehabilitation also minimises closure costs.

11.2 Closure Objectives

In closing and rehabilitating the MLA area, Hillgrove will:

- Protect human health and safety.
- Reduce the need for long term monitoring and maintenance through design of and construction of landforms that are geotechnically and geochemically stable.
- Develop landforms that are consistent with the surrounding landscape.
- Rehabilitate the site to an appropriate land use consistent with the standards identified for that land use.
- Reinstate native vegetation.
- Improve the visual amenity of the existing site.
- Develop an environmental monitoring and reporting program which is focused towards demonstrating the achievement of closure outcomes.
- Undertake progressive rehabilitation of the site during operations.
- Ensure that the full cost of decommissioning and rehabilitation is understood and that a mechanism for funding exists.
- Ensure that residual risks and liabilities are identified and controlled to an acceptable level.

11.3 Stakeholder Involvement

The closure consultation process aims to keep stakeholders informed by developing and agreeing on final closure objectives and criteria, and on a process for the handover and relinquishment of the leases following closure.

The closure consultation process has been, and will continue to be, part of Hillgrove's broader stakeholder consultation (see Chapter 8), involving both formal and informal processes.

11.4 Baseline Environmental Data

Baseline environmental data is described in Chapter 5, and baseline data relating to previous mining activities at Kanmantoo is outlined below. The baseline environmental database will be expanded following an additional flora and fauna survey to capture any additional species present during Spring 2007.

The last period of mining ceased on June 30 1976. Following closure, some attempts were made to rehabilitate the site by covering the tailings dam and the top of the waste rock dump. A description of the current components of the site is outlined below (see Figure 1.2).

11.4.1 Old Pit

The old pit is 480 m long and 410 m wide (see Plate 5.1). The site had been fenced to prevent public access, particularly from Mine Road. Standard industry practice is to construct an earth bund around the perimeter of the pit to prevent accidental vehicle access. Currently no such bund exists.

The old pit currently contains approximately 100,000 kL of water (see Plate 5.2). The pit water has a low pH (2.8) and contains elevated metal concentrations (see Table 5.3).

11.4.2 Old Waste Rock Dump

The old waste rock dump covers an area of 34 ha and is 55 m high at its highest point (see Plate 5.3). The dump was constructed by end-dumping rock over an advancing face. Separation of non-acid forming (NAF) waste rock and potentially-acid forming (PAF) waste rock does not appear to have been undertaken, with evidence of PAF rock around the dump (Appendix 11). A groundwater monitoring bore south of the old waste rock dump contains groundwater with heavy metal concentrations exceeding SA EPA criteria. REM (2006) concluded that it was likely the old waste rock dump has impacted that groundwater (see Section 5.7.3)

Visual assessment of the dump indicates that vegetation on the top of the old waste rock dump is impacted by the presence of salts, probably from oxidation of pyrite and the subsequent formation of acid conditions. This is supported by the groundwater monitoring results.

No shaping of the old waste rock dump batters has occurred with all batters being at the angle of repose (rill angle of rock) (Plate 11.1). Revegetation of the old waste rock dump has been limited to the top of the dump where native species have been planted, although vegetation establishment and colonisation of the surface has been poor (see Plate 5.3). This is probably due to:

- Poor growing medium with respect to the depth and type of material (it is unknown if the soil placed on top was topsoil, subsoil or soil impacted by previous mining activities).

Plate 11.1
Bare batters of
old waste rock dump



Plate 11.2
Heap leaching operations on site



Plate 11.3
Old tailings dam seepage pond



- Acid rock drainage and, in particular, the presence of salts and low pH conditions.
- The surface of the old waste rock dump being very exposed and presenting difficult growing conditions.
- Grazing by kangaroos and introduced animals, e.g., rabbits.

No attempts have been made to revegetate the batters of the waste rock dump and these remain largely devoid of vegetation (see Plate 11.1). The steep batter slopes (approximately 37°) and no growth medium for plants make any vegetation establishment almost impossible.

11.4.3 Old Process Plant Area

The old process plant area is located on freehold land and does not form part of this MLA area. It is currently used by Neutrog for the manufacture of fertilisers.

11.4.4 Heap Leach Facilities

South Australian Mining Resources established a heap leaching operation in 2003 for the treatment of the low grade oxidised ore stockpile which remained following the closure of the mine in 1976. The current operation involves the placement of low grade oxidised ore onto leach pads which are then irrigated with acid water to leach copper from the ore (Plate 11.2). The leachate is collected in plastic lined drains and then pumped to the plant where scrap iron is used to attract the copper. The copper is then stripped from the iron and sold.

11.4.5 Old Tailings Dam

The old tailings dam was constructed during the past operations (1970-76) as a valley fill facility with a wall constructed across a valley and tailings contained behind. While the design of the tailings dam required a compacted clay layer for the base of the facility, it is understood that this clay liner was not constructed. On the downstream side of the tailings dam wall is a containment pond which captures seepage from the dam (Plate 11.3). The water in this pond is acidic indicating that the tailings material contains pyrite which has oxidised and has subsequently come into contact with water, resulting in acid drainage. No engineered cover system for the old tailings dam was developed to prevent acid drainage. The old tailings dam is currently covered with approximately 300 mm of soil, with vegetation having established on parts of the tailings dam surface.

11.5 Closure Domains

11.5.1 Final Land Use

To determine the appropriate final land use(s) for the MLA area, it is necessary to determine the capacity of the area to support that use. The Kanmantoo Copper Project can be divided into a number of domains, which can be assessed for their capacity to support the intended final land use.

The following domains have been identified (Figure 11.1):

- Open pit(s).
- Integrated waste landform (tailings storage facility, waste rock storage and ROM pad).
- Infrastructure (process plant, administration, workshops).
- Surface water structures.
- *Eucalyptus odorata* and other woodland.
- *Lomandra effusa* and other native grassland.
- Introduced pasture.
- Rehabilitated old tailings dam.
- Other disturbed areas.

A number of final land uses have been considered for the MLA area following mine closure. Ongoing consultation and discussion are likely to identify other land uses for consideration as part of the development of the final MCRP. This MCRP proposes land uses for each domain (Table 11.1), with a preference towards land uses which complement, rather than conflict with each other.

Table 11.1 Proposed land uses for each domain

Domain	Proposed land use
Open pit(s)	Open pit void
Integrated waste landform	Native vegetation
Process plant/ infrastructure/administration	Native vegetation
Surface water structures	Native vegetation
<i>E. odorata</i> woodland	Enhancement of remaining area
<i>L. effusa</i> grassland	Enhancement of existing area
Introduced pasture	Native vegetation
Rehabilitated old tailings dam	No change
Other disturbed areas	Native vegetation

11.6 Closure Concept for Each Domain

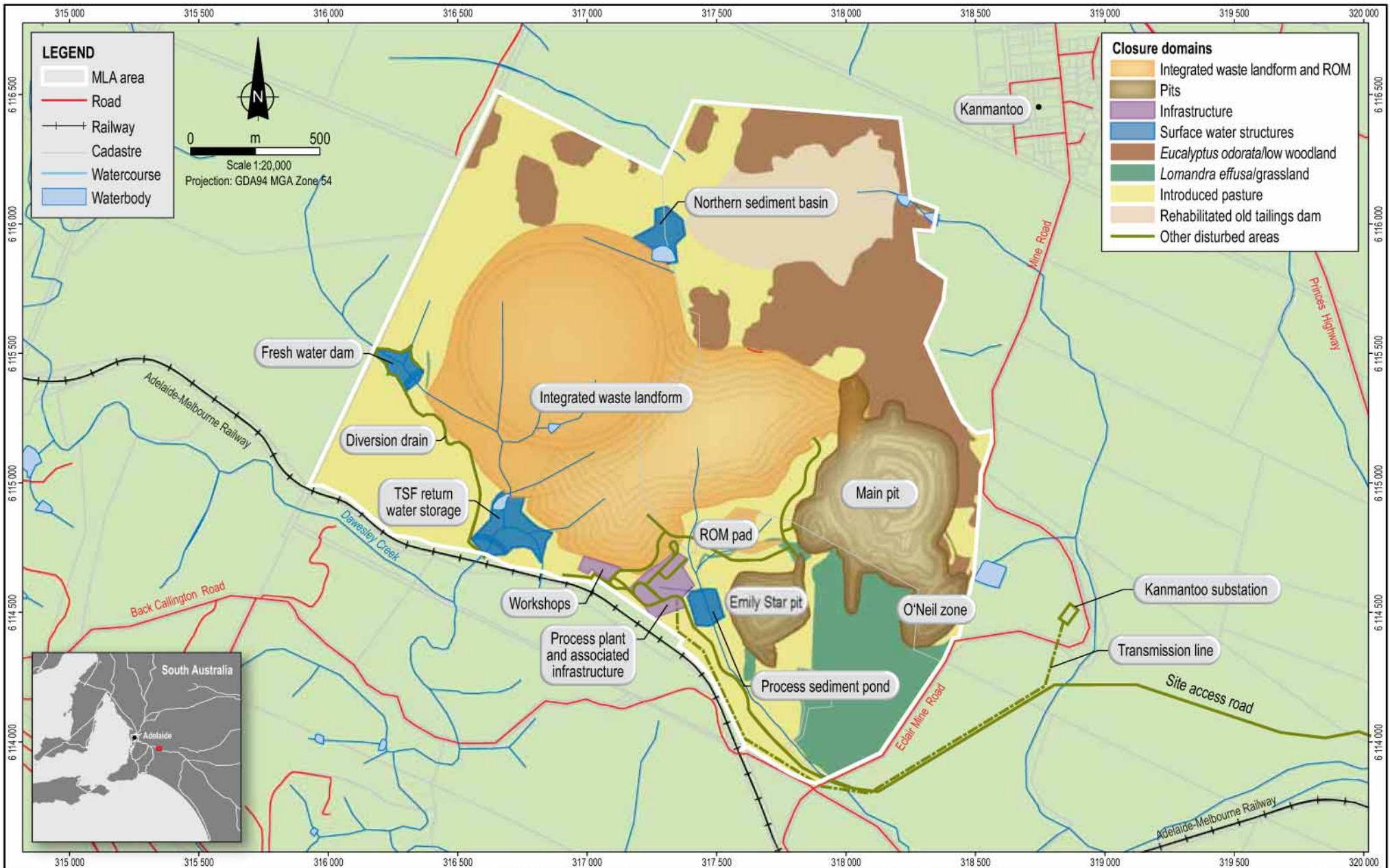
11.6.1 Integrated Waste Landform

Description

The integrated waste landform will incorporate the existing waste rock dump and will be expanded to include a new tailings storage facility (TSF), expanded waste rock storage and ROM pad. This domain will cover an area of approximately 129 ha. As outlined in Section 11.4.2, some revegetation of the old waste rock dump has occurred however the batters are unrehabilitated and there is evidence of potentially acid forming waste rock within the dump.

Final Land Use

The integrated waste landform will be revegetated with native species with *E. odorata* on the surface of the waste rock storage and *L. effusa* on the surface of the TSF and batters of the integrated waste landform.



LEGEND

- MLA area
- Road
- Railway
- Cadastrate
- Watercourse
- Waterbody

Scale 1:20,000
 Projection: GDA94 MGA Zone 54

Closure domains

- Integrated waste landform and ROM
- Pits
- Infrastructure
- Surface water structures
- Eucalyptus odorata*/low woodland
- Lomandra effusa*/grassland
- Introduced pasture
- Rehabilitated old tailings dam
- Other disturbed areas



Closure Considerations

The integrated waste landform will constitute the most significant closure feature within the landscape, and the largest area of disturbance requiring rehabilitation.

The key issues for the closure of the integrated waste landform are:

- Stability of the outer batter slopes.
- Design of the integrated waste landform to improve the existing visual amenity of the site.
- Design of the cover system to encapsulate potentially acid forming waste rock and tailings.
- Management of surface water runoff from the top surface and batters.
- Establishment of a self sustaining ecosystem.
- A restriction on future land uses to ensure successful rehabilitation.

Closure outcomes for this domain are outlined in Table 11.2.

Table 11.2 Closure outcomes for the integrated waste landform domain

Outcome	Action
Establish self sustaining communities of <i>E. odorata</i> and <i>L. effusa</i>	Landform design to include assessment of safe angle for humans to traverse with safety.
	Undertake testwork and modelling on topsoil and waste rock to determine the most appropriate safe and stable landform.
	Continue research with State Flora into the propagation of <i>L. effusa</i> . Collection of seed from native species within the MLA area. Topsoil to be removed from disturbed areas and stockpiled for use in rehabilitation. Progressive rehabilitation of the integrated waste landform to test revegetation strategy. Monitoring of revegetation over time to demonstrate success.
	Undertake testing of materials and modelling to develop store and release cover system. Establish trial area and monitor store and release cover system to verify model. Develop model of sulphur distribution to manage the placement of PAF waste rock.

Proposed Approach

It is proposed that the batters of the integrated waste landform will be shaped to form a concave profile with a steeper slope angle at the top, e.g., 25° and a shallower angle at the bottom, e.g., 12°. This landform shape mimics that of surrounding landforms where the upper sections are steeper while the lower sections have a gentler slope. Once mining commences, laboratory and field test work of the waste rock together with topsoil will be undertaken to determine the most stable landform.

Cover System

Geochemical assessment of the waste rock and tailings has indicated the potential for both tailings and waste rock to be PAF. The presence of PAF material will require an engineered cover system to be designed to manage this risk. Prevention of acid rock drainage can be achieved by three types of cover systems, namely a water cover, dry (soil) cover, or synthetic cover.

Water Cover. Placement of PAF material under water is a proven technique to minimise the oxidation of pyrite. The water acts as barrier to the diffusion of oxygen from the atmosphere to the PAF material below and subsequently prevents oxidation. Water covers are only feasible in wet climates where rainfall exceeds evaporation. The application of a water cover system at Kanmantoo is not feasible given the significant deficit between rainfall and evaporation.

Dry (Soil) Cover. Dry cover systems (also known as a store and release cover system) are a common prevention and control technique for PAF waste rock and tailings used at numerous mine sites around Australia and the world. Dry covers can involve a single layer of oxidised rock or soil or can be quite complex involving several layers of different material types, including compacted layers.

The purpose of a dry cover system is to control or limit the quantity of water infiltrating into the PAF waste below. The amount of infiltration through the dry cover is therefore the key consideration in the design of the cover system. The volume of water which infiltrates through the cover system is dependent on:

- Rainfall.
- Evaporation.
- Transpiration.
- Soil moisture storage properties.
- Runoff.

Synthetic Cover. A synthetic cover is a variation to the use of a soil cover. A synthetic barrier (usually a liner made of high-density polyethylene (HDPE)) is used to cover PAF tailings or waste rock and then this synthetic liner is covered with soil and vegetation established. The synthetic liner minimises the infiltration of water into the PAF material below while the soil layer above allows the establishment of vegetation.

Closure

Two approaches are being used for closure of the integrated waste landform, both of which are aimed at minimising infiltration into the PAF material below.

Tailings Storage Facility. The final tailings surface will be domed. The tailings deposition pattern will be reversed during the final year of operation such that tailings is deposited through a series of risers constructed on wing walls from the decant to create the domed tailings surface.

A HDPE liner will be placed over the tailings and covered with waste rock supplemented with soil to form a growth medium. A HDPE liner was selected for the TSF as the tailings solids have been finely crushed and therefore do not present a risk with regard to puncturing the liner. Placement of the waste rock and soil over the top of the liner will

occur after a layer of fine material has been placed over the liner to protect it against puncture by the waste rock.

The area will be seeded with grasses and shrubs only (Figure 11.2). No large trees are to be planted on this surface to protect the HDPE liner from damage caused by tree roots. Topsoil removed from the integrated waste landform areas prior to construction will be respread over the prepared top surface.

Waste Rock Storage. The majority of dry covers constructed in Australia have a cover depth of between 1 to 2 m of soil and/or waste rock. Some cover systems also have a compacted layer or capillary break (coarse gravel layer) at the interface between the PAF waste rock and the loose soil above. The actual final configuration (depth and whether a compacted layer is required) of the dry cover will be determined following test work of material properties once mining commences and representative samples are available. For the purposes of this conceptual closure plan it has been assumed that a dry cover consisting of 0.5 m of compacted clay and 1.5 m of uncompacted soil or oxidised waste rock will be used.

E. odorata woodland will be established on the surface of the waste rock storage and this will link up with the remnant woodland on the eastern boundary. Further work is required on the areas where *E. odorata* currently exists to understand characteristics such as the depth of roots, to determine if the proposed depth of cover is suitable. The preferred option on the slopes of the integrated waste landform is to create a *L. effusa* grassland.

ROM Pad. On completion of mining, the remaining ore on the ROM stockpile will be fed to the concentrator. Any contaminated material will be removed and either processed or placed in the TSF. The ROM pad will then be rehabilitated following the same approach for the waste rock storage as described above.

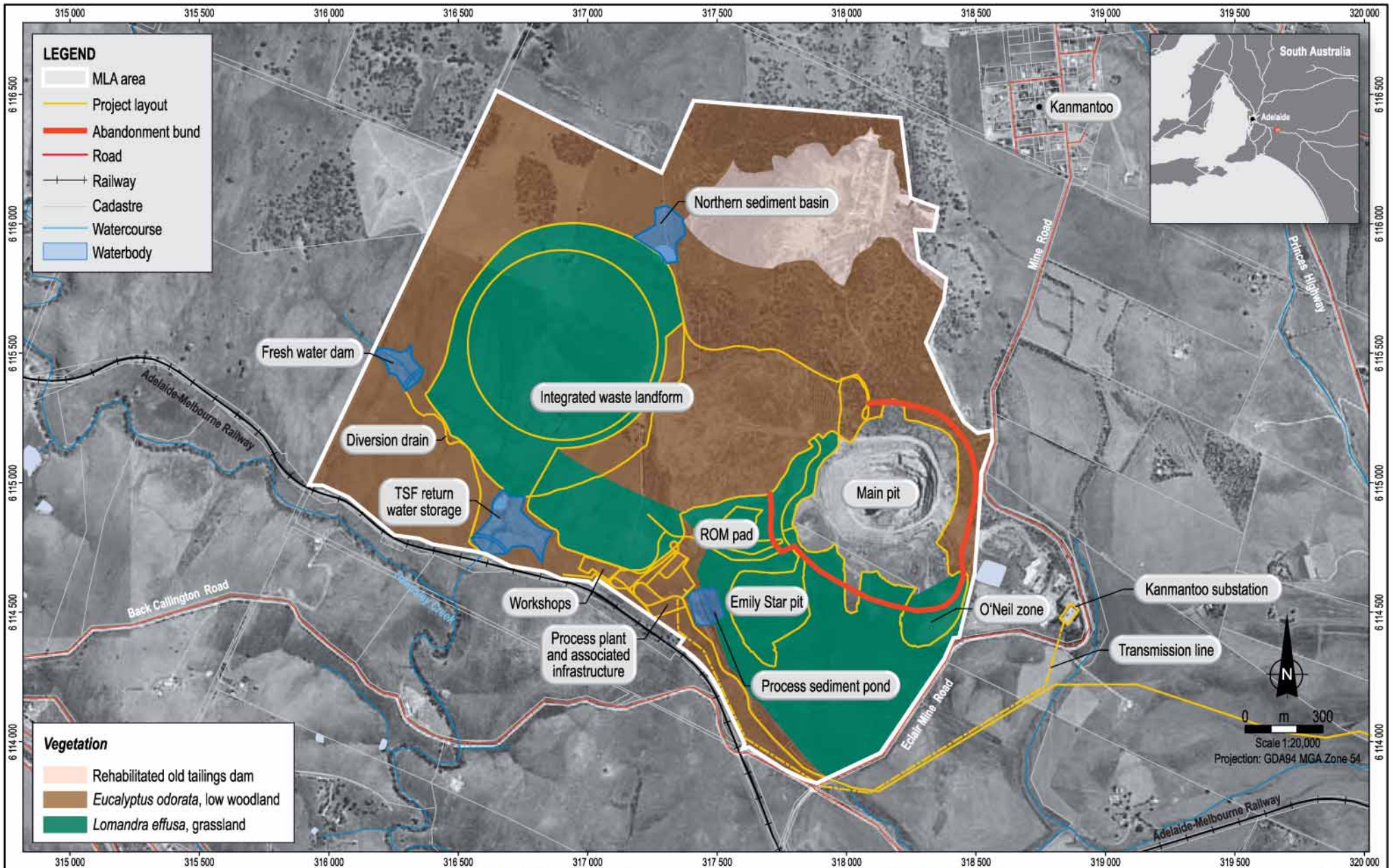
Residual Risk Assessment

Residual impacts on public safety, landform stability, environmental condition and visual amenity considering the likelihood and consequence following the implementation of the closure strategies are outlined in Table 11.3.

Table 11.3 Summary of integrated waste landform residual impacts post-closure

Impact	Likelihood	Consequence	Residual Risk / Benefit
Embankment failure and release of tailings.	Virtually impossible	Disastrous	Medium
Damage to HDPE liner.	Possible	Moderate	Medium
Discharge of contaminated water.	Unlikely	Moderate	Low
Erosion of cover system.	Likely	Moderate	Medium
Death of vegetation.	Possible	Minor	Low
Improved visual amenity.	Virtually certain	Minor	Medium (benefit)
Fire.	Possible	Moderate	Medium

Embankment Failure. The TSF has been designed as an integrated waste landform with waste rock placed around the TSF. The integrated waste landform design has a



Source:
 Place names, roads, drainage and cadastral from DEH, SA (optimum scale 1:50,000)
 Mine Layout from Hillgrove Resources
 Vegetation inferred from vegetation mapping undertaken by Ecological Associates.


 Date: 21.05.07
 MXD: HillgroveResources_KanmantooGIS
 Job No: 5000_02_F11.02_GIS_AI

Hillgrove Copper Pty Ltd
 Kanmantoo Copper Project


Proposed post-closure vegetation distribution in the MLA area following rehabilitation

Figure No: **11.2**

number of benefits in allowing progressive rehabilitation during operations and the possibility of post closure release of tailings following closure is virtually eliminated due to the tailings being encapsulated with waste rock (see Appendix 12, Section 5). Consequently the risk of embankment failure is **virtually impossible** following closure as the tailings are encapsulated within the waste rock storage. The consequence of a significant release of tailings however is considered **disastrous** due to impacts on the downstream environment. The residual risk is therefore **medium**.

Damage to HDPE Liner. Damage to the HDPE liner could occur when the liner is placed over the tailings following closure. This damage could occur during placement of the liner, as a result of placement of cover material or tree roots. Strategies to prevent damage to the liner include checking of all welds and the liner generally prior to the cover material being placed, a sand layer or similar over the liner for protection before the cover material is placed and planting the area with native grasses rather than trees. In addition a land use restriction will be included in any sale of land to ensure that the area continues to be appropriately managed (e.g., large trees are not permitted to become established on the surface of the TSF, the integrated waste landform is not grazed by stock).

Damage to the liner is **possible** however the area impacted would be small resulting in minor infiltration into the tailings which is considered to have **moderate** consequence with the subsequent residual risk being **medium**.

Discharge of Contaminated Water. Design of the store and release cover for the waste storage and placement of a HDPE liner over the tailings is focused on preventing infiltration of water into PAF material below. In addition the underdrainage and decant system is fitted with airlocks to prevent oxygen into the base of the tailings at closure. It is considered **unlikely** that discharge of contaminated water would occur, with the consequence being **moderate** and the residual risk **low**.

Erosion of Cover System. Laboratory testwork on waste rock and topsoil together with computer modelling of various landforms will be used to develop the final landform. Fundamental to the development of a stable landform is minimising erosion. All landforms will erode and therefore it is considered **likely** that the integrated waste landform will erode over time. Incorporating the expected amount of erosion into the design of the cover system will ensure that it is not compromised and therefore any erosion as it is expected is considered to be **negligible** and the residual risk **low**.

Death of vegetation. Revegetation of the integrated waste landform will occur over the project life. During this time it is expected that the revegetation strategy will be refined as monitoring information is analysed. Following closure it is considered **possible** that vegetation may die however, this is also part of a natural cycle. Use of native species is proposed as they are adapted to the climate. The consequence of any death is considered **minor** as adjacent vegetation and seed within the soil profile will provide a seed source to colonise any areas. The residual risk is therefore **low**.

Visual Amenity. Residual risks for visual amenity have been addressed in Section 9.13.4.

Fire. The potential for fire to burn revegetated areas is considered **possible**. The use of native species local to area and which have adapted to fire is positive in terms of reducing the consequence. A fire however has the potential to burn large areas and the vegetation may take some time to regenerate. It is therefore considered that the consequence of fire particularly during the early stages of revegetation is **moderate** and the residual risk **medium**.

As the MLA area is privately-owned land, Hillgrove will ensure that a land use restriction is included in any sale of land to ensure that the area continues to be appropriately used (e.g., large trees are not permitted to become established on the surface of the TSF, the integrated waste landform is not grazed by stock).

Costs involved with the long-term management of the site will be estimated and funds for this will be provided in the form of a trust, bond or similar fund established by Hillgrove.

11.6.2 Open Pit

Description

Two open pits will be developed as part of the project. The Main pit, which is an enlargement of the existing pit, and Emily Star, which is a smaller satellite pit just to the south of Main pit. Some native vegetation will require removal as part of the expansion of the old pit and the development of the Emily Star pit. The area covered by the open pits is approximately 47 ha of which 16 ha is existing disturbance.

Emily Star. Once Emily Star has been mined additional exploration drilling will occur from the bottom of the pit to determine if there is any potential for underground extensions of the orebody. At this stage the mine plan has assumed that no opportunities to develop an underground mine beneath the Emily Star pit are available and, therefore, the pit will be backfilled with waste rock from Main Pit and the surface rehabilitated.

Rehabilitation of the backfilled Emily Star pit will involve the same approach as that used for the integrated waste landform with a 0.5 m compacted clay layer and 1.5 m of oxide rock/soil. The backfilled pit will be shaped to form a water shedding profile and to allow for settlement.

Main Pit. The final pit void will remain as a permanent feature in the landscape, with the main issue being public safety. An abandonment bund that cannot be crossed by vehicles will be constructed of competent rock to prevent inadvertent public access. This will be located around the pit, beyond the zone of potential pit wall failure. As with the old pit, acid drainage will collect in the bottom of the pit and form a water body with pH similar to that currently observed, i.e., pH 2.8.

The concept of using the open pit void as a water storage has been raised as an option. This concept requires further assessment with regard to feasibility in terms of water quality, impact on surrounding groundwater and economics. The storage capacity of 25,000 to 35,000 ML would place the Kanmantoo open pit as the fourth largest storage in South Australia behind Mt Bold, South Para and Blue Lake (see Appendix 17). The small surface area means that evaporation losses would be low compared with the other storages, which cover a large area but are relatively shallow in comparison. The

Kanmantoo open pit would therefore be a highly efficient water storage in terms of evaporative losses.

The potential for the pit to remain as a permanent source of water will be investigated with SA Water, Mount Barker District Council, DWLBC and PIRSA.

Final Land Use

The Emily Star pit will be backfilled with waste rock and rehabilitated as outlined for integrated waste landform and revegetated with *L. effusa*. The Main pit will remain as a pit void, with some backfilling of sections such as the O’Neil zone.

Closure Considerations

The expanded open pit will cover an area of approximately 47 ha. The key issues for closure include:

- Public safety.
- Groundwater.
- Contamination.
- Visual.

Closure outcomes for the open pit domain are outlined in Table 11.4.

Table 11.4 Closure outcomes for the open pit domain

Outcome	Action
Reduce risk to public. Reinststate land disturbed by tracks to a condition which is safe and stable which will facilitate revegetation and minimise visual impact of activities.	Construct abandonment bund around pit perimeter 10 m beyond the area of unstable rock mass. Place signs at appropriate locations to warn the public.
	Collection of seed from native species within the MLA area. Topsoil to be removed from disturbed areas and stockpiled for later use in rehabilitation. Monitoring of revegetation over time to demonstrate success.
	Complete a contaminated site assessment to identify areas of contamination. Remove contaminated material to the TSF or to a licensed disposal facility. Groundwater monitoring around open pit.
	Revegetate area and in particular area outside of abandonment bund to reduce visual impact with trees and shrubs.

Proposed Approach

An abandonment bund 4 m wide and 2 m high will be constructed around the open pit and will join with the integrated waste landform. This abandonment bund will prevent any accidental vehicle access to the pit. Signs located at appropriate locations will also be installed to warn the general public of the presence of the open pit.

Deterioration in groundwater quality affecting suitability for water uses (potable use and agricultural use) is described in Section 9.4.3. The water balance (REM 2007a) indicates that the final pit void will become a permanent groundwater sink in which evaporative losses will exceed rainfall and groundwater inflows. Following closure monitoring of groundwater bores will continue and this information used to compare with model predictions.

The abandonment bund has the potential to impact on visual amenity. Revegetation on the outside of the bund with native trees, shrubs and grasses will be undertaken to reduce this visual impact.

Residual Risk Assessment

Residual impacts on public safety and visual amenity considering the likelihood and consequence following the implementation of the closure strategies are outlined in Table 11.5. Groundwater risks have been previously covered in Section 9.4.3

Table 11.5 Summary of open pit residual impacts post-closure

Impact	Likelihood	Consequence	Residual Risk
Injury as a result of access to open pit.	Virtually impossible	Disastrous	Medium
Visual amenity impact due to abandonment bund.	Unlikely	Minor	Low

Injury as a result of access to open pit. With the construction an abandonment bund around the open pit and placement of signs accidental access to the open pit is **virtually impossible**. Deliberate access to the open pit however could be disastrous with the possibility of serious injury and subsequently the residual risk is **medium**.

Visual amenity impact due to abandonment bund. The abandonment bund once constructed is likely to be seen from adjacent roads. Following revegetation of the area outside of the abandonment bund it is considered that visual amenity is **unlikely** to be impacted with **minor** consequence. Therefore the residual risk is **low**.

11.6.3 Infrastructure

Description

This domain includes the process plant, administration buildings and workshops and covers an area of approximately 7 ha. Vegetation in the area is currently introduced pasture.

Final Land Use

Infrastructure areas will be revegetated to *E. odorata* low woodland.

Closure Considerations

Significant disturbance in the form of buildings, workshops and process plant will occur within the infrastructure domain. The majority of this will be removed following closure.

Key issues for the rehabilitation of the infrastructure domain include:

- Identification and removal of contamination.
- Demolition and removal of equipment.
- Management of surface water.
- Establishment of *E. odorata* woodland community.

The closure outcomes for this domain are outlined in Table 11.6.

Table 11.6 Closure outcomes for infrastructure domain

Outcome	Action
Establishment of self sustaining <i>E. odorata</i> woodland community. Reinstate land disturbed by tracks to a condition which is safe and stable which will facilitate revegetation and minimise visual impact of activities.	Remove buildings and cover any exposed foundations.
	Collection of seed from native species within the MLA area. Topsoil to be removed from disturbed areas and stockpiled for later use in rehabilitation.
	Complete a contaminated site assessment to identify areas of contamination. Remove contaminated material to the TSF or to a licensed disposal facility.
	Establish surface water management controls following rehabilitation to prevent excessive erosion.
	Revegetate area to establish a <i>E. odorata</i> woodland.

Proposed Approach

On completion of the project, all equipment will be removed from the site and all infrastructure will be dismantled and removed from the MLA area. Depending on their condition, major items, e.g., crusher, conveyors and modular buildings, will be sold for re-use on other projects. The remaining items will be sold as scrap metal.

Concrete will be broken up and either disposed of on site, used as clean landfill in areas of existing disturbance where the landform is amenable to filling, or transported off site for disposal in an appropriate clean fill facility.

Contaminated concrete, e.g., concrete contaminated with hydrocarbons, will be cleaned on site and taken to an appropriate registered facility.

Once plant and equipment are removed, contaminated material will be removed and remediated or disposed of at an appropriate registered facility. Large concrete footings and foundations will be made safe and buried in situ. Topsoil will be placed over the area followed by ripping and seeding with a combination of native trees and grasses.

Residual Risk Assessment

Table 11.7 summarises the residual impacts on public safety, landform stability, contamination and visual amenity considering the likelihood and consequence following the implementation of the closure strategies outlined above.

Table 11.7 Summary of infrastructure areas residual impacts post-closure

Impact	Likelihood	Consequence	Residual Risk
Infrastructure remaining on site is a safety hazard.	Unlikely	Moderate	Low
Contaminated material causes poor vegetation establishment.	Unlikely	Moderate	Low
Contamination of surface water.	Unlikely	Minor	Low

Infrastructure remaining a safety hazard. Infrastructure will be removed following closure. The only components which may remain are the concrete footings which will be buried. It is therefore considered **unlikely** that public safety could be impacted. The consequence of any accident is considered to be **moderate** with the residual risk being **low**.

Contaminated material causes poor vegetation establishment. A contaminated site assessment will be completed following closure to identify any areas of contamination that require remediation. The likelihood of contamination causing poor vegetation establishment is considered to be **unlikely** and the consequence **moderate** with the residual risk being **low**.

Contamination of surface water. As outlined above, a contamination assessment will be completed following closure to identify any areas that require remediation. In addition the surface water management system implemented for operations will remain in place while areas are being rehabilitated. If any surface water was contaminated, the surface water storages would capture this contamination. The likelihood of surface water becoming contaminated is considered to be **unlikely** and the consequence **minor** with the residual risk being **low**.

11.6.4 Surface Water Structures

Description

Four surface water retention structures will manage surface water during operations:

- Fresh water dam.
- TSF return water storage.
- Process sediment pond.
- Northern sediment basin.

The surface water structures will be developed on areas of introduced pasture covering an area of approximately 7 ha.

Final Land Use

Following closure it is likely that surface water storages will remain to collect any sediment from rehabilitated areas.

Once revegetated areas have been successfully established and runoff water quality meets water quality objectives it is proposed that the storages be rehabilitated and natural drainage line re-established. The water storages and in particular the TSF return water storage is a valuable asset, being HDPE lined. It is possible that during the ongoing stakeholder consultation that these storages may be identified for other uses following closure and therefore they would remain on site.

Closure considerations

The water storages will remain important following closure for the collection of surface water runoff from rehabilitated areas.

The key issues for the management of the water storages after closure include:

- Collection of surface water after closure.
- Establishment of self sustaining ecosystem.

The closure outcome for this domain are outlined in Table 11.8.

Table 11.8 Closure outcomes for water storage domain

Outcome	Action
Establishment of self sustaining <i>E. odorata</i> woodland community. Reinstate land disturbed to a condition which is safe and stable which will facilitate revegetation and minimise visual impact of activities.	Remove HDPE liner and reshape area to prevent ponding of water.
	Collection of seed from native species within the MLA area. Topsoil to be removed from disturbed areas and stockpiled for later use in rehabilitation.
	Complete a contaminated site assessment of sediment in water storages to identify contamination. Remove contaminated material to the TSF (immediately after closure) or to a licensed disposal facility.
	Establish surface water management controls following rehabilitation to prevent excessive erosion.
	Revegetate area to establish a <i>E. odorata</i> woodland.

Proposed Approach

Following closure, sediment in the dams will be analysed to determine contaminant concentrations. If levels exceed background levels, the material may be removed and reprocessed. Otherwise, the material will be placed in the TSF. All pipework and infrastructure will be removed.

Immediately following closure it is likely that these storages will continue to be required to capture sediment from recently rehabilitated areas and demonstrate that water quality objectives have been achieved.

Minor surface drainage structures, such as sediment traps established during operations, will be retained post-closure. The reasons for this are:

- Surface drainage established during operations will be complete and stable.
- Clean water will remain separated from water draining areas of disturbance.
- Although vegetation will establish, sediment traps will continue to provide a final filter for runoff from the rehabilitated site.
- These areas may have been colonised by fauna, thereby creating new habitat areas.

Residual Risk Assessment

Table 11.9 summarises the residual risks on the project following the rehabilitation of the surface water storages considering the likelihood and consequence of the impact occurring following rehabilitation.

Table 11.9 Summary of surface water storage residual impacts post-closure

Impact	Likelihood	Consequence	Residual Risk
Unsuitable conditions for the establishment of vegetation.	Unlikely	Moderate	Low

Unsuitable conditions for the establishment of vegetation. The rehabilitation of the surface water storages will involve the reshaping of embankments, ripping to remove any compaction, topsoil and revegetation of the area. Conditions unsuitable for establishment of vegetation growth are considered **unlikely**, as topsoil will be stored in stockpiles less than 2 m high and revegetated. The consequence of poor conditions for

the establishment of vegetation is considered **moderate** as the areas involved are relatively small and amelioration of soil can be undertaken. The residual risk is therefore **low**.

11.6.5 *Eucalyptus odorata* woodland

Description

Flora surveys (Appendix 5) have identified areas of high quality *E. odorata* woodland existing on the site and in particular to the north of Main pit (see Section 5.9). Other areas of lesser quality also exist and the opportunity exists during operations to manage these areas with the goal of improving the quality of the woodland by reducing exotic weeds, encouraging the development of native species and reducing the presence of grazing. This area of woodland will also be an important source of seed for use in rehabilitation of areas around the site.

Final Land Use

E. odorata woodland.

Closure Considerations

There are no particular considerations following closure for this domain. Activities to improve the quality of the existing woodland will be undertaken during operations and include the following:

- Reducing the presence of exotic weeds.
- Encouraging the regeneration of native species.
- Eliminating grazing in the area.

Closure outcomes for this domain are outlined in Table 11.10.

Table 11.10 Closure outcomes for the *E. odorata* domain

Outcome	Action
Improve the quality of the existing <i>E. odorata</i> woodland. Reinstate land disturbed by tracks to a condition which is safe and stable which will facilitate revegetation and minimise visual impact of activities.	Collection of seed from native species within the MLA area. Monitoring of revegetation over time to demonstrate success. Weed eradication program. Feral animal control to reduce grazing pressure. Rehabilitation of drill holes in accordance with PIRSA guideline.

Proposed Approach

During operations a weed management plan will be initiated to control weeds within the woodland and subsequently encourage the regeneration of native species. If required, feral animal control will also be undertaken to reduce grazing pressure from rabbits etc.

Residual Risk Assessment

No activities are planned in this area. Some exploration has been undertaken previously and access roads through this area will continue to be used. Table 11.11 summarises the residual risks on the *E. odorata* woodland following closure of the site.

Table 11.11 Summary of *E. odorata* woodland residual impacts post closure

Impact	Likelihood	Consequence	Residual Risk / Benefit
Improved condition of <i>E. odorata</i> woodland.	Virtually certain	Moderate	High (Benefit)
Failure of rehabilitation of exploration sites.	Unlikely	Negligible	Very Low

Improvement to existing *E. odorata* woodland. The management practices proposed during operations means that it is **virtually certain** that an improvement to the existing *E. odorata* woodland will occur. The vegetation community is listed under the EPBC Act as being a Nationally Threatened Ecological Community and therefore improving the condition of this vegetation community will have a **moderate** consequence. The benefit of this management is considered to be **high**.

Failure of rehabilitation of exploration sites. Exploration drilling occupies only a small area. All sites following drilling are rehabilitated in accordance with PIRSA guidelines on the construction and abandonment of drillholes. The likelihood of rehabilitation to fail is considered **unlikely** and the combination of the small area and available surrounding seed source means that the consequence of any failure of rehabilitation is likely to be **negligible** with the residual risk **very low**.

11.6.6 *Lomandra effusa* grassland

Description

The *L. effusa* grassland occurs mainly to the south of the existing pit, with some scattered plants also occurring to the west of the pit where the integrated waste landform will be constructed. Expansion of the existing pit will remove areas of grassland permanently.

Final Land Use

L. effusa grassland.

Closure Considerations

There are no particular considerations following closure for this domain. Activities to improve the quality of the existing grassland will be undertaken during operations and include the following:

- Reducing the presence of exotic weeds.
- Encouraging the regeneration of native species.
- Eliminating grazing in the area.

Closure outcomes for this domain are outlined in Table 11.12.

Table 11.12 Closure outcomes for the *L. effusa* domain

Outcome	Action
Improve the quality of the existing <i>L. effusa</i> grassland. Reinstate land disturbed by tracks to a condition which is safe and stable which will facilitate revegetation and minimise visual impact of activities.	Collection of seed from native species within the MLA area. Continue with current propagation research being conducted by State Flora. Monitoring of revegetation over time to demonstrate success. Weed eradication program. Feral animal control to reduce grazing pressure. Rehabilitation of drill sites in accordance with PIRSA guideline.

Proposed Approach

Research is currently being undertaken by State Flora into the propagation of *L. effusa*. Assuming that this research is successful, it is proposed to establish a *L. effusa* grassland over large areas of the integrated waste landform and over the backfilled Emily Star pit.

Residual Risk Assessment

No activities are planned in this area. Some exploration has been undertaken previously. Table 11.13 summarises the residual risks on the *L. effusa* grassland following closure of the site.

Table 11.13 Summary of *L. effusa* grassland residual impacts post-closure

Impact	Likelihood	Consequence	Residual Risk / Benefit
Improved condition of <i>L. effusa</i> grassland.	Virtually certain	Moderate	High (Benefit)
Failure of rehabilitation of exploration sites.	Unlikely	Negligible	Very Low

Improvement to existing *L. effusa* grassland. The management practices proposed during operations means that it is **virtually certain** that an improvement to the existing *L. effusa* grassland will occur. The vegetation community is listed under the EPBC Act as being a Nationally Threatened Ecological Community and therefore improving the condition of this vegetation community will have a **moderate** consequence. The benefit of this management is considered to be **high**.

Failure of rehabilitation of exploration sites. Exploration drilling occupies only a small area. All sites following drilling are rehabilitated in accordance with PIRSA guidelines on the construction and abandonment of drillholes. The likelihood of rehabilitation to fail is considered **unlikely** and the combination of the small area and available surrounding seed source means that the consequence of any failure of rehabilitation is likely to be **negligible** with the residual risk **very low**.

11.6.7 Introduced Pasture**Description**

Large areas of introduced pasture exist across the site, although the establishment of the integrated waste landform will cover a large area of introduced pasture. Some of the resulting areas of pasture around the integrated waste landform will be too small to

support commercial grazing and hence it is proposed to establish native vegetation in these areas as part of the project’s significant environmental benefit offset plan.

Final Land Use

Establish *E. odorata* woodland.

Closure Considerations

The main closure consideration for this domain is the revegetation of pasture areas to *E. odorata* woodland. This process will obviously take time to develop however areas for revegetation will be available immediately and consequently Hillgrove will have time to trial various techniques. Table 11.14 summarises the closure outcomes for the introduced pasture domain.

Table 11.14 Closure outcomes for the introduced pasture domain

Outcome	Action
Establish self sustaining <i>E. odorata</i> woodland. Reinstate land disturbed by tracks to a condition which is safe and stable which will facilitate revegetation and minimise visual impact of activities.	Collection of seed from native species within the MLA area. Monitoring of revegetation over time to demonstrate success. Weed eradication program. Feral animal control to reduce grazing pressure. Rehabilitation of drill holes in accordance with PIRSA guideline.

Residual Risk Assessment

Table 11.15 summarises the residual risks of the establishment of *E. odorata* woodland following closure of the site.

Table 11.15 Summary of residual risk to introduced pasture area post-closure

Impact	Likelihood	Consequence	Residual Risk / Benefit
Revegetation efforts unsuccessful.	Unlikely	Moderate	Low

Revegetation efforts fail. Revegetation of native species is not an uncommon activity with many local landowners and community groups successfully revegetating land previously used for agricultural purposes. It is considered **unlikely** that revegetation will not be successful and, if this was to occur, it would be in isolated areas and the consequence would be **moderate**, resulting in a **low** residual risk. The establishment of *E. odorata* woodland covering a large area of the site will have significant benefits. This vegetation community has recently been listed under the EPBC Act as a Nationally Threatened Ecological Community.

11.6.8 Rehabilitated Old Tailings Dam

No activities are planned within this domain.

11.6.9 Other Disturbed Areas

Description

This domain includes access roads, storage compounds for explosives and detonators and infrastructure associated with groundwater bores, pipelines, electricity substation and powerlines.

Final Land Use

Establish *E. odorata* woodland.

Closure Considerations

The main closure consideration for this domain is the revegetation of disturbed areas to *E. odorata* woodland. Table 11.16 summarises the closure outcomes for the domain of other disturbed areas.

Table 11.16 Closure outcomes from disturbed areas domain

Outcome	Action
Establish self sustaining <i>E. odorata</i> woodland. Reinstate land disturbed by tracks to a condition which is safe and stable and which will facilitate revegetation and minimise visual impact of activities.	Complete a contaminated site assessment of sediment in water storages to identify contamination. Remove contaminated material to the TSF (immediately after closure) or to a licensed disposal facility.
	Collection of seed from native species within the MLA area. Monitoring of revegetation over time to demonstrate success. Weed eradication program. Feral animal control to reduce grazing pressure. Rehabilitate drill holes in accordance with PIRSA guideline.

Proposed Approach

Maintenance of a road into the site will be required to enable monitoring and maintenance activities to be undertaken. Roads and hardstand areas not required for long term monitoring and maintenance will be respread with cleared topsoil and vegetation, ripped and seeded. It is expected that, during rehabilitation, deep ripping of these areas will be required to break the compacted surface and enable infiltration of rainwater and root penetration. The following will be undertaken for those access tracks and roads that are no longer required:

- Remove contaminants such as hydrocarbons.
- Remove pipes and culverts to re-establish water courses.
- Rip surfaces to retain topsoil and any moisture.
- Replace stockpiled topsoil, seed and fertilise.
- Redirect local drainage as necessary to minimise erosion until regrowth is established.

Storage Compounds for Explosives and Detonators. On completion of mining, magazine compounds will be dismantled and all infrastructure removed from the site for reuse elsewhere or recycling. Concrete pads will be removed and disposed of in an appropriate manner. Topsoil will be replaced on the disturbed area, which will then be ripped and seeded.

Infrastructure. Unless otherwise agreed, groundwater bores, above-ground pipeline infrastructure, power lines, electrical substations, communication towers and other items of infrastructure will be removed, with the recovered materials sold for recycling, reused or disposed of at the local landfill. The bores will be capped below ground level and the upper casings removed. Buried metal plates will be installed to allow bores to be located, using a metal detector and geographical positioning system, if required for future re-establishment. The well pads will be spread with topsoil, ripped and seeded.

Residual Risk Assessment

Table 11.17 summarises the residual risks of the establishment of *E. odorata* woodland following closure of the site.

Table 11.17 Summary of residual risk to other disturbed areas post-closure

Impact	Likelihood	Consequence	Residual Risk
Infrastructure remaining on site is a safety hazard.	Unlikely	Moderate	Low
Contaminated material causes poor vegetation establishment.	Unlikely	Moderate	Low
Contamination of surface water.	Unlikely	Minor	Low

Residual risks for this domain are as described for the infrastructure domain (Section 11.6.3).

11.7 Closure Management

11.7.1 Progressive Rehabilitation

Progressive rehabilitation, i.e., ongoing rehabilitation during the life of the mine, will be undertaken where possible to minimise the amount of rehabilitation required on closure. This will allow for trialling of rehabilitation techniques,

The main area available for progressive rehabilitation will be components of the integrated waste landform.

11.7.2 Cover Design Trials

Cover trials will be established to determine the most appropriate method for covering the integrated waste landform. These trials will involve physical testing of material properties in a laboratory and using this information to develop a cover design which initially can be computer modelled and then field tested.

11.7.3 Material Management

Vegetation Harvesting

Cleared vegetation will be stockpiled within or along the topsoil stockpiles, for subsequent respreading on rehabilitated surfaces.

Topsoil

Topsoil (0 to 150 mm) and vegetation will be stripped and stockpiled close to the areas where they will eventually be placed. Stockpiles will be no greater than 2 m in height and will be formed in shapes that will aid the capture of incident rainfall and encourage

continuing biological activity within the soil. The stockpiles will be ripped and seeded as necessary to encourage the development of cover vegetation (as the majority of stockpiles will be formed during construction and will not be used for a number of years).

Opportunities for topsoil to be stripped and immediately respread on rehabilitated surfaces will be maximised to provide both environmental and economic benefits. Opportunities for this immediate placement will be investigated as the mining schedule is refined.

Subsoil

The nature of the subsoils will be assessed during topsoil stripping to determine their stability and susceptibility to erosion, and identify their value as material for cover layers on landforms and other erosive slopes.

Waste Rock

Throughout mining operations, the suitability of various types of waste rock for use in the integrated waste landform cover will be assessed.

11.7.4 Revegetation

Revegetation Species Selection

Species selected to revegetate the rehabilitation areas, where practicable, will be:

- Local to the Kanmantoo area.
- Aggressive colonisers suitable to a range of soil conditions.
- Able to provide good cover and contribute to the landscape function.
- Available in the quantities required for the project rehabilitation.

The species seed mix and planting densities for revegetation (along with fertiliser requirements) in disturbed areas will be determined in consultation with relevant experts, the Kanmantoo-Callington Landcare Group and DWLBC.

Revegetation Timing and Method

Revegetation trials on the integrated waste landform and other areas of the site will be conducted to evaluate the most effective techniques. Revegetation trials will focus on *E. odorata* and *L. effusa*, and will build on the results of trials for this species that are currently in progress.

Weed Control

Areas progressively rehabilitated will be monitored for evidence of the introduction and establishment of weeds, with the objective of identifying and treating them before they become persistent.

Where weeds have become established in progressively rehabilitated areas, appropriate weed control measures will be undertaken, as described in Section 9.8.2.

11.7.5 Post-Closure Management and Monitoring

A detailed post-closure management and monitoring plan will be established as part of the closure planning process. This plan will be based on the conceptual plan described

herein and the monitoring and reporting procedures described in Chapter 10. Post-closure monitoring requirements will reduce over time until all closure objectives are achieved and the ML can be relinquished.

11.7.6 Final Decommissioning

Final decommissioning and rehabilitation activities are associated with:

- Contamination assessment and remediation.
- Ongoing monitoring and assessment (including engineering inspection of the TSF).
- Process plant, contractors area and administration site.
- Access roads and tracks.
- Integrated waste landform.
- Final site tidy up.
- Employee and Community support expenses.

A final decommissioning plan will be developed in consultation with regulatory authorities during operations and as part of the closure process. This plan will further detail completion criteria and refine the timeline for decommissioning and determination of compliance with regulatory authority requirements.

11.8 Financial Provision

The cost estimate for rehabilitation of the site has been prepared using the NSW Department of Primary Industries Rehabilitation Cost Calculation Tool. The estimated cost is AUD\$12.9 million (this does not include the revenue from resaleable items). Closure costs are summarised in Table 11.18. Financial provision for mine rehabilitation and closure activities will be in the form of a bank guarantee.

Table 11.18 Summary of estimated closure costs

Aspect	Estimated Cost (\$AUD)
Infrastructure areas	1,551,382
Tailings storage facility	5,030,285
Waste rock storage	2,926,160
Active mine and voids	32,540
Other	221,825
Sub Total (domains and other sundry items)	9,762,192
Contingency	1,179,463
Third-party management	2,032,438
Total	12,974,093

11.9 Closure Schedule

The progress of closure planning (including progressive rehabilitation) will be reported on an annual basis as part of the operation's annual mining and rehabilitation compliance report to PIRSA.

A conceptual closure timeline for the project is shown in Table 11.19 where Year 1 corresponds to the commencement of mining.

Table 11.19 Schedule for rehabilitation of each domain

Domain	Year											
	1	2	3	4	5	6	7	8	9	10	11	12
Integrated waste landform	■	■	■	■	■	■	■	■	■			
Open pits				■				■				
Infrastructure									■			
Surface water storages											■	
<i>E. odorata</i>	■	■	■	■	■	■	■	■				
<i>L. effusa</i>	■	■	■	■	■	■	■	■				
Introduced pasture	■	■	■	■	■	■	■	■	■			
Old TSF												
Other disturbed areas								■	■			
Monitoring		■	■	■	■	■	■	■	■	■	■	■

11.10 Long-term Site Management

A detailed post-closure management plan will be established as part of the closure planning process. Post-closure management and monitoring requirements are expected to reduce over time, and the ML will be relinquished when all closure objectives have been met.

As the MLA area is on privately-owned land, Hillgrove will ensure that a land use restriction is included in any sale of land to ensure that the area continues to be appropriately used (e.g., large trees are not permitted to become established on the surface of the TSF, the integrated waste landform is not grazed by sheep and erosion is controlled).

Costs involved with the long-term management of the site will be estimated and funds for this will be provided in the form of a trust, bond or similar fund established by Hillgrove. Likely long term management activities include inspection of the site to identify any areas of erosion and subsequent repair, inspection of revegetated areas and in particular the identification of any weed invasion and implementation of control strategies.

12. Environmental Management Systems

Environmental management of the Kanmantoo Copper Project will be in accordance with the Hillgrove environmental management system (EMS), which will be modelled on the requirements of the international standard for environmental management systems, AS/NZS ISO 14001. Key elements of the EMS are:

- Commitment.
- Planning.
- Implementation.
- Checking and corrective action.
- Management review.

The interaction of these elements is shown in Figure 12.1 and discussed in the following sections.

12.1 Commitment

Hillgrove is committed to achieving best practice outcomes through:

- High operating standards in all aspects of its activities to minimise environmental impact and prevent environmental harm.
- Communication and consultation with all stakeholders.
- Employee awareness of sound environmental practice as part of day-to-day activities.
- Continuous improvement through measurement of environmental performance.
- Regular audits and review of policies, systems and procedures.
- Compliance with applicable legislation.

Hillgrove's Environmental Policy is provided in Figure 12.2.

12.2 Planning

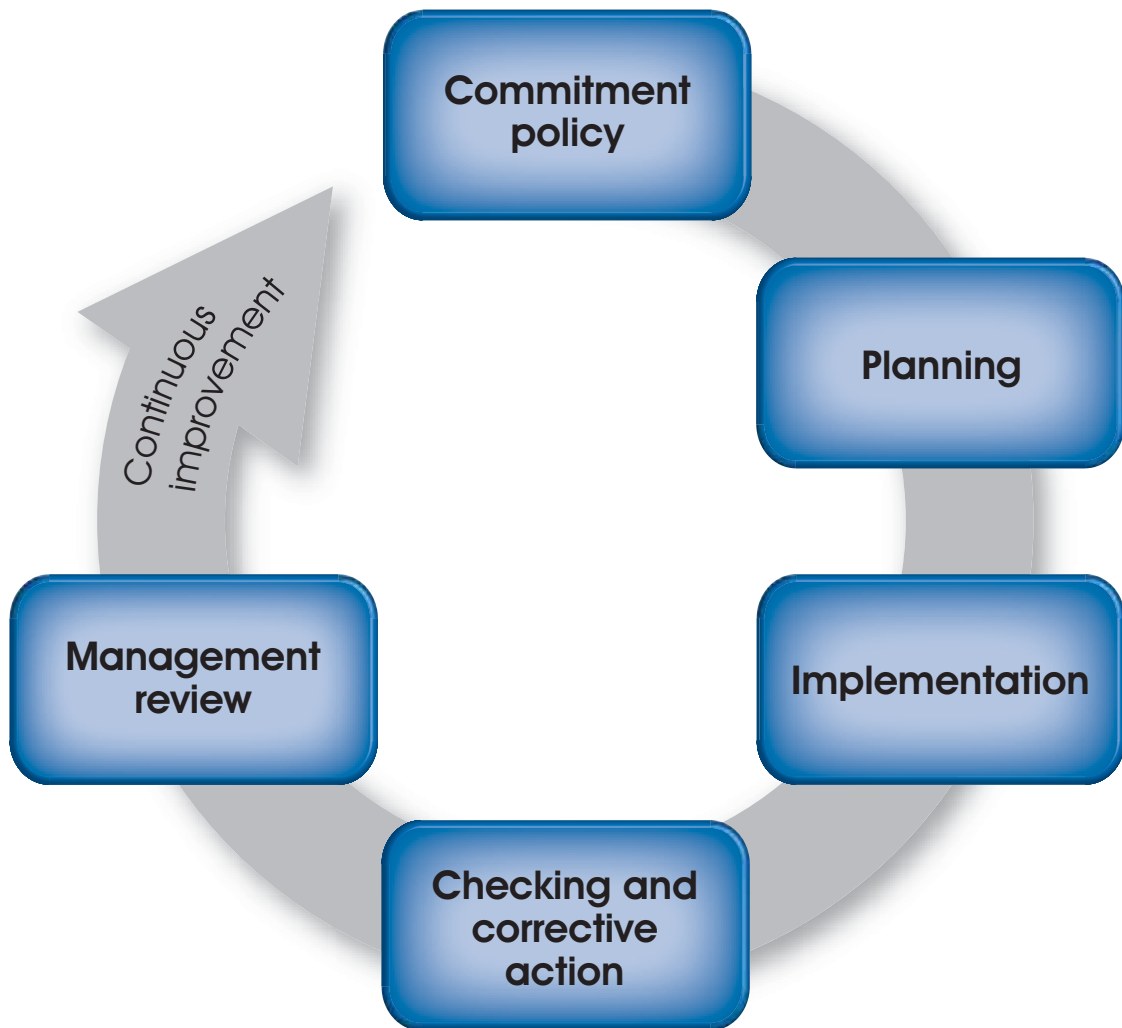
12.2.1 Risk Management

It is necessary to anticipate, prevent and mitigate environmental risks and impacts to protect the environment. Hillgrove will undertake risk assessments in accordance with Standards Australia (2006) in order to:

- Anticipate, prevent and mitigate environmental risks and impacts.
- Minimise loss in all areas of the organisation.
- Improve the quality of decision-making within the organisation.

During the detailed design phase of the project, the preliminary hazard analysis (Section 9.15) will be reviewed and refined as necessary to assess the risks associated

Environmental management system elements



Environmental Policy

It is the policy of Hillgrove Resources Limited to protect the environment, public health, safety and natural resources by establishing environmental excellence as a primary objective for all company operations and activities. The achievement of this objective is characterized by conducting operations in an environmentally sound manner and continual improvement in our environmental performance.

To carry out this policy, we:

Establish environmental improvement objectives for every operation and assign responsibility and accountability for environmental performance and continuous improvement to managers, and supervisors;

Establish as an essential element of management the implementation of this policy fully into our design, operation and contracting activities;

Comply with all laws and regulations relating to the environment and public health and safety, where laws and regulations do not exist, adopt appropriate standards and where technically and economically feasible, provide additional levels of protection;

Provide adequate resources to implement this policy;

Ensure employees awareness of this policy and the legal penalties for violations of laws and regulations, and encourage internal and external communications regarding this policy and company environmental practices and issues;

Conduct constructive communications with interested parties related to environmental and public health and safety issues and take appropriate measures to make positive contributions to the economic and social well being of the communities in which we operate;

Implement measures to conserve natural resources such as energy and water;

Minimise the generation of hazardous waste and ensure proper disposal of all wastes;

Mitigate the impact of our activities on the environment and natural resources;

Support the use of sound scientific principles in decisions related to environmental and public health and safety issues by conducting or supporting appropriate research, studies and evaluations to develop more effective methods for the protection of the environment, public health and safety and mitigation of impacts related to our activities;

Develop, implement and test environmental incident contingency plans;

Conduct periodic reviews and environmental audits of all operations and activities of the company to assure implementation of this policy, sound environmental management practices, identification of potential improvements and impacts on the environment, natural resources and the public, and report the findings to management and take timely corrective actions as appropriate.



Job No:

5000

Hillgrove Copper Pty Ltd

**HILLGROVE
RESOURCES**

Hillgrove Resources environmental policy

Figure No:

12.2

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Kanmantoo Copper Project

with the design of various aspects of the project. In identifying a risk the following hierarchy of controls will be used:

- Eliminate.
- Substitute.
- Engineer.
- Isolate.
- Administration.
- Protection.

A detailed risk register, building on the information from the preliminary hazard assessment (Section 9.15) will be developed to document risks and risk action plans will detail the control measures and assign responsibilities for management and implementation.

Job Risk Analysis

Job risk analysis will be used as a tool to identify and record risks associated with specific work activities. A job risk analysis requires personnel to examine the task they are about to undertake and:

- Break the job into separate, defined steps.
- For each step, identify the potential hazards that could occur with that step.
- For each potential hazard, list the method to be followed to prevent the hazard causing an injury, loss, damage or environmental incident.

12.2.2 Environmental Management Plan

A risk-based environmental management plan (EMP) will be developed for the project to:

- Document project commitments and impact mitigation requirements set out in this MLP.
- Document conditions of approval resulting from the environmental approval process and requirements of the *Mining Act 1971* and other relevant legislation.
- Provide the basis for the development of environmental guidelines and work procedures to be prepared by the construction contractor.

The EMP will be based on the environmental and social objectives outlined in Chapter 9 of this report and will be monitored and evaluated against key environmental performance standards to ensure environmental compliance. The EMP will include individual plans that address:

- Water.
- Air quality.
- Noise and vibration.
- Traffic.
- Waste.
- Hazardous materials.
- Flora and fauna.

- Archaeology and heritage.
- Erosion control.
- Rehabilitation.

12.2.3 Emergency Response Plan

Hillgrove will develop an Emergency Response Plan that establishes specific actions to manage significant events such as fires, car accidents, chemical or oil spills, tailings spills or concentrate spillage.

All incidents, both minor and major, will be recorded in an incident register that will form part of the EMS documentation. In the event of a major incident, Hillgrove will:

- Ensure that the area is safe.
- Take immediate action to contain the incident.
- Report emergencies to the relevant emergency service.
- Notify the relevant regulatory authority.
- Remediate the site.
- Investigate and prepare a report detailing the findings of the environmental incident investigation.
- Review environmental procedures.

Hillgrove will have an emergency response team that will be trained to respond to emergencies, lead evacuations and administer first aid. They will also be trained to manage large spills of tailings, process water and chemicals used on site.

No ambulance will be kept on site as an ambulance service and fully-equipped hospital with on-call doctor for emergencies are nearby at Mt Barker. A first aid room will be provided in the administration building and first aid boxes kept in the workshops, crusher control and mill control buildings, laboratory, and in vehicles. A qualified safety officer will also be employed on site to coordinate emergencies.

A fire trailer will be located on site to provide fire protection. Fire hydrants with hose reels will be placed in the workshop and administration areas, concentrate shed, and fuel storage area. Portable fire extinguishers will be fitted on all buildings, the fuelling station, plant areas and all vehicles. Smoke detectors will be located in all transportable buildings, control rooms and switch rooms.

12.3 Implementation

12.3.1 Roles and Responsibility

All Hillgrove and contractor personnel are responsible for the environmental performance of their activities and complying with the relevant environmental management procedures.

The site Resident Manager will be responsible for ensuring that sufficient resources are available for all project activities to be undertaken in full compliance with statutory regulations and are consistent with the Hillgrove Environmental Policy.

The Resident Manager will be assisted by the Environmental Scientist, whose specific responsibilities will be to:

- Ensure that the environmental and community relations aspects of Hillgrove's environmental policy, systems and management measures are implemented uniformly, and are revised and maintained as required.
- Implement the environmental management plan.
- Ensure that contractors fulfil their contractual obligations.
- Implement induction procedures and appropriate training.
- Ensure compliance with licence and lease conditions and company policy via the establishment and maintenance of appropriate reporting systems and databases.
- Continue to develop the conceptual closure plan.
- Participate with personnel to improve work practices on site.
- Undertake internal site environmental audits.
- Provide advice as required to other project personnel.
- Liaise with stakeholders.

12.3.2 Communication

Inductions

Following appointment, each employee and contractor will undergo a formal site induction to ensure that they have the appropriate knowledge concerning health, safety, environment and community relation procedures. The induction will address areas such as:

- Background to project approval.
- Legislative obligations of both individual and company.
- Hillgrove environmental policy.
- Traffic management plan.
- Key environmental issues at the site.
- Outline of the environmental management plan and obligations.
- Structure of the environment and community relations sections.
- Site environmental management policies and procedures.
- Site safety and occupational health policies, procedures and employee obligations.
- Hazard and incident reporting and management.
- Emergency services and procedures.
- Site security.
- Employment policies and conditions of employment.

Training

In addition to general inductions, ongoing reinforcement will be provided through specific work area inductions and weekly 'tool box' meetings, where health and safety, environmental and community relations issues that may arise from time to time will be discussed, including changes to policies and procedures. Specific environmental training will be provided to personnel involved in:

- Maintaining and operating pollution control equipment/structures.
- Storing and handling hazardous materials.
- Responding to environmental incidents, e.g., fuel spills.

Safety, Health and Environment Committee

Hillgrove proposes to develop a Safety, Health and Environment committee. This committee will be formed from representatives from across the site and assist with internal communication and encouraging fellow workers to adopt safe work practices, follow environmental requirements and identify when activities may cause community concern.

Ongoing Community Consultation

Hillgrove's community consultation program is ongoing and will continue through the life of the project to ensure due consideration of all project-related opportunities and concerns. Details about the program are provided in Section 8.4.

12.4 Checking and Corrective Action

Inspections

Hillgrove will conduct regular inspections of construction and operations activities to ensure that environmental management plans are correctly implemented. The frequency of inspection will depend on the potential risk associated with the activity.

Audits

Internal audits will be conducted or arranged by Hillgrove to ensure the environmental management system is correctly implemented and management plans are effective in managing the potential environmental impacts of the project. A program of undertaking audits will also be implemented with the likely timing being:

- Within two months of the commencement of construction activities.
- Periodically, during construction.
- Annually, during operations.
- Following a major environmental incident.

Recording

Hillgrove will establish and maintain an auditable record system that will include the following documentation:

- Approved Mining and Rehabilitation Program (MARP).
- Environmental management plans.
- Monitoring results.

- Environmental monitoring reports.
- Audit reports.
- Incident register.
- Complaints register.
- Risk register.

12.5 Management Review

Any environmental procedures found to be deficient as a result of an audit or investigation after an environmental incident will be revised and the EMP updated to reflect the new procedures.

Annual reviews of the overall effectiveness of the EMS will be undertaken by senior management to ensure continual improvement, sustainability and effectiveness.

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14. Glossary

14.1 Units and Symbols

%	percentage (proportion out of one hundred).
/	per.
μg	microgram (one millionth of a gram).
$\mu\text{g/L}$	micrograms per litre; unit commonly used to express the concentration of trace metals in a liquid.
μm	micron (one millionth of a metre).
bcm	bank cubic metre; measure of volume of material mined.
$\text{CO}_2\text{-e}$	carbon dioxide equivalent.
dB	decibel, unit used to express sound intensity.
g	gram.
GJ	gigajoule.
GWh	gigawatts per hour.
ha	hectare.
kg	kilogram.
kL	kilolitre.
km	kilometre.
km^2	square kilometre.
kV	kilovolt.
L	litre.
m	metre.
m^2	square metre.
mg	milligrams (one thousandth of a gram).
mg/kg	milligrams per kilogram; unit commonly used to express the concentration of metal (such as copper) in a rock or sediment; is equal to parts per million.
mg/L	milligrams per litre; unit commonly used to express the concentration of variables in a liquid (e.g., total suspended solids).
ML	megalitre, one million litres.
ML/a	megalitres per annum.
mm	millimetre.
mm/s	millimetres per second.
Mm^3	million cubic metres.
Mt	million tonnes.
Mt/a	million tonnes per annum.
MW	megawatt.
MWh	megawatt hours.
ppm	parts per million.
s	second.
t	tonne.
tph	tonnes per hour.
tpa	tonnes per annum.

14.2 Words

ABS	Australian Bureau of Statistics.
acid	substance with a pH less than 7.0; the lower the pH the higher the corrosive ability of the substance.
acid formation	the process whereby acid is formed by the oxidation of minerals (particularly sulphides) exposed to air and water.
acid rock drainage (ARD)	runoff of acidic water, typically from mined materials, following acid formation within the material.
acidic	having a pH less than 7.0.
Ag	silver.
AGO	Australian Greenhouse Office.
AHD	Australian Height Datum.
AHPI	Australian Heritage Place Inventory.
Al	aluminium.
alkaline	having a pH greater than 7.0.
alluvium	silt, sand, clay, gravel or similar loose material deposited by flowing water.
amenity	the desirability of an area.
amphibians	animals (such as frogs) adapted to living both on land and in water.
ANCOLD	Australian National Committee On Large Dams.
andalusite	a hard mineral of various colours consisting of aluminium silicate.
ANFO	ammonium nitrate/fuel oil.
ANZECC	Australian and New Zealand Environment and Conservation Council.
aquatic	living in or on water, or concerning water.
aquifer	a water-bearing layer of sediment or rock.
aquitard	a layer in the geological profile that separates two aquifers and restricts the flows between them.
archaeology	the scientific study of human history, particularly the relics and cultural remains of the distant past.
AARD	Aboriginal Affairs and Reconciliation Department.
ARD	acid rock drainage; see acid rock drainage above.
ARI	average recurrence interval.
ARMCANZ	Agricultural and Resource Management Council of Australian and New Zealand.
artefact	anything made by human workmanship, particularly by previous cultures (such as chipped and modified stones used as tools).
As	arsenic.
AS	Australian Standard.
ASX	Australian Stock Exchange.
AusRivAS	Australian River Assessment System.
background	the conditions (e.g., noise levels, bird populations) already present in an area before the commencement of a specific activity (e.g., a mining operation).
base metals	a metal which oxidises when heated in air, e.g., lead, copper, tin and zinc.
best practice	a process, technique, or use of technology, equipment or resource that has a proven record of success.

biodiversity	the diversity of different species of plants, animals and microorganisms, including the genes they contain, in the ecosystem of which they are part.
biotite	a black, dark brown, or green silicate mineral found in igneous and metamorphic rocks. It is a member of the mica group of minerals and shares a similar crystal structure.
bismuthinite	a sulphide mineral, important ore for bismuth. The crystals are steel-grey to off-white with a metallic luster.
blasting	detonation of explosive charge in a mine to assist in the removal of hard rock.
bore	a well, usually of less than 20 cm diameter, sunk into the ground and from which water is pumped.
bund	an earth, rock, or concrete embankment constructed to prevent the inflow or outflow of liquids or the transmission of noise.
Ca	calcium.
calcareous	containing or characteristic of calcium carbonate.
Cambrian	relating to the earliest part of the Palaeozoic era, in which invertebrate animal life, including trilobites, appeared, and marine algae developed.
carbon dioxide equivalent	a unit of greenhouse gas emissions calculated by multiplying the actual mass of emissions by the appropriate Global Warming Potential. This enables emissions of different gases to be added together and compared with carbon dioxide.
catchment	the entire land area from which water (e.g., rainfall) drains to a specific water course or waterbody.
Cd	cadmium.
channel	river or irrigation channel, includes bed and bank.
Cl	chlorine.
clay	a discrete mineral species, belonging to the layered silicate group of less than 2 microns in diameter.
CO	carbon monoxide.
CO ₂	carbon dioxide.
CO ₃	carbonate.
colluvial	loose rock or soil at the base of a cliff or steep slope.
compaction	the process of close packing of individual grains in a soil or sediment as a response to pressure.
concentration	the amount of a substance per unit of mass or volume of the medium in which it occurs.
conglomerate	a coarse-grained sedimentary rock containing fragments of other rock larger than 2 mm (0.08 in.) in diameter, held together with another material such as clay.
conservative	a prediction, assumption, or measurement that errs on the side of safety.
contingency plan	plan put in place to handle an event considered unlikely to occur.
contractor	specialist brought in to perform a specific task, such as the construction of mine infrastructure or the excavation (mining) of an open pit.
Cr	chromium.
cross-section	a two-dimensional diagram of an object presented as if the object had been cut along its length.

crusher	that part of an ore-processing plant where the ore is mechanically crushed into smaller pieces.
Cu	copper.
cyclone	a device that generates a vortex to clear particulate matter from air or water.
DAARE	Department of Aboriginal Affairs and Reconciliation.
DFS	definitive feasibility study.
delamerian orogeny	a mountain-building period during the Cambrian to Ordovician in South Australia. The orogeny caused substantial folding, buckling, and faulting of the strata, and resulted in the creation of a major mountain range, the eroded stumps of which can today be seen as the Mount Lofty and Flinders Ranges.
density	1. the mass of a substance (e.g., sediment) divided by its volume; water has a density of exactly 1 kilogram per litre; gold has a density of 19.3 kilograms per cubic litre. 2. the coverage of vegetation (e.g., trees) per unit of distance (along a linear transect) or unit of area (in an area transect).
deposition	laying down of particulate material (e.g., sediment in a lake or tailings solids in a tailings storage).
dewater	to remove water from (e.g., a mine pit or an aquifer).
DEWR	Department of Environment and Water Resources.
dissolved oxygen	the amount of gaseous oxygen dissolved in water and available for a biochemical activity (e.g., fish respiration).
distribution of species	the entire area in which a population of a species, subspecies or other taxon is found.
diversity of species	the number or relative abundance of species in a defined area.
DOC	dissolved organic carbon.
drawdown	a reduction in water level and/or pressure level in an aquifer as a result of groundwater extractions.
drilling	the action of boring holes (usually less than 30 cm in diameter and up to several hundred metres deep) into the ground, typically to establish a water bore or to collect samples to investigate the below surface geology.
DTED	Department of Trade and Economic Development.
DTEI	Department for Transport, Energy and Infrastructure.
DWLBC	Department of Water, Land and Biodiversity Conservation.
ecology	the science dealing with the relationships between organisms and their environments.
ecosystem	an interacting system of animals, plants, other organisms and non-living parts of the environment.
EIS	environmental impact statement.
EL(s)	exploration licence(s).
emission	a discharge of a substance (e.g., dust) into the environment.
EMS	environmental management system.
environment	a general term for all the conditions (physical, chemical, biological and social) in which an organism or group of organisms (including human beings) exists.
environmental planning	planning (e.g., of a mining operation) that places emphasis on the possible environmental impacts of a development.
EPA	Environment Protection Authority.

EPBC Act	<i>Environment Protection and Biodiversity Conservation Act 1999.</i>
EPCM	Engineering, Procurement and Construction Management.
ephemeral	not permanent, e.g., a stream that flows only seasonally or after rainfall or a lake that periodically dries out, or a plant that is present seasonally.
erosion	the wearing away of the land surface (whether natural or artificial) by the action of water, wind and ice.
evaporation	the loss of water as vapour from the surface of a liquid that has a temperature lower than its boiling point.
excavators	vehicles used to excavate holes and move soil, earth, or rocks.
exotic	introduced to a particular environment (see also introduced).
failure	(of wall) structural collapse or breach.
fault	fracture of the earth's crust caused by the relative movement of the rock masses.
fauna	a general term for animals (birds, reptiles, marsupials, fish, etc.), particularly in a defined area or over a defined time period.
Fe	iron.
feasibility study	a preliminary technical and economic study to assess the viability of a project.
feed	material being fed into a process.
feldspathic	an extremely common aluminosilicate mineral found in most igneous and metamorphic rocks and many sediments. It contains varying proportions of calcium, sodium, potassium, and other minerals.
filterable metal	the portion of a metal in a water sample that is able to pass through a filter normally having a pore size of 0.45 micron.
flocculant	chemical substance added to a flotation process to aid flocculation.
flood plain	a low-lying plain adjacent to a river subject to occasional or frequent flooding and formed by sediment deposition during flooding episodes.
flora	a general term for plants, particularly those found in a defined area or characteristic of a defined time period.
flowsheet	1. diagram representing the sequence of events and decision-making logic of a particular process. 2. the series of steps within the processing plant by which metals are recovered from ore.
fluvial	relating to, or formed by, a stream or river.
fold	to cause a layer of rock to bend, or to undergo this process.
food chain	the assemblage of organisms of various energy (trophic) levels linked by the transfer of food energy.
foraging	searching for food over a wide area.
formation	a large stratigraphic sequence of rock beds (sandstone, shale, limestone, etc.) generally deposited over a distinct geological period (e.g., during a glacial period).
fugitive	noise, dust, or light that has escaped into the environment (e.g., from a mine site).
galena	a lustrous blue-gray crystalline mineral that consists mainly of lead sulphide and is the main source of lead.
gangue	a mineral without economic value that is part of an ore deposit. Quartz, calcite, and fluorite are common gangue minerals.

geochemistry	the study of the chemical composition of the earth or of the chemical interaction of elements, molecules, or particles derived from the earth.
geotechnical	a term currently employed to cover the fields of soil mechanics, rock mechanics, and engineering geology.
geosyncline	subsiding elongate or basin-like trough that allows an accumulation of sedimentary and volcanic rocks.
grade	the concentration of metal, e.g., copper, either in an individual rock sample or averaged over a specified volume of rock; copper grade is usually given in %.
grader	vehicle used to smooth a soil or rock surface.
gradient	rate of change of a given variable (such as temperature or elevation) with distance.
gravel	sedimentary particles or rock fragments generally between 2 and 10 mm in size.
greenhouse gases	carbon dioxide, methane, nitrous oxide, perfluorocarbons, hydrofluorocarbons and sulphur hexafluoride.
grinding	a process used to reduce the particulate size of a mine rock or soil, typically occurs after crushing.
gross domestic product	gross domestic product (or, for states, gross state product) represents the sum total in any period of economic output of selected goods and services traded on the monetary market.
ground vibration	vibration transmitted through the ground following blasting.
groundwater	all waters occurring below the land surface; the upper surface of the soils saturated by groundwater in any particular area is called the water table.
groundwater discharge	discharge of groundwater into rivers, streams or open pits.
habitat	the particular local environment occupied by an organism.
haul trucks	heavy vehicles used for the transportation of ore or waste rock.
HCO ₃	bicarbonate.
HDPE	high density polyethylene.
heavy metals	generally used to describe the following metals: arsenic, iron, manganese, silver, mercury, chromium, lead, zinc, copper, nickel, selenium and cadmium.
HFCs	hydrofluorocarbons.
Hg	mercury.
hydrogeology	the study of groundwater, including its occurrence, recharge and discharge processes and the properties of aquifers.
hydrology	the study of water, particularly its movement in streams, rivers, or underground.
indicator	any physical, chemical, or biological characteristic of the environment used to assess (i.e., indicate) environmental condition.
indigenous	belonging to, or found naturally in, a particular environment (see also exotic).
Indigenous	a cultural group (and their descendants) who have a historical association with a given region, or parts of a region, and who formerly or currently inhabit the region.
inflow	flow directed into a particular feature, such as a lake or a mine pit.
infrastructure	the supporting installations and services that supply the needs of a project.
in situ	in its natural or original place.

interbedded	occurring between beds, or lying in a bed parallel to other beds of a different material.
introduced	see exotic.
intruded	geological term for (igneous) rock formed by the injection of molten magma up into the earth's crust and its subsequent cooling and crystallisation.
invertebrates	commonly, animals without a backbone (jellyfish, worms, molluscs, etc.).
ISQG	Interim Sediment Quality Guidelines.
K/CCCC	the Kanmantoo/Callington Community Consultative Committee.
LAeq	the steady sound level that contains the same amount of acoustical energy as a given time-varying sound.
landform	a specific feature of a landscape (such as a hill) or the general shape of the land.
leach	dissolution and removal of a soluble substance from a soil or a rock, e.g., the leaching of salt (by water) from a soil.
leachate	the fluid in which a leached substance is dissolved or transported.
LGA(s)	Local Government Area(s).
lift	each separate layer placed in the construction of an embankment or waste rock emplacement.
lithology	the description of rocks on the basis of colour, mineralogical composition, and grain size.
load	the amount of a substance discharged into a body of water (e.g., salt or sediment); usually expressed as mass over a specified time (e.g., tonnes per year).
loam	type of soil intermediate in texture between clay and sand, consisting of a mixture of clay, sand, gravel, silt, and organic matter.
macropods	marsupials belonging to the family Macropodidae, which includes kangaroos, wallabies, tree kangaroos and pademelons.
magnetite	a common black magnetic mineral consisting of iron oxide. It is an important ore of iron.
mean	average; the sum of the data divided by the number of data points.
mean annual rainfall	the average amount of rain that falls each year.
median	the middle value of a set of numbers arranged in order of magnitude (or the mean of the middle two numbers).
metallurgical	pertaining to metals, particularly their extraction from ore.
metamorphosed	having been structurally altered as a result of, or resulting from, exposure to intense heat and/or pressure.
MCA	Minerals Council of Australia.
Mg	magnesium.
mill	ore processing plant.
mine materials	material removed during excavation of the mine pit (e.g., topsoil, waste rock, or ore).
mine waste	by-products of mining operations with no economic value.
mine water	all water used in mining and processing (including for dust suppression and in leach tanks).
mineralisation	the occurrence of metals or minerals within a rock sequence that may potentially constitute ore.
ML	mining lease.
MLA	mining lease application.

MLA area	the mining lease application area, which incorporates the areas covered by the project, including pit, processing plant, tailings storage, waste emplacements, stockpiles, bunds, dams, etc.
MLP	mining lease proposal.
Mn	manganese.
model	a mathematical simulation of a natural system (such as the variation of particulate levels within a lake) used to predict how the system will change with time, particularly where external changes have been imposed upon it (such as from mining operations).
monitoring	systematic sampling and, if appropriate, sample analysis to record changes over time caused by impacts such as mining.
MPL(s)	miscellaneous purposes licence(s).
MSDS	Material Safety Data Sheet.
Na	sodium.
NAF	non-acid forming.
NATA	National Association of Testing Authorities.
native	see indigenous.
natural	existing in, or formed by, nature (generally excludes anything obviously modified by human beings).
natural degradation	deterioration occurring due to natural circumstances (such as extreme weather conditions).
NEPC	National Environmental Protection Council.
neutral	neither acidic nor basic (e.g., a pH equal to 7.0).
Ni	nickel.
nitrate	NO_3^- , nitrogen compound commonly found in waterbodies and used by plants and algae as a nutrient.
NO_2	nitrogen dioxide.
NOHSC	National Occupational Health and Safety Commission.
non-combustible residue	dust residue that cannot be burnt (i.e., free of organic litter).
noxious	introduced species considered to be harmful to native species or to the habitat of native species.
NPI	National Pollution Inventory.
NPW Act	<i>National Parks and Wildlife Act 1972.</i>
NTU	nephelometric turbidity unit.
nutrient status	state of nutrient (nitrogen and phosphorus) concentration of a waterbody.
nutrients	generally refers to nitrogen and phosphorus, which are essential for biological growth.
NVC	Native Vegetation Council.
NVMP	Native Vegetation Management Plan.
open pit	large hole excavated in an open-cut mining operation to remove the ore.
operations	mining and ore processing activities.
operations phase	that period of the mining project, after construction and prior to decommissioning, during which pit excavation and metal extraction takes place.
order of magnitude	an approximate 10-fold difference between two numbers (e.g., 21 and 230) is one order of magnitude; an approximate 100-fold difference is two orders of magnitude (e.g., 21 and 2,150), etc.

ore	a mineral or mixture of minerals containing a metal in sufficient amounts for its extraction to be profitable.
ore processing	the mechanical and chemical process by which a metal is extracted from an ore.
orebody	a solid mass of ore (both high and low grade) that is geologically distinct from the rock that surrounds it and that is commercially extractable.
overburden	material that overlies a deposit of ore which must be removed for the ore to be mined.
oxidation	the process by which an element or compound undergoes a chemical reaction involving the removal of electrons; often involves reaction with oxygen to form an oxide (e.g., the rusting of iron).
PAF	potentially acid forming.
particle size distribution	the relative proportions of particles (e.g., in a sediment) that fall within specific size categories.
passive	performing a function without electrical or mechanical action or movement (e.g., a jar-and-funnel rain gauge).
Pb	lead.
perennial	<ol style="list-style-type: none"> 1. a plant living for at least several years, and usually flowering each year. 2. waters or streams lasting throughout the year.
perimeter	outer boundary.
permeability	the ability of a rock or soil to allow fluid to pass through it.
PET–HPDE	polyethylene terephthalate—high density polyethylene; recyclable compounds used to make plastic drink bottles and piping.
PFCs	perfluorocarbons.
PFS	prefeasibility study.
pH	a measure of the degree of acidity or alkalinity of a solution; expressed numerically (logarithmically) on a scale of 1 to 14, on which 1 is most acid, 7 is neutral and 14 is most basic (alkaline).
piezometer	a small-diameter cased bore used to measure groundwater levels.
PIRSA	Primary Industries and Resources South Australia.
pit	see open pit.
pit water	water inflow into the pit from incident rainfall, surface inflow or groundwater seepage from pit walls.
PM ₁₀	the fraction of dust with a particle size of 10 μm (microns) or less. A health indicator for the fine particles of respirable dust capable of being inhaled into the lungs.
PM _{2.5}	the fraction of dust with a particle size of 2.5 μm or less. A health indicator for the very fine particles of respirable dust capable of deep penetration into the lungs and alveoli.
pollution	the alteration of air, soil, or water as a result of human activities such that it is less suitable for any purpose for which it could be used in its natural state.
potable water	water of quality suitable for human consumption.
potentiometric level	the level to which water rises in a well due to water pressure in the confined aquifer.
precipitation	<ol style="list-style-type: none"> 1. the process of changing from a dissolved compound into a solid, insoluble compound. 2. rain, hail and snow.

process method	method used to extract metals from the ore.
process plant	where the extraction of metals from the mined ore occurs.
process reagents	the chemicals and solutions used in the process method.
process water	water used during the processing of ore.
progressive rehabilitation	rehabilitation of mined or disturbed areas as soon as practicable after they are released during the life of the mine.
prospective	potentially containing an economic ore deposit.
PSD	particle size distribution.
pyrite	a cubic iron sulphide mineral with a brassy metallic luster that is used as an iron ore.
pyrrhotite	a widely occurring yellow-brown lustrous iron sulphide mineral, used as an iron ore.
quality control	procedures built into a sampling and analytical program to maintain the quality of the results obtained.
quantify	to determine the quantity or amount of a component in a substance.
quarry	an open pit from which construction materials are excavated.
radius	distance from the centre of a circle to its perimeter.
rainfall events	periods of rainfall.
RASO	Register of Aboriginal Sites and Objects.
reagents	chemicals used as part of an industrial process.
receptor	a designated place at which an impact may occur (e.g., a dwelling).
recharge	the addition of water to an aquifer, directly from the surface, indirectly from the unsaturated zone, or by discharge from overlying or underlying aquifer systems.
recolonise	the process of animal and plant species re-establishing themselves in a disturbed area.
refining	to bring to pure state.
regrowth	natural regeneration of vegetation following clearing, fire, etc.
rehabilitation	the restoration of a landscape and especially the vegetation following its disturbance.
remobilisation (of sediment)	resuspension of deposited sediment.
replicate samples	samples taken as close to each other in time and space as possible to test analytical accuracy.
reptiles	cold-blooded vertebrates, including lizards, snakes, turtles, and crocodiles.
reserve	commercially extractable minerals.
residual environmental impacts	impacts from an activity (e.g., mining) that remain after management and mitigation measures.
residue	see tailings.
resource	minerals in the ground, but not necessarily commercially extractable.
revegetated	an area that has been planted with trees, bushes and grasses after being disturbed.
richness (of fauna or flora)	a measure of the number of species in a given area or assemblage.
riparian	pertaining to, or situated on the bank of, a body of water, especially a water course such as a river.
river system	a river and its tributaries draining a catchment.
RL	reduced level.
ROM	run-of-mine; see run-of-mine ore stockpile.

routine monitoring	monitoring performed on a regular basis, with the same observations and tests conducted each time.
run of mine (ROM) ore stockpile	the stockpile of freshly mined ore used to feed the mill and process plant.
runoff	that portion of precipitation (rain, hail and snow) that flows from a specific area as water.
runon	that portion of precipitation (rain, hail and snow) that can potentially flow across a specific area as water.
SACOME	South Australian Chamber of Mines and Energy.
SADEH	South Australian Department of the Environment and Heritage.
SAG	semi-autogenous grinding.
sampling period	range of time over which samples are taken.
sand	siliceous group of particles within the size range 63 microns to 2 millimetres.
Sb	antimony.
SEB	significant environmental benefit.
schist	a regionally metamorphosed rock characterised by banding caused by a parallel arrangement of minerals.
sediment load	see load.
sediment transport	the movement of sediment particles by the action of water, wind or gravity.
sedimentary rocks	rocks resulting from the consolidation of loose sediment that has accumulated in layers.
seepage	1. subsurface movement of water. 2. emergence of subsurface flow at the ground surface.
seismic risk	the possibility of earth movement due to a seismic event (e.g., an earthquake).
sequence (geological)	layers of (predominantly) sedimentary rocks sourced from a common geological environment or period.
SES	State Emergency Service.
sheet flow	runoff that is of substantial lateral extent and relatively uniform depth (rather than concentrated in channels).
silt	a sediment with particles finer than sand and coarser than clay, i.e., 2 to 63 microns.
siltstone	silt that has consolidated into rock.
site-specific	an observation that is particular to one site.
slurry	mixture of fluid and solid (e.g., tailings water and solids).
SO ₂	sulphur dioxide.
SO ₄	sulphate.
soak	a small area where the water table has intersected the ground surface.
solubilisation	the process of dissolving.
solvents	organic liquids that will dissolve solids (e.g., benzene or toluene).
species	a taxonomic grouping of organisms that are able to interbreed with each other but not with members of other species.
species diversity	a measure of the number of different species in a given area.
sphalerite	a yellow or brownish ore of zinc consisting of crystalline zinc sulphide.

spigot	a tap for controlling the flow of liquid from a pipe.
standing water	water that is pooled and still.
station	a specific location established for repeated sampling, gauging, weather measurements, etc.
staurolite	a reddish-brown or black mineral of iron and magnesium that occurs as prismatic crystals in metamorphic rocks, often in a cross shape.
stockpile	a pile used to store material (such as low-grade ore) for future use.
storage capacity	the maximum volume of liquid able to be retained in a structure or container (e.g., a reservoir or lake).
stratigraphic	the origin, composition, and development of rock strata.
stream gauging	determination of water level and velocity in a stream or river for the purpose of calculating the rate of flow.
stripping	removal of vegetation and topsoil.
sub-aqueous	below the surface of water.
substrate	an underlying layer (e.g., of sediment under water).
sumps	pits sunk to collect water.
supernatant	the layer of water above settled solids.
surface waters	all water flowing over, or contained on, a landscape (e.g., runoff, streams, lakes, etc.).
suspended (solids)	solids held in suspension by the turbulent flow of a fluid.
syngenetic	a mineral deposit formed contemporaneously with, and by essentially the same processes as, the enclosing rocks.
tailings	by-product of the metal extraction process consisting of crushed rock from which the metal has been extracted (the solid fraction or portion) and a liquid fraction or portion composed of water and residual chemicals used in the extraction process.
tailings storage facility (TSF)	a storage facility for tailings.
TAPM	The Air Pollution Model.
TDS	total dissolved solids.
temperature inversion	an atmospheric phenomenon in which air temperature increases with height over a particular interval.
tenure (of land)	terms of holding or authority of ownership.
terrestrial	pertaining to land.
throughput	quantity of material (ore, chemicals, etc.) moving through a system (e.g., an ore-processing plant).
topography	physical relief and contour of a region.
topsoil	upper layer of soil, usually containing more organic material and nutrients than the subsoil beneath it.
total metal	total mass of filterable and non-filterable metal in a water sample.
total suspended particulate (TSP) matter	mass of all suspended particulates.
total suspended solids (TSS)	a common measure used to determine suspended solids concentrations in a waterbody and expressed in terms of mass per unit of volume (e.g., milligrams per litre).
toxic	poisonous to a specific organism, sometimes resulting in death.
toxicant	a substance that is poisonous.
toxicity	effect of any substance that produces a harmful effect on living organisms; described as acute (short term) or chronic (long term).

transect	a line across a study area along which observations are made and changes can be observed (e.g. changes in vegetation).
transgression	a sea level rise, producing a vertical sequence of facies representing progressively deeper water environments.
transport	movement (e.g., of sediment) via a medium such as river water.
tributary	a stream or river that flows into a larger river or lake.
TSP	see total suspended particulate matter.
TSS	see total suspended solids.
turbidity	the optical property of water that prevents light from being transmitted; turbidity or muddiness is caused by the presence of very fine suspended matter such as clay or organic matter.
TWA	time weighted average.
understorey	the smaller species of plants that form neither the canopy nor the ground cover.
upper limits	the higher values within a defined range.
variable	<ol style="list-style-type: none"> 1. not constant, subject to change (e.g., temperature, rainfall or population). 2. water quality indicator (e.g., pH, metal concentration).
vegetated	covered with plants.
velocity	speed in a given direction.
vibration	oscillating movement.
WAP	water allocation plan.
waste oils	used oils and lubricants retrieved from machinery.
waste rock	uneconomic rock extracted from the ground during a mining operation to gain access to the ore.
waste rock storage	structure to hold waste rock, formed by the placement of waste rock in stacked layers (typically 7 to 10 m), engineered in such a way as to maximise stability and minimise erosion.
water balance	the sum of the inputs and outputs and changes in storage levels of water in a given locality.
water chemistry	the interaction of the chemical constituents (dissolved metals, suspended particles, etc.) of water.
water column	the body of water overlying the bed of a stream, lake, swamp, or ocean.
water hardness	the concentration in water of certain mineral salts (particularly calcium carbonate, CaCO ₃); generally a function of calcium and magnesium concentrations.
water quality	degree of the lack of contamination of water.
water quality criteria	generally refers to numeric levels specified for key water quality variables, such as dissolved metals or pH, which can be measured to determine the suitability of water for human consumption, supporting aquatic life, etc.
water table	the surface of the groundwater, below which soil and rock are saturated.
waterbird	any bird that frequents the water in, or inhabits the margins of, lakes or rivers.
watercourse	stream or river, running water.
weathering	the in-situ physical disintegration and chemical decomposition of rock materials at or near the earth's surface.

weed	any plant (in particular an herbaceous one) that survives in an area where it is harmful or troublesome to the desired land use.
well	an opening in the ground that gives access to underground water.
wetland	a low-lying area regularly inundated or permanently covered by shallow water.
wildlife mortality	rate at which a species of wildlife dies.
wind erosion	wearing away of exposed soil, earth, or rock surfaces by the abrasive action of wind-blown particles (e.g., grains of sand).
worst-case scenario	a sequence of events likely to result in the worst-case effects on the environment.
yield	(of a water bore). 1. the capacity of the bore to produce water. 2. the amount of water actually withdrawn.
Zn	zinc.

15. Study Team

Hillgrove Resources Limited appointed Enesar Consulting Pty Ltd to prepare this MLP. This report draws on the work of a number of specialist consultants and their contributions are gratefully acknowledged.

The individuals listed below contributed to the preparation of the MLP.

15.1 Hillgrove Resources Limited

D. Ferguson Director, Exploration and Operations
M. Adams Project Manager, Kanmantoo Copper Project
A. Reeves Project Engineer, Kanmantoo Copper Project
J. Popow Landowner Liaison Officer, Kanmantoo Copper Project

15.2 Consultants to Hillgrove

15.2.1 Enesar Consulting Pty Ltd

D. Browne MLP Project Director, mine closure assessment
T. Halliday MLP Project Manager
M. Jones MLP report
G. Hamilton MLP report
F. Howe MLP report
D. Moriarty MLP report, native vegetation and mine closure assessments
K. Sutherland MLP report
P. O'Donohue MLP report
V. Alivanoglou MLP report
M. Haywood MLP report
A. Jenkinson MLP report
S. Kenny MLP report, socio-economic and native vegetation assessments
K. Levingstone MLP report
J. Rowntree MLP report
H. Blaszkiewicz Drafting
F. Thomson Drafting/GIS
H. Kotasek GIS
D. Smith GIS
G. Young GIS
D. Oram Information Technology
J. Bant Editing/administration
A. Gils Formatting

15.2.2 Specialist Consultants

Aquaterra

G. Passfield Surface water management
M. Driver Surface water management

Australian Heritage Services

S. Freeman Non-Indigenous cultural heritage assessment

Blastotechnology

C. Mackenzie Blasting assessment

Coffey Mining

C. Lane Tailings storage facility design (integrated waste landform)

Ecological Associates

M. Cooling Fauna and flora assessment

G. Kerr Fauna assessment

P. Hudson Fauna assessment

B. Taylor Flora assessment

J. Smith Flora assessment

Environmental Geochemistry International Pty Ltd

W. Stewart Geochemistry assessment

S. Miller Geochemistry assessment

Maunsell

S. Mitchell Traffic assessment

A. Teakle Traffic assessment

M. Boulden Traffic assessment

Pacific Sene

P. Fitzpatrick Indigenous archaeology and cultural heritage assessment

Resource and Environmental Management

P. Howe Groundwater assessment

T. Hodgkin Groundwater assessment

Sonus Pty Ltd

C. Turnbull Noise assessment

M. Dewhurst Noise assessment

Tonkin Consulting

C. Purton Air quality, odour and greenhouse gas assessment

J. Torringer Air quality, odour and greenhouse gas assessment

Wax Design Space Pty Ltd in association with Brett Grimm

W. Keates Visual assessment

B. Grimm Visual assessment

15.3 Other Project Consultants

Lycopodium

M. Warren Feasibility Study Manager

Snowden

G. Davidson Mine and integrated waste landform design

Attachment 1

Kanmantoo Project Update Newsletter

KANMANTOO PROJECT UPDATE – APRIL 2007

A Progress Report From Hillgrove Resources Limited

Kanmantoo/Callington Community Consultative Committee

The Kanmantoo/Callington Community Consultative Committee (CCC) held a public meeting in the Callington Memorial Hall on 19 April, chaired by Bob Goreing. Draft Notes of the meeting are attached.

The next meeting of the CCC is scheduled for Thursday 3 May at 7.30pm in the Callington Memorial Hall, and will focus on traffic and indigenous heritage. It will be advertised in The Mount Barker Courier. As always, all interested parties are invited to attend.

From Hillgrove's Managing Director

Hillgrove recently released its fourth quarter report to the Australian Securities Exchange (ASX). Some of the highlights included:

The fourth quarter has proved an exciting period for Hillgrove with the commencement of the Definitive Feasibility Study of the Kanmantoo Copper Gold Mine, and robust growth in the company's finances with continuing increases in the value of our investments matched with capital raisings well supported by our shareholders and the wider investment community.

The Definitive Feasibility Study of the Kanmantoo Copper Gold Mine redevelopment started with Lycopodium Engineering Pty Limited commissioned to lead manage the study.

New high grade copper zones highlighted significant new mineralisation not incorporated in the PFS economic model, with better results including:

O'Neil Zone:

- 24m at 3.14% Copper and 0.91g/t Gold including 10m at 3.88% Copper and 1.66g/t Gold in KTRC 386;
- 36m at 1.43% Copper and 0.37% Gold including 16m at 1.93% Copper and 0.31g/t Gold in KTRC 388.

South East Zone:

- 9m at 2.15% Copper and 0.58g/t Gold, 7m at 1.58% Copper and 0.73g/t Gold in KTDD 094;

- 18.7m at 1.46% Copper and 0.67g/t Gold including 11.7m at 2.12% Copper and 0.63g/t Gold in KTDD 095.

New high grade Mt Rhine gold zones were also identified 50kms north of Kanmantoo, with better results including: 6m at 15.9g/t Gold in MRCS003; 6m at 15.4g/t Gold in MRCS001.

The exploration and development drilling program at Kanmantoo is continuing with further significant zones of mineralisation intersected, confirming the prospectivity of the area and the potential for a mineralised system of considerable size. The drilling has continued to increase both the resource tonnage, the confidence level and, with substantial gaps and possible strike extensions targeted for drilling, there is excellent potential for further significant copper resource growth in and around the old open cut.

Exploration and resource definition drilling is ongoing but particularly concentrated during the Definitive Feasibility Study throughout this quarter.

I'm looking forward to attending the CCC meeting on the 3rd of May.

David Archer, Managing Director



David Archer

CCC Fauna Presentation

Dr Greg Kerr, senior ecologist with Ecological Associates Pty Ltd, presented the findings of a fauna survey he conducted at the Kanmantoo mine property at the CCC meeting on April 19. The survey found that species abundance was low, most probably due to the time of year when the survey was conducted. However, no threatened species of national significance were recorded.

The survey covered mammals, birds and reptiles and the CCC brief can be found on the Hillgrove website at www.hillgroveresources.com.au. Full details will be available in the CCC library being established at the offices of The Adelaide Hills Regional Development Board in Mt Barker. Please contact Stephen Marlow (details below).

The survey cautioned that the mining proposal could impact on habitats and this could be mitigated by:

- Avoiding remnant vegetation for pit, spoil, plant, traffic where possible
- Controlling noise, dust, runoff
- Rehabilitating / revegetating remnants on site
- Rehabilitating remnants off-site.

CCC European Heritage Presentation

Sean Freeman from Australian Heritage Services Pty Ltd gave a fascinating insight into the European heritage of the Kanmantoo site and an assessment of the remaining buildings and ruins. A search of all the relevant federal, state and local non-indigenous heritage Registers has been conducted and none of the remaining heritage items located within the project area are included in any of these Registers. All works currently anticipated within the Kanmantoo Copper Project area will avoid direct impact on areas containing items of non-indigenous heritage, including the Paringa Smelter complex.



Paringa Smelter

Options for minimising and mitigating development impacts are to:

- Control impact risks arising from site operations (e.g. erosion, nearby excavations and blasting etc.).
- Thorough recording and documentation of non-indigenous heritage structures, in consultation with Heritage SA, as a baseline measure to assess the current status of these structures.

The CCC brief for Sean's presentation is also on the Hillgrove website (www.hillgroveresources.com.au) and the full presentation will be available in the CCC library.

Hillgrove increases its community sponsorships

Hillgrove has added the Callington and District Little Athletics Centre to its list of local sponsorships. Landholder Liaison Officer, John Popow says sponsoring the Centre for its current season fits with existing support to the Callington Eagles Netball Club, Callington Eagles Football Club, the Callington Primary School Environmental Complex, the Callington Kindergarten, and the Bremer-Nairne Cricket Club.

District Council of Mt Barker visits site

Mayor Ann Ferguson and elected members of the District Council of Mount Barker recently visited the Kanmantoo operation – for many their first visit to a mineral exploration site.

Guided by General Manager - Exploration & Operations, Dale Ferguson, and Project Manager, Marty Adams, the Councillors were given an extended tour that included a drive down into the pit and viewing the proposed site for the copper processing plant.

Judging by the number of questions and the positive comments at the end of the tour, the visit was a huge success and will be followed up as project milestones occur.

Hillgrove will continue to keep the Council and other community groups fully informed and engaged in the project, and reminds local residents that all meetings of the Kanmantoo-Callington Community Consultative Committee are widely advertised and are always open to all members of the public.



Current Work Programme

April Work Program

Work during April again focused on the DFS, with work continuing on the various specialist studies being co-ordinated by Lycopodium and Enesar (environmental consultants). Exploration and sterilisation drilling was also completed in and around the old Kanmantoo pit with the primary objective of locating the proposed mine infrastructure.

Drill results returned during the month have identified further copper mineralisation with the widest (84m) intersection recorded at the Kanmantoo project to date.

May Work Program

During May it will be business as usual with Hillgrove and the independent consultants continuing work on the DFS. Whilst this work is under way drill rigs will be visible from time to time from both Mine Road and Back Callington Road.

Limited regional exploration including soil sampling and rock chip sampling will be conducted in the vicinity of the old Wheel Ellen workings.

How to Contact Us

There are many ways to stay informed about the progress of the program, or seek additional information. Key contacts are:

Landholder Liaison Officer	John Popow	0427 131 018	johnp@hillgroveresources.com.au
Project Manager	Marty Adams	0439 670 045	martya@hillgroveresources.com.au
General Manager, Exploration & Operations	Dale Ferguson	08 9322 6377	dalef@hillgroveresources.com.au
Community Consultative Committee Secretariat	Stephen Marlow	08 8431 5907	marcomms@bigpond.net.au

We have added a community section to our website which provides an outline of our activities in the area. A landholder information section is continually being developed and will be regularly added to over time: www.hillgroveresources.com.au.

Contacts for Primary Industry and Resources South Australia (PIRSA), the government body who regulate mining and exploration in South Australia, are:

PIRSA	Sam Walker	08 8463 3088	walker.sam@saugov.sa.gov.au
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PIRSA's website is www.pir.sa.gov.au and provides a wealth of useful information including the *Mining Act 1971*, prescribed forms, mines regulation and other detail.

If you would prefer to have an emailed copy of the newsletter please go to the website and fill in your details under Project News which is part of the Kanmantoo Community sections. The direct link is www.hillgroveresources.com.au/Kanmantoo/KanmantooProjectNews

Hillgrove Resources Limited
ACN 004 297 116
PO Box Z5323, St Georges Terrace, Perth WA 6831
Tel: (08) 9322 6377 Fax: (08) 9322 6640
www.hillgroveresources.com.au