# V Coal Mine – Environmental Management Plan

## Table of Contents

### APPENDIX V ENVIRONMENTAL MANAGEMENT PLAN

## TABLES

## FIGURES

## Glossary, Abbreviations and Units

| Term | Definition |
|---|---|
| Electrical Conductivity | Electrical conductivity or salinity are measures of the total concentration of inorganic ions (salts) in the water. |
| Hardness as $CaCO_3$ | Hardness is expressed in mg/L as $CaCO_3$. Increasing calcium and magnesium in waters (hardness) is usually associated with increases in alkalinity. Changes in alkalinity will directly affect metal speciation. |
| Tributary | A tributary is a stream which flows into another stream or river (a key stream). |
| Turbidity | The turbidity or 'muddiness' of water is caused by the presence of suspended particulate and colloidal matter consisting of suspended clay, silt, phytoplankton and detritus. |

| Abbreviation | Definition |
|---|---|
| °C | Temperature |
| AARC | AustralAsian Resource Consultants |
| AMD | Acid Mine Drainage |
| ANZECC | Australian and New Zealand Environment and Conservation Council |
| ARMCANZ | Agriculture and Resource Management Council of Australia and New Zealand |
| As | Arsenic |
| Ba | Barium |
| Bo | Boron |
| $CaCO_3$ | Calcium Carbonate |
| Cd | Cadmium |
| Cfu | Colony forming units |
| Chl 'a' | Chlorophyll 'a' |
| Co | Cobalt |
| CoC | Chain of Custody |
| Cr | Chromium |
| Cu | Copper |
| DERM | Department of Environment and Resource Management |
| DERM | Department of Environment Resource Management |
| DO | Dissolved Oxygen |
| e.g. | Exempli gratia (for example) |
| EC | Electrical Conductivity |
| EIS | Environmental Impact Statement |
| EMOS | Environmental Management Overview Strategy |
| EP Act | *Environmental Protection Act 1994* |
| EPA | Environmental Protection Authority |
| EPP | Environmental Protection Policy |
| ESCP | Erosion Sediment Control Plan |
| Fe | Iron |

| Abbreviation | Definition |
|---|---|
| g | Gram |
| g/ml | Gram per millilitre |
| GDR | Great Dividing Range |
| GED | General Environmental Duty |
| ha | Hectare |
| Hg | Mercury |
| i.e. | Id est. (that is) |
| IDC | Index of Diversion Condition |
| km | Kilometres |
| L | Litre |
| LCD | Lagoon Creek Downstream |
| LCL | Lagoon Creek Lagoon |
| LCSRD | Lagoon Creek final SRD Discharge |
| LCU | Lagoon Creek Upstream |
| Li | Lithium |
| LP Act | *Land Protection (Pest and Stock Route) Management Act 2002* |
| LSCU | Little Sandy Creek upstream |
| ml | Millilitre |
| Mn | Manganese |
| MRL | mandatory reporting level |
| NCC | Native Companion Creek |
| $NH_4^+$ | Ammonium |
| Ni | Nickel |
| OC | Organochlorine Pesticides |
| OP | Organophosphorus Pesticides |
| Pb | Lead |
| RBL | Rating Background Levels |
| RCU | Rocky Creek upstream |
| REMP | Receiving Environment Monitoring Program |
| RP | Release Point |
| SCU | Sandy Creek upstream |
| SEIS | Supplementary Environmental Impact Statement |
| SMD | Slightly to Moderately Disturbed |
| SMU | Soil management unit |
| SPU | Spring Creek upstream |
| SRD | Spoil runoff dam |
| TN | Total Nitrogen |
| TP | Total Phosphorus |
| TPH | Total Petroleum Hydrocarbons |

| Abbreviation | Definition |
|---|---|
| TSS | Total Suspended Solids |
| µg | Microgram |
| µg/ml | Microgram per millilitre |
| µS/cm | Micro Siemens per centimetre |
| WA | Western Australia |
| WC | Well Creek |
| WHO | World Health Organisation |
| Zn | Zinc |
| % | Percentage |

# Appendix V Environmental Management Plan

## Executive Summary

Hancock Prospecting Pty Ltd (HPPL) (the Proponent), through its wholly owned subsidiary company, Hancock Coal Pty Ltd (HCPL) is proposing to develop the Alpha Coal Project (Mine) (the Project), a 30 million tonne per annum (Mtpa) product open cut thermal coal mine to target the seams in the Upper Permian coal measures of the Galilee Basin, Queensland, Australia. An Environmental Impact Statement (EIS) for the Alpha Coal Project (Issue 3, November 2010) was prepared and made available for public comment and review from 5 November 2010 to 20 December 2010. A supplementary EIS (SEIS) report has been prepared in response to the submissions made by interested and affected parties including members of the public, advisory agencies and organisations, in addition to amendments made to the Project Description since the release of the EIS.

An Environmental Management Plan (EM Plan) was prepared as part of the aforementioned Alpha Coal Project EIS as a requirement under Section 201 of the *Environmental Protection Act 1994* (EP Act) as part of the application for an Environmental Authority (mining activities) process. Section 202 of the EP Act states that the purpose of an EM Plan is to propose environmental protection commitments to assist the administering authority prepare the draft Environmental Authority.

This EM Plan has been prepared for the coal mine component of the Alpha Coal Project and has been updated accordingly to capture changes that have arisen through the Supplementary EIS (SEIS) process, i.e. changes attributed to the Project Description amendments, additional studies conducted, and due to comments raised in submissions. The EM Plan for the railway corridor can be found in SEIS Volume 2, Appendix AC. The port element of the project at Abbot Point does not form part of this EM Plan. North Queensland Bulk Port Corporation (NQBP), the Port Authority under the *Transport Infrastructure Act 1994* for Abbot Point port, is responsible for the port area environmental approvals.

The content of this EM Plan addresses the Department of Environment and Resource Management (DERM) Guideline No. 8, preparing an Environmental Management Overview Strategy (EMOS) for non-standard Mining Projects and has been prepared in accordance with Section 2003 of the EP Act. The commitments expressed are measurable and auditable; they set objectives and outline control strategies to achieve the objectives. A summary of the EM Plan Sections is provided in Table V-1 below.

## Table V-1 Summary of Sections within the Environmental Management Plan

| Section Number | Section name | Description |
|---|---|---|
| Section V-1 | Introduction | Provides background on the Proponent, describes each of the relevant mining leases and land tenure, and identifies the relevant stakeholders |
| Section V-2 | Project Description | Describes the relevant mining activities and the land on which the mining activities are to be carried out |
| Section V-3 | Environmental Values, Impacts, Commitments, and Draft Conditions | • Describes the following<br>– Environmental values likely to be affected by the mining activities;<br>– Potential adverse and beneficial impacts of the mining activities on the environmental values;<br>– Environmental protection objectives;<br>– Performance criteria;<br>– Control strategies adopted to achieve the environmental protection objectives;<br>– Commitments; and<br>– Proposed Environmental Authority conditions. |
| Section V-4 | Environmental Management | Describes details of the Project's systems for monitoring, reporting, research, training and auditing |
| Section V-5 | Definitions | describing all the definitions used according to the mine operation environmental conditions |
| Section V-6 | References | |

# V.1 Introduction

Hancock Prospecting Pty Ltd (HPPL) (the Proponent), through its wholly owned subsidiary company, Hancock Coal Pty Ltd (HCPL) is proposing to develop the Alpha Coal Project (Mine) (the Project), a 30 million tonne per annum (Mtpa) product open cut thermal coal mine to target the seams in the Upper Permian coal measures of the Galilee Basin, Queensland, Australia. The coal mine will be supported by privately owned and operated rail and port infrastructure facilities. At the Project site the coal will be mined, washed and conveyed to a train load-out facility where it will be transported approximately 500 kilometres (km) to the east coast of Australia to the port facility of Abbot Point for export.

An Environmental Impact Statement (EIS) for the Alpha Coal Project was prepared (Issue 3, November 2010) and was made available for public comment and review from 5 November 2010 to 20 December 2010. A supplementary EIS (SEIS) report has been prepared in response to the submissions made by Individuals, Advisory Agencies and Organisations, in addition to amendments made to the Project Description since the release of the EIS.

An Environmental Management Plan (EM Plan) was prepared as part of the aforementioned Alpha Coal Project EIS as a requirement under Section 201 of the *Environmental Protection Act 1994* (EP Act) as part of the application for an Environmental Authority (mining activities) process. Section 202 of the EP Act states that the purpose of an EM Plan is to propose environmental protection commitments to assist the administering authority with preparing draft Environmental Authority.

Excluded from this EM Plan is the proposed Abbot Point Coal Terminal. The North Queensland Bulk Ports Corporation (NQBPC) is the owner and port authority for the Port of Abbot Point. The port facility has a current handling capacity of 21 Mtpa. In 2007, approvals were granted to expand the handling capacity to 50 Mtpa. Since this time NQBP, as the proponent, has completed a Voluntary Environmental Assessment (VEA) for a proposed further expansion of the port for a handling capacity of 110 Mtpa (the Abbot Point Coal Terminal X110 Expansion Project). A VEA has been completed as the proposed expansion project does not trigger the requirement for an EIS under the *State Development and Public Works Organisation Act 1971* (SDPWO Act). This VEA has been referred and will be assessed by the Coordinator General (CG) as part of Section 9 of the development scheme, which manages land use within the Abbot Point State Development Area (APSDA). The port element of the project at Abbot Point does not form part of this SEIS.

## V.1.1 The Project

The Proponent has a mining lease application (MLA 70426) over the Project site. MLA 70426 for the Project site includes sufficient area in order to design and locate the following key coal mine related components:

- Coal Handling Preparation Plant (CHPP);
- Run of Mine (ROM) stockpiles;
- Borrow pits;
- Tailings storage facility (TSF);
- Raw water dam;
- Environmental dams;
- Light Industrial Area (LIA);
- Mine Infrastructure Area (MIA);

- Rail infrastructure;
- Accommodation Village;
- Access roads;
- Water and wastewater treatment systems; and
- Communications and electrical components.

The Project is approximately 130 km south-west of Clermont and approximately 360 km south-west of Mackay. The nearest residential area to the Project is the township of Alpha, located approximately 50 km south of the Project. Access to the mining lease is from the DegullaFigure 0-1 Road north off the Capricorn Highway at Alpha.

Specific Alpha Coal Project (Mine) location Figures for the Alpha Coal Project (Mine) include:

- Figure V-1, Regional Project Location
- Figure V-2, illustrating the land tenure including property titles and names as well as the Mining Lease Application (MLA), the Exploration Permit Coal (EPC 1210) and Mineral Development Licence (MDL) for the Alpha Coal Project (Mine) location;
- Figure V-3, illustrating the project road and rail infrastructure;
- Figure V-4, illustrating the project layout including the location of all proposed project road and rail infrastructure including; access points, ramps, roads, stock routes, dams, rail loop and train load-out facility;
- Figure V-5, illustrating the proposed Mining Infrastructure Area (MIA) building layout.
- Figure V-6, illustrating the proposed Light Industrial Area (LIA) building layout,
- Figure V-7, illustrating the Alpha Coal Project (Mine) project disturbance area and easements across the Project site.


Mining Lease Application (MLA70426) Boundary

Barcaldine Regional Council Boundary

Alpha Coal Project Railway Corridor

Source: See Copyright Details below and for full disclosure Please Refer to the SEIS ***Volume 2, Appendix B***

0 25 50km

Scale 1:2 000 000 (A4)

Datum: GDA94, MGA Zone55

N W E S

**HANCOCK** PROSPECTING PTY LTD

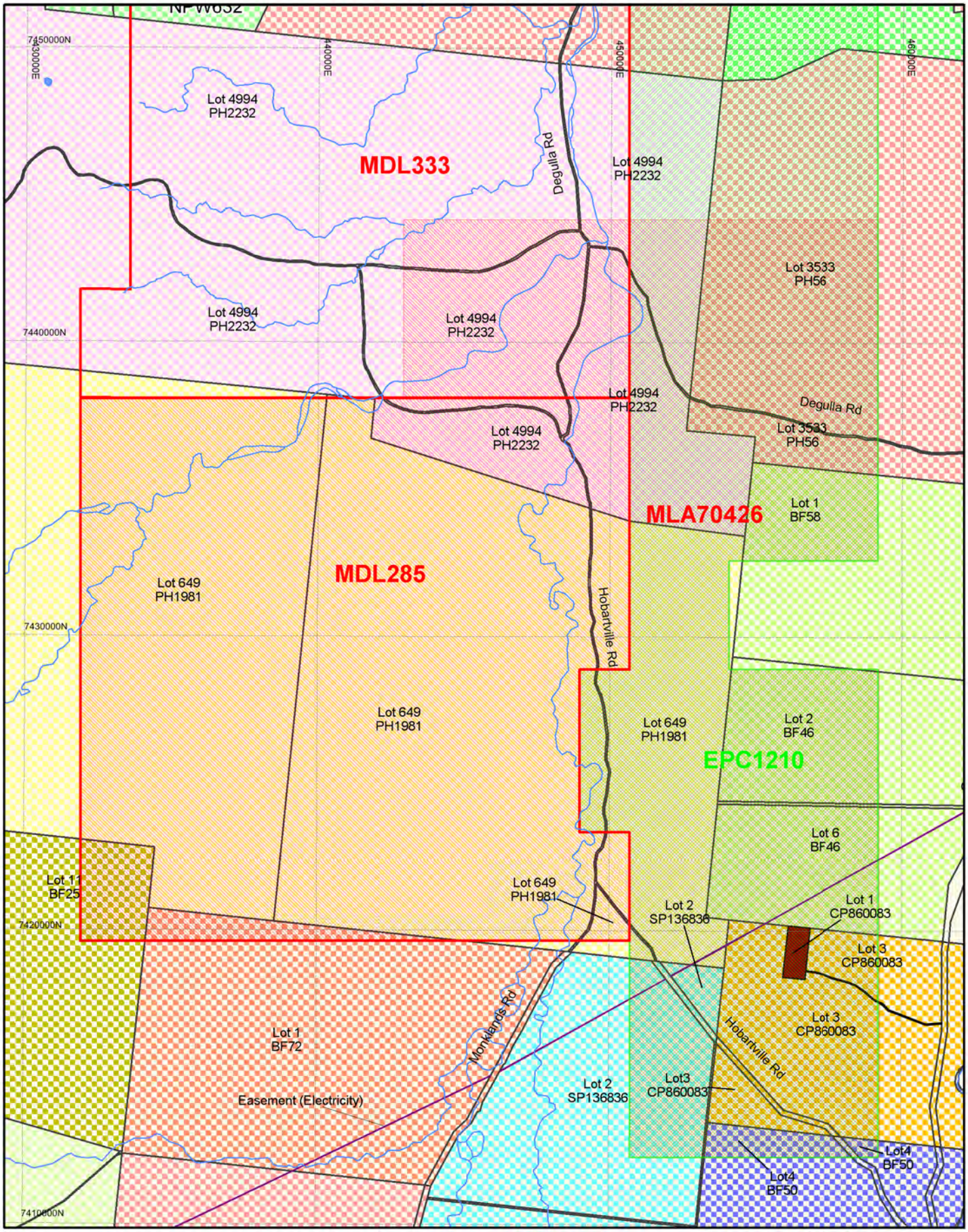
Alpha Coal Project
Supplementary Environmental Impact Statement

# REGIONAL PROJECT LOCATION

Job Number | 4262 6680
Revision | A
Date | 12-04-2011

Figure: V-1

File No: 42626680-g-2045.wor




Source: See Copyright Details below and for full disclosure Please Refer to the SEIS ***Volume 2, Appendix B***

0 2.5 5km
Scale 1:175,000 (A4)
Datum: GDA94, MGA Zone55

N W E S

**HANCOCK PROSPECTING PTY LTD**

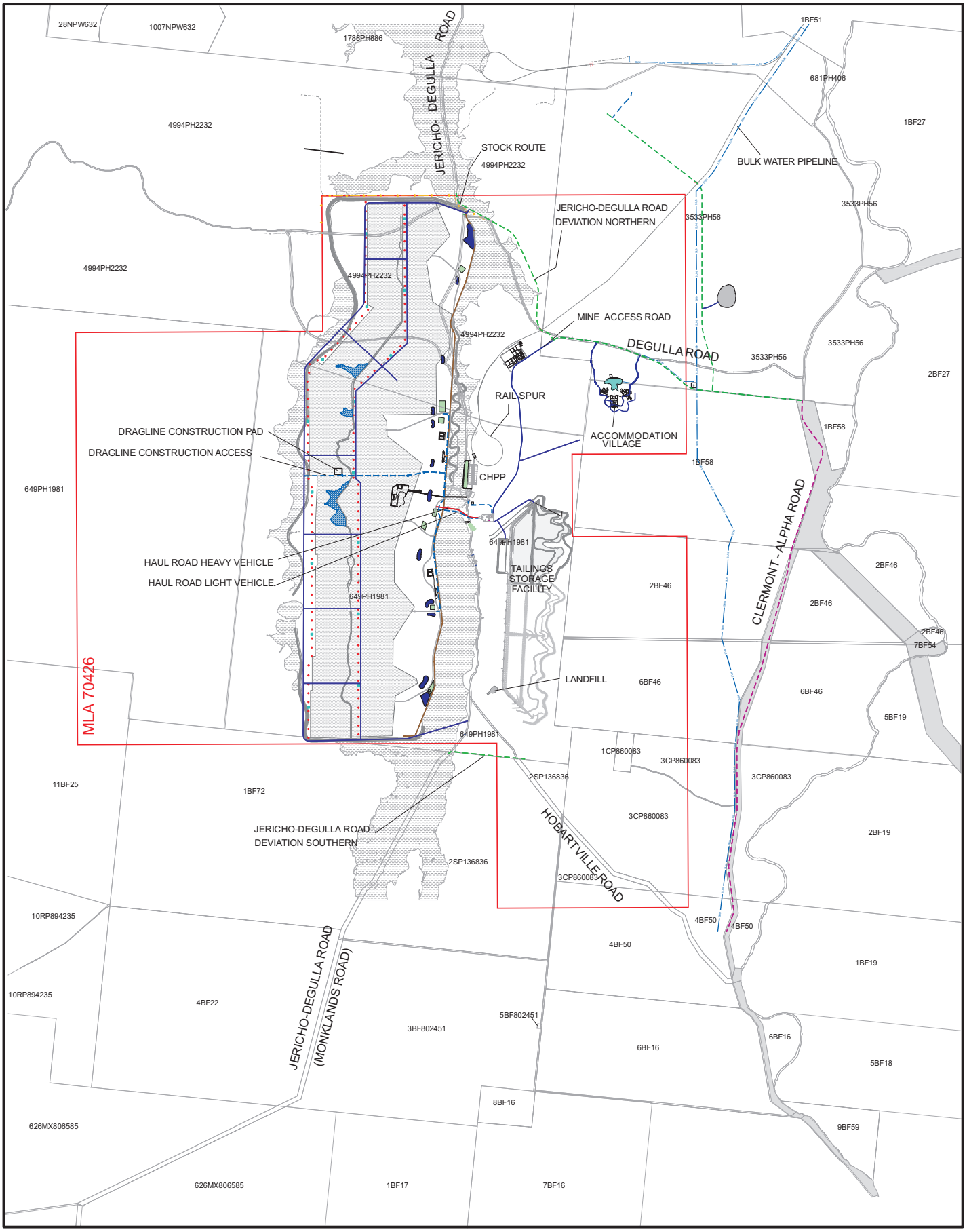
Alpha Coal Project
Supplementary Environmental Impact Statement

# ALPHA COAL PROJECT (MINE) PROPERTY DESCRIPTIONS AND MINING TENURE

Job Number 4262 6680
Revision A
Date 12-04-2011

**Figure: V-2**

File No: 42626680-g-2046.wor




RAIL LINE
STATE CONTROLLED ROAD - (TWO-WAY SEALED)
COUNCIL ROAD - (TWO-WAY SEALED)
COUNCIL ROAD - (TWO-WAY UNSEALED)
TWO-WAY SEALED ROAD
TWO-WAY UNSEALED ROAD
SINGLE LANE UNSEALED ROAD
TWO WAY HAUL ROAD
FLOOD LEVEES

Source: See Copyright Details below and for full disclosure Please Refer to the SEIS ***Volume 2, Appendix B***

0 2 4Km
Scale 1:150 000 (A3)
Datum: GDA94, MGA Zone55

N W E S

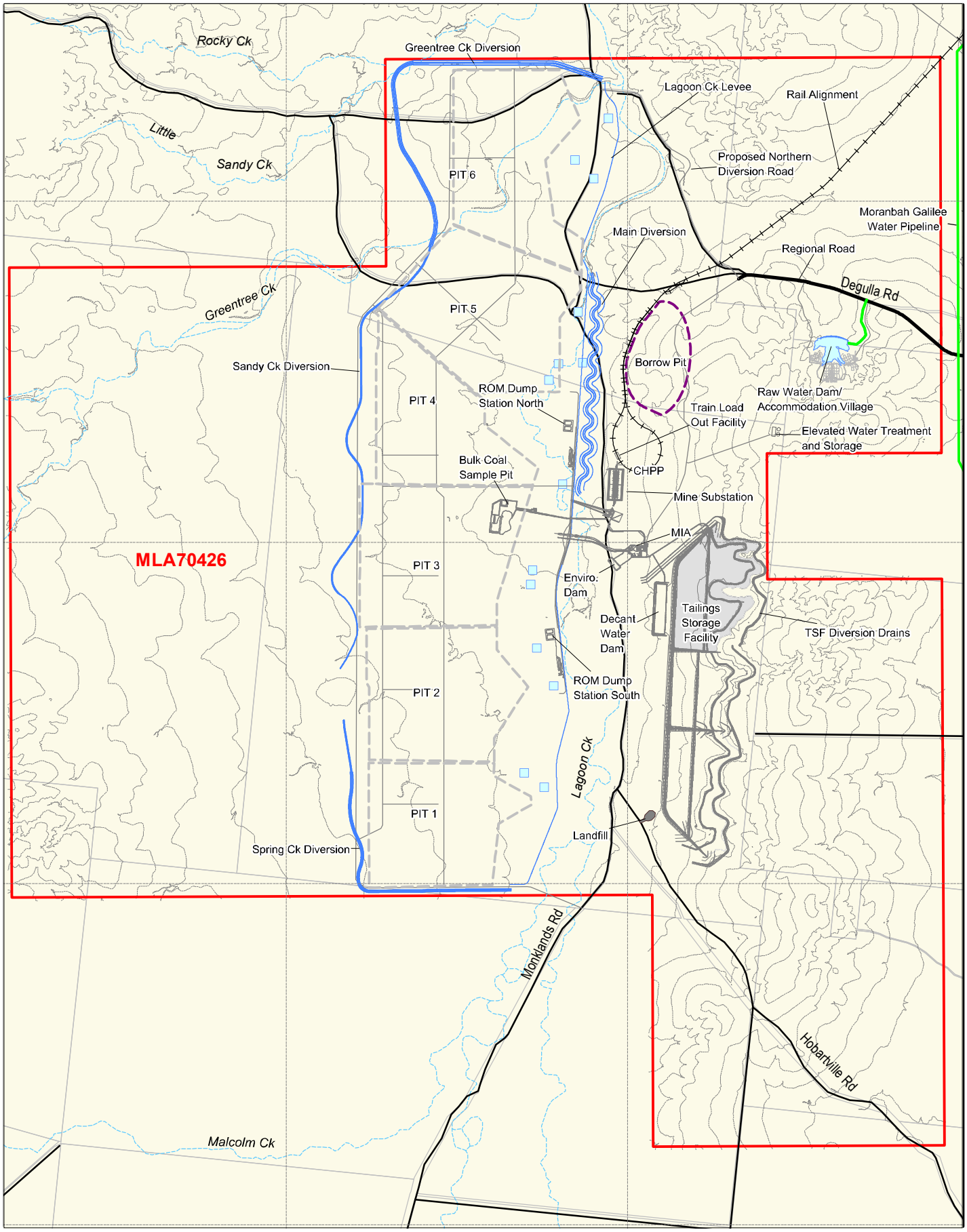
**HANCOCK PROSPECTING PTY LTD**
Alpha Coal Project
Supplementary Environmental Impact Statement

# ALPHA COAL PROJECT (MINE) PROJECT ROAD AND RAIL INFRASTRUCTURE

Job Number | 4262 6680
Revision | A
Date | 12-04-2011

Figure: V-3

File No: 42626680-g-2047.cdr




Source: See Copyright Details below and for full disclosure Please Refer to the SEIS ***Volume 2, Appendix B***

0 2 4Km

Scale 1:150,000 (A4)

Datum: GDA94, MGA Zone55

N W E S

**HANCOCK** PROSPECTING PTY LTD

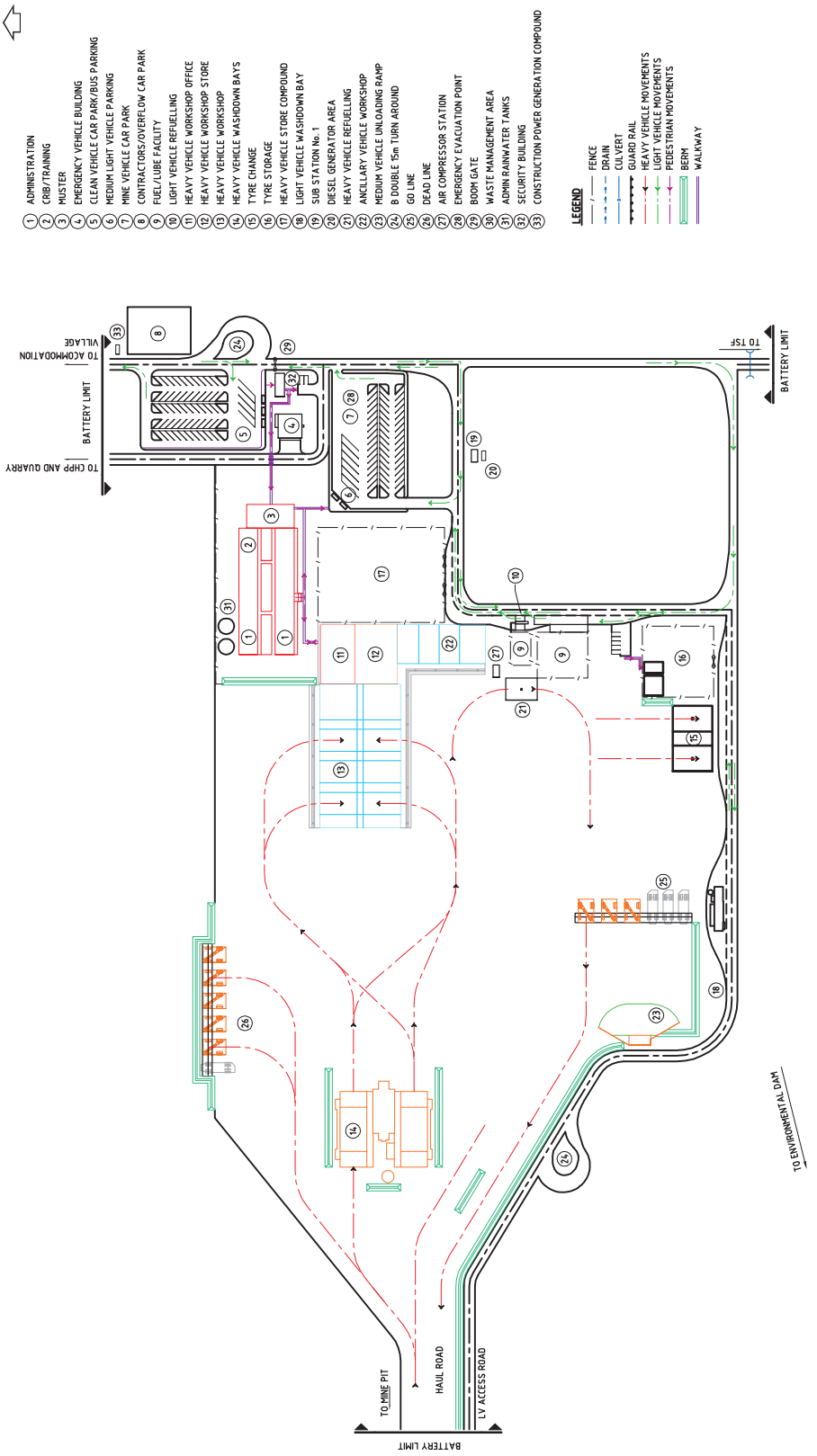
Alpha Coal Project
Supplementary Environmental Impact Statement

# ALPHA COAL PROJECT (MINE)
# PROJECT LAYOUT

| | |
|---|---|
| Job Number | 4262 6680 |
| Revision | A |
| Date | 12-04-2011 |

Figure: V-4

File No: 42626680-g-2050.wor




Source: See Copyright Details below and for full disclosure Please Refer to the SEIS ***Volume 2, Appendix B***

0 2 4Km

Scale 1:150 000 (A3)

Datum: GDA94, MGA Zone55

N W E S

**HANCOCK PROSPECTING PTY LTD**

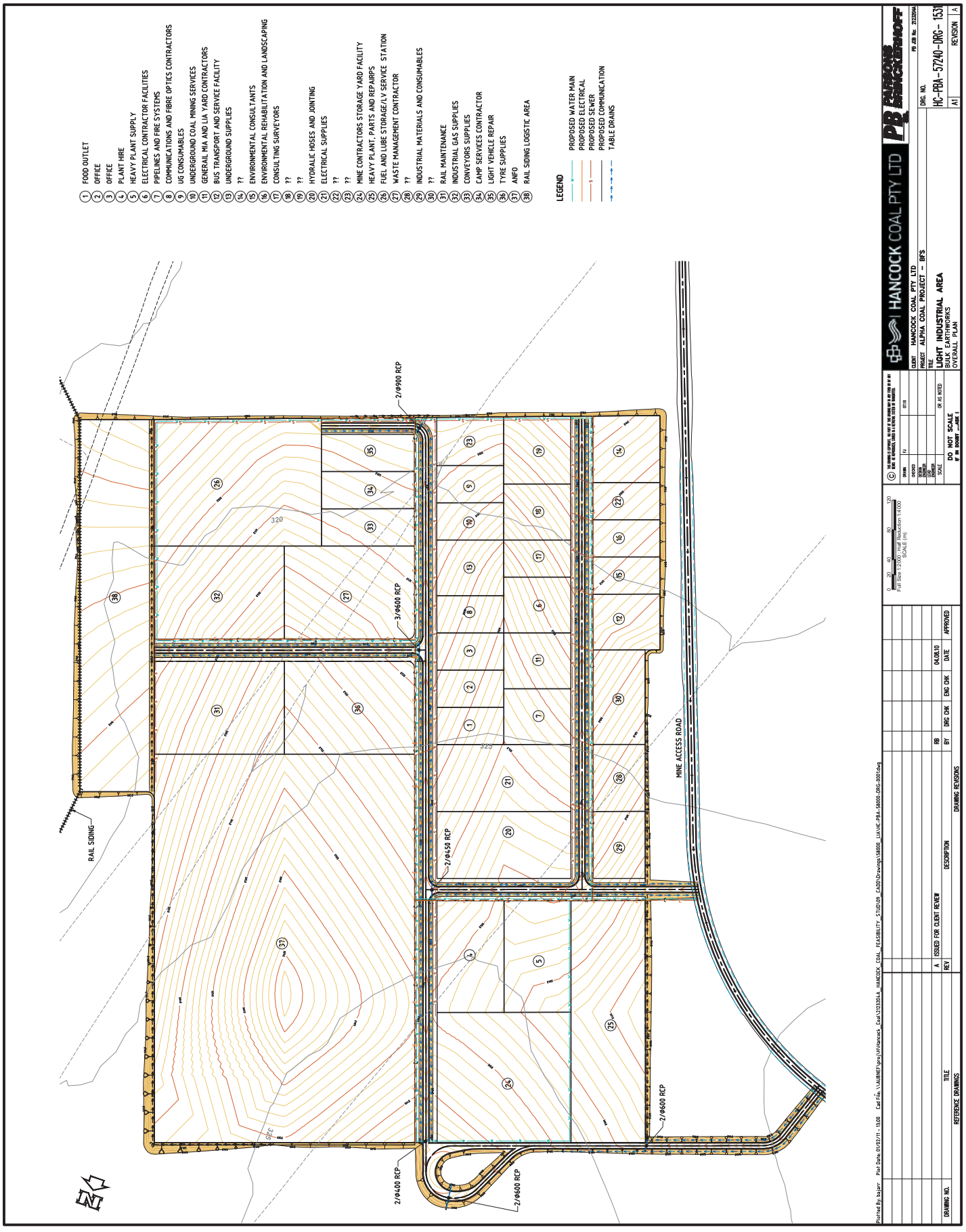
Alpha Coal Project
Supplementary Environmental Impact Statement

# ALPHA COAL PROJECT (MINE) MINE INFRASTRUCTURE AREA (MIA) BUILDING LAYOUT

Job Number 4262 6680
Revision A
Date 12-04-2011

Figure: V-5

File No: 42626680-g-2048.cdr




Source: See Copyright Details below and for full disclosure Please Refer to the SEIS ***Volume 2, Appendix B***

Datum: GDA94, MGA Zone55

HANCOCK PROSPECTING PTY LTD

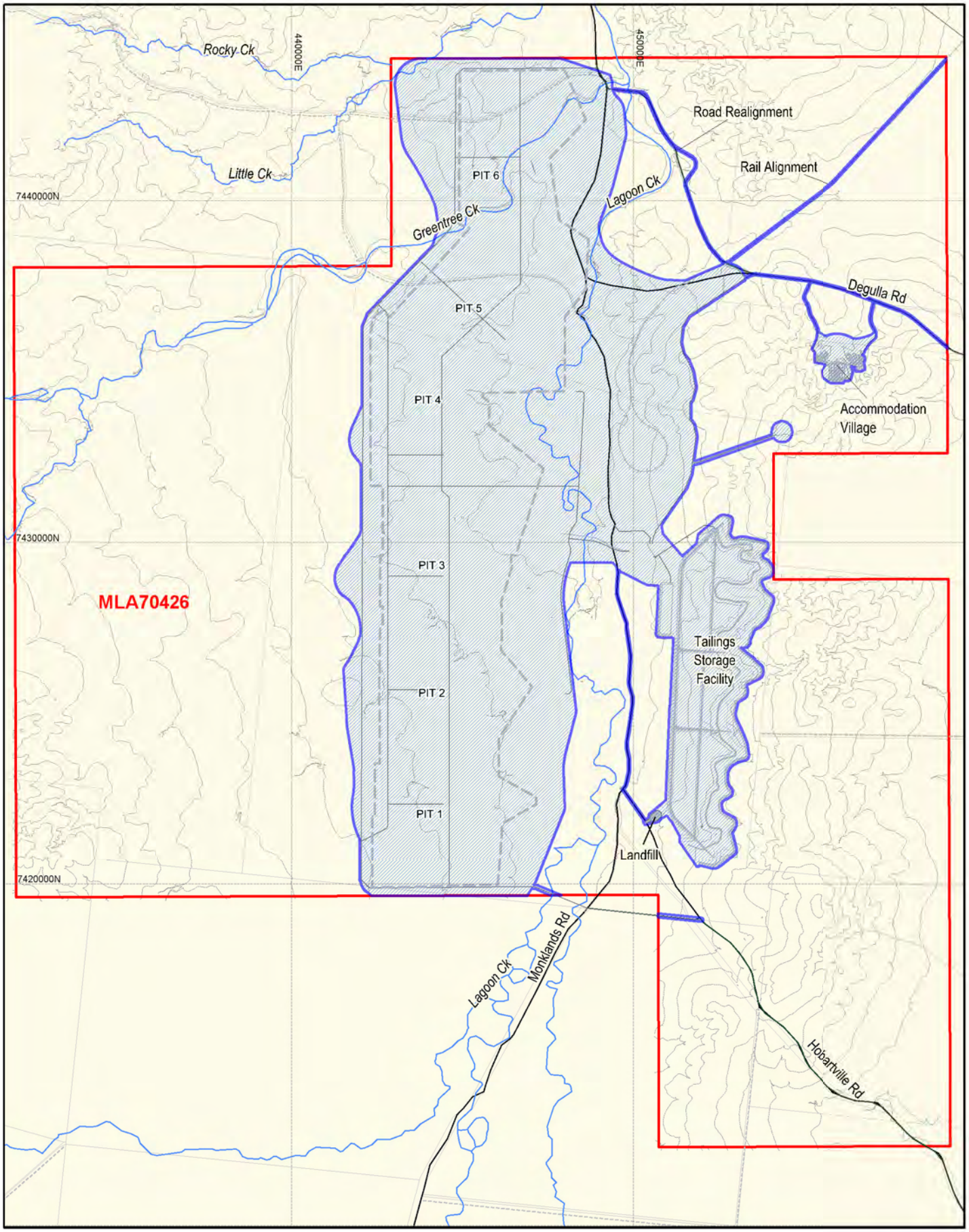
Alpha Coal Project
Supplementary Environmental Impact Statement

ALPHA COAL PROJECT (MINE)
LIGHT INDUSTRIAL AREA
(LIA) BUILDING LAYOUT

| | |
|---|---|
| Job Number | 4262 6680 |
| Revision | A |
| Date | 03-03-2011 |

Figure: V-6

File No: 42626680-g-2064.cdr




Contour (10m interval)

Pit Outline

Mining Lease Application (MLA70426) Boundary

Project Disturbance Area

Source: See Copyright Details below and for full disclosure Please Refer to the SEIS ***Volume 2, Appendix B***

0 2 4Km

Scale 1:150,000 (A4)

Datum: GDA94, MGA Zone55

N W E S

**HANCOCK** PROSPECTING PTY LTD

Alpha Coal Project
Supplementary Environmental Impact Statement

# ALPHA COAL PROJECT (MINE) DISTURBANCE AREA

Job Number | 4262 6680
Revision | A
Date | 12-04-2011

Figure: V-7

File No: 42626680-g-2049.wor

### V.1.1.1 Mine Sequencing

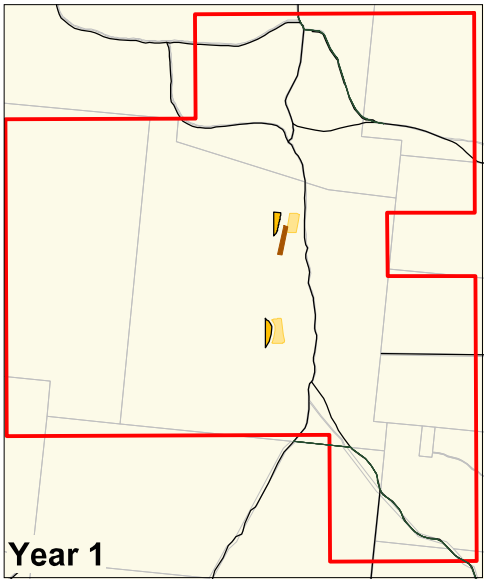
Table V-2 details the quantity of coal anticipated to be mined annually over the LOM, including the amount of product coal produced annually. The schedule highlights that the mine will be in full production by year 5 of the mine.

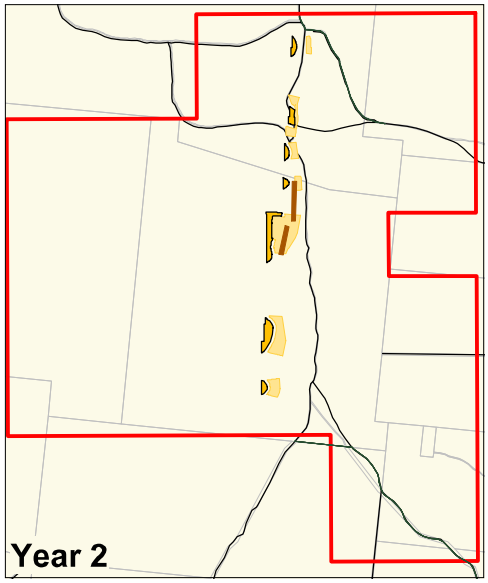
Figure V-8 and Figure V-9 are overviews of the mine sequence figures for the years 1, 2, 3, 4, 5, and 10, 15, 20, 25 and 30, respectively.

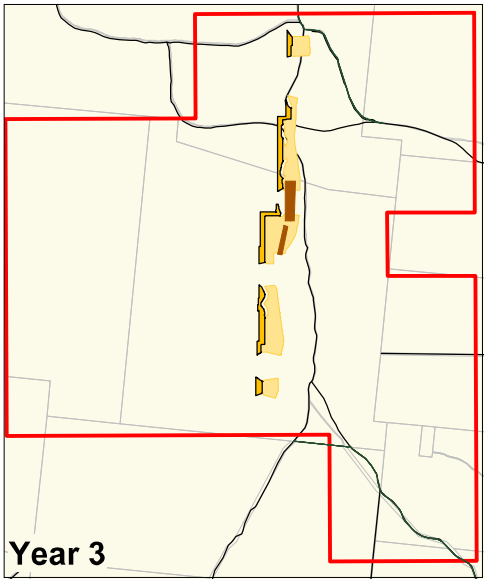
**Table V-2: Schedule of coal mined over the life of the mine**

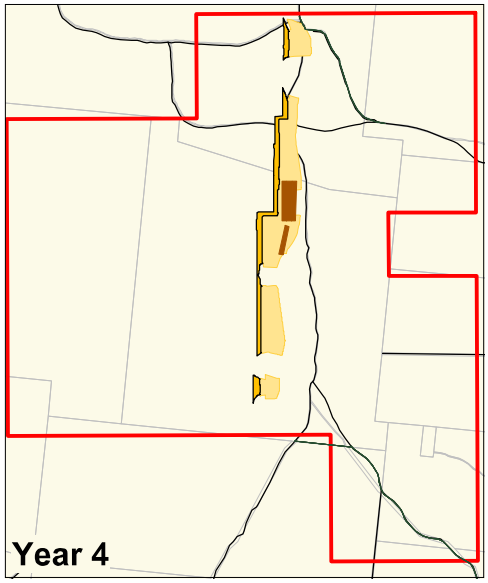
| LOM year | Prime Waste | ROM Coal | Product Coal |
|---|---|---|---|
| | Mbcm | Mt ROM | Mt Product |
| 1 | 71.6 | 4.8 | 3.8 |
| 2 | 146.9 | 16.6 | 12.0 |
| 3 | 192.3 | 25.4 | 18.1 |
| 4 | 243.5 | 35.1 | 25.0 |
| 5 | 265.6 | 43.1 | 30.0 |
| 6 | 247.7 | 43.8 | 30.0 |
| 7 | 246.7 | 44.0 | 30.1 |
| 8 | 266.3 | 45.5 | 30.1 |
| 9 | 263.1 | 45.2 | 30.0 |
| 10 | 259.2 | 44.8 | 30.0 |
| 11 | 255.5 | 45.1 | 30.0 |
| 12 | 277.0 | 45.6 | 30.0 |
| 13 | 263.1 | 45.9 | 30.0 |
| 14 | 267.9 | 45.6 | 30.0 |
| 15 | 283.4 | 45.6 | 30.0 |
| 16 | 292.4 | 45.4 | 29.9 |
| 17 | 300.6 | 45.3 | 30.0 |
| 18 | 311.8 | 45.4 | 30.0 |
| 19 | 307.4 | 45.4 | 30.0 |
| 20 | 323.3 | 45.8 | 30.1 |
| 21 | 334.0 | 46.2 | 30.1 |
| 22 | 344.3 | 46.5 | 30.0 |
| 23 | 340.1 | 46.7 | 30.0 |
| 24 | 346.3 | 46.1 | 30.0 |
| 25 | 356.0 | 46.0 | 30.0 |
| 26 | 378.2 | 45.7 | 30.1 |

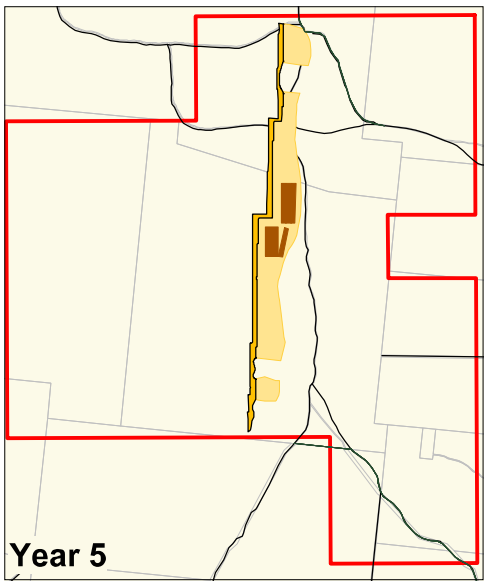
| LOM year | Prime Waste | ROM Coal | Product Coal |
|---|---|---|---|
| | Mbcm | Mt ROM | Mt Product |
| 27 | 391.9 | 46.1 | 30.1 |
| 28 | 394.4 | 46.4 | 30.1 |
| 29 | 411.9 | 46.7 | 30.1 |
| 30 | 411.8 | 46.4 | 30.0 |




Mining Lease Application (MLA704026) Boundary

Working Face and Void

Spoil Dump Area

Rejects

Source: See Copyright Details below and for full disclosure Please Refer to the EIS ***Volume 2 - Appendix B***

0 5 10Km

Scale

Datum: GDA94, MGA Zone55

N W E S

**HANCOCK** PROSPECTING PTY LTD

Alpha Coal Project

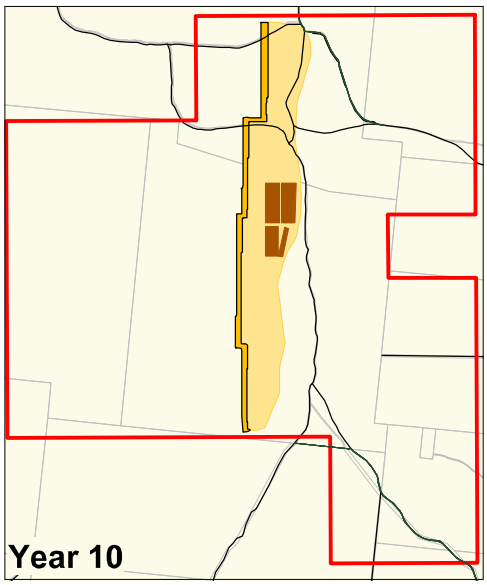
Supplementary Environmental Impact Statement

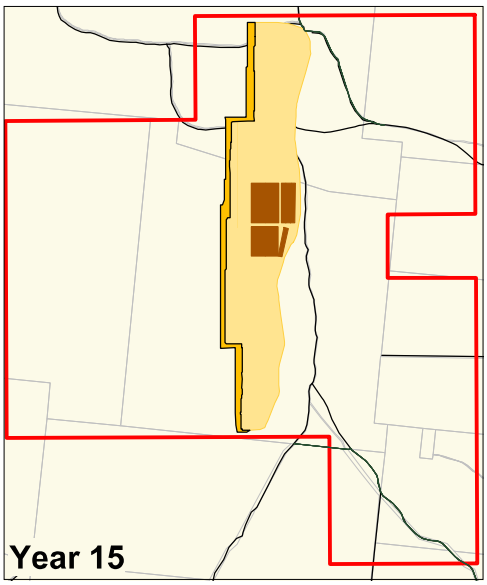
# MINING SEQUENCE OVERVIEWS YEARS ONE TO FIVE

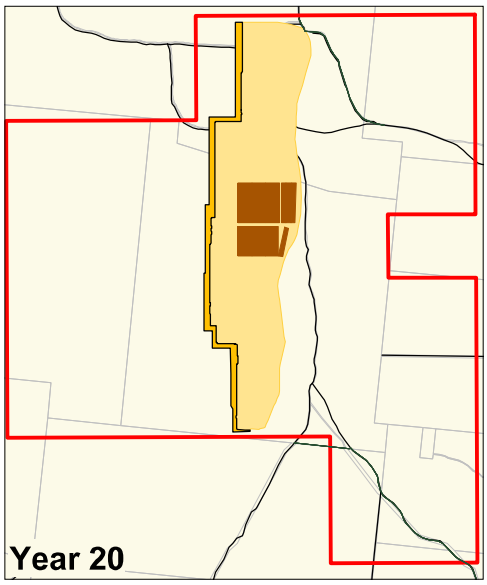
| | |
|---|---|
| Job Number | 4262 6680 |
| Revision | A |
| Date | 06-06-2011 |

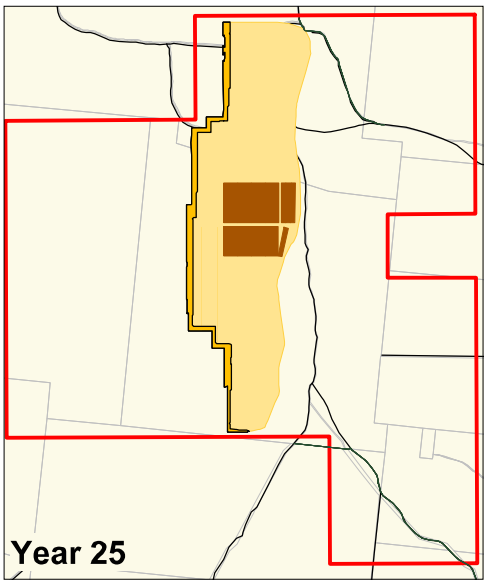
Figure: V-8

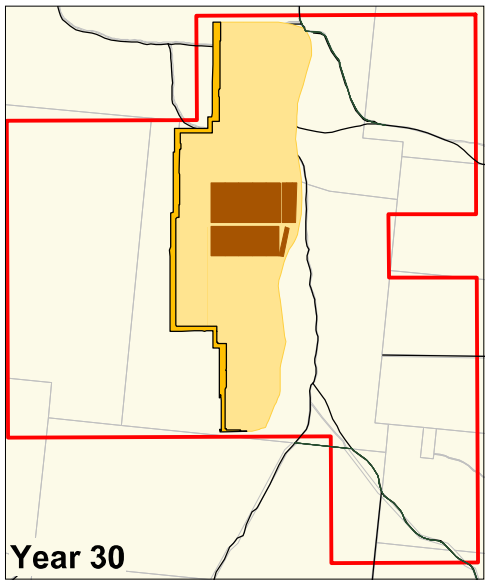
File No: 42626680-g-2068.wor




Mining Lease Application (MLA704026) Boundary
Working Face and Void
Spoil Dump Area
Rejects

Source: See Copyright Details below and for full disclosure Please Refer to the EIS ***Volume 2 - Appendix B***

0 5 10Km
Scale

Datum: GDA94, MGA Zone55

N
W E
S

**HANCOCK** PROSPECTING PTY LTD

Alpha Coal Project
Supplementary Environmental Impact Statement

# MINING SEQUENCE OVERVIEWS YEARS TEN TO THIRTY

| | |
|---|---|
| Job Number | 4262 6680 |
| Revision | A |
| Date | 06-06-2011 |

Figure: V-9

File No: 42626680-g-2068.wor

### V.1.2 Project Proponent

The Proponent is an Australian company that has been engaged in the exploration and development of mineral resources for over 50 years. The Proponent's mineral exploration capability covers; iron ore, thermal coal, uranium, molybdenum, lead / zinc, gold, diamonds and petroleum.

The pioneering spirit of Hancock that led the development of the Pilbara region in Western Australia is now being directed to the vast potential of the Galilee Basin in Queensland with HCPL and the Alpha Coal Project (Mine). HCPL, a subsidiary of HPPL has a long-standing interest in the development of the Galilee Basin, with the parent company having held coal exploration permits and investigated the Alpha region since the 1970s.

### V.1.3 Land Use and Tenure

Existing land uses across the MLA include the following:

- Bushland;
- Cattle grazing;
- Coal exploration;
- Transmission lines;
- Roads;
- Two homesteads; and
- Farming infrastructure (various access tracks, fences, stockyards and sheds).

The dominant land use within the boundaries of MLA 70426 is cattle grazing. The Project area contains landscape that has been cleared and maintained for grazing together with remnant mid height woodland dominated by Boxwood and Ironbark. Land cover within the Project area is principally a combination of open forest and woodland with areas of open improved grazing pasture. Several isolated areas have been previously cropped for fodder species to supplement grazing on native and introduced pastures.

Two homesteads, Hobartville and Wendouree, are located within the Project area. These homesteads will be purchased subject to the Project proceeding. They will either be removed, relocated or uninhabited during the operational life of the Project.

There are several ephemeral creeks and surface water dams located on the Project site. These creeks and dams provide habitat, movement corridors and water for terrestrial fauna species within the Project site. The dams provide a water source for livestock and other terrestrial fauna and migratory birds, especially when the creeks are dried.

Land tenure underlying the Project site and within the surrounding areas is illustrated in Figure V-2 and details of properties MLA 70426 span are provided Table V-3 below.

**Table V-3 Property Tenure**

| Property name | Cadastre |
|---|---|
| 'Wendouree' | Lot 4994 PH2232 |
| 'Surbiton South' | Lot 3533 PH56 |
| 'Hobartville' | Lot 649 PH1981 |
| 'Burtle' | Lot 1 BF 58 |
| | Lot 2 BF 46 |
| | Lot 6 BF 46 |
| Reserve | Lot 1 CP860083 |
| 'Tresillian' | Lot 3 CP860083 |
| 'Mentmore' | Lot 4 BF 50 |
| 'Monklands' | Lot 2 SP136836 |
| 'Kia Ora ' | Lot 1 BF 72 |
| 'Spring Creek' | Lot 11 BF 25 |

### V.1.4 Stakeholders

The Proponent is undertaking an extensive program of community consultation and stakeholder engagement relating to the Alpha Coal Project (Mine), which aims to identify community issues or concerns, to ensure the Proponent can be responsive in mitigating issues where possible. The Proponent is also proactively working with stakeholders with the aim to establish long-term relationships between the Proponent and the affected Queensland communities.

To date key stakeholders include, but are not limited to, the following:

- Local education centres including; day cares, kindergartens, schools, TAFE, colleges and universities;
- Local Councils; Barcaldine Regional Council, Central Highlands Regional Council, Isaac Regional Council, Longreach Regional Council, Mackay Regional Council, Whitsunday Regional Council;
- Emergency services; Police, Ambulance, Fire and Rescue;
- Landowners;
- Community members;
- Community organisations such as; sporting associations, rotary, historical groups, aged groups, theatre, arts, show societies, Lifeline, Anglicare, scouts and girl guides;
- Transport organisations;
- Queensland (QLD) Health;
- QLD Aboriginal & Islander Health;
- QLD Social Welfare;
- QLD Dept Water & Waste Management;
- QLD Roads and Highways;
- Qld Resources Council;

- Non Government Organisations (NGOs);
- Indigenous groups;
- Government agencies including DIP, DERM, DTMR, DEEDI, and SEWPaC; and
- Business owners and related service providers.

### V.1.5 Standard Environmental Conditions

The mining activity will be subject to the conditions of an Environmental Authority (EA) (mining activities) and the conditions of a Mining Lease (ML).

## V.2 Project Description

The development of the Alpha Coal Project (Mine) involves the open cut mining of 30 Mtpa of product thermal coal within the Galilee Basin. The coal mine will be supported by privately owned and operated rail and port infrastructure facilities for the transport and delivery of export coal.

The proposed Alpha Coal Project (Mine) involves two key components, the mine and the CHPP and associated mine infrastructure outlined below.

### V.2.1 Coal Mine

The mine will be a new open cut thermal coal mine located within MLA 70426. MLA 70426 is over Exploration Permit Coal (EPC) 1210 and Mineral Development Licenses (MDL) 333 and 258. The mine is proposed to produce 30 Mtpa of thermal coal across the scheduled 30 year life of mine (LOM), however there may be sufficient Joint Ore Reserves Committee (JORC) resources to potentially extend the Project life beyond 30 years.

The Project consists of six open cut pits (totalling approximately 24 km in total strike length) in a north to south direction along the centre of MLA 70426. The overburden will be removed by truck and shovel, dragline and in-pit crush and convey (IPCC) methods. The overburden will be initially stockpiled in out-of-pit spoil emplacement areas and then used to backfill the open cut pits. The coal will be mined by excavators and transported by truck operations. Raw coal will pass through one of two ROM facilities where it will be reduced in size for further processing at the CHPP.

Activities with the potential to release contaminants to the environment are considered Environmentally Relevant Activities (ERAs). ERAs are defined in schedule 2 of the Environmental Protection Regulation 2008. As part of the approval process of the mine, ERAs will have to be applied for through the DERM or local government depending on which authority is the administrator. Table V-4 below presents the ERAs that will be applicable to the Alpha Coal Mining proposed activities.

**Table V-4 Identified ERAs applicable to the Alpha Coal Mine**

| ERA Number | ERA Name | Description |
|---|---|---|
| 8 | Chemical Storage | (1) Chemical storage (the relevant activity) consists of storing—<br>(a) 50t or more of chemicals of dangerous goods class 1 or class 2, division 2.3 in containers of at least 10m3; or<br>(b) 50t or more of chemicals of dangerous goods class 6, division 6.1 in containers capable of holding at least 900kg of the chemicals; or<br>(c) 10m3 or more of chemicals of class C1 or C2 combustible liquids under AS 1940 or dangerous goods class 3; or<br>(d) the following quantities of other chemicals in containers of at least 10m3—<br>(i) 200t or more, if they are solids or gases;<br>(ii) 200m3 or more, if they are liquids.<br>(2) The relevant activity does not include—<br>(a) in-transit storage of chemicals; or<br>(b) storing chemicals for carrying out an activity under section 7; or<br>(c) transporting petroleum under the Petroleum Act 1923 or<br>the Petroleum and Gas (Production and Safety) Act 2004; or<br>(d) carrying out an activity to which section 55, 56, 57 or 58 applies. |
| 15 | Fuel burning | (1) Fuel burning (the relevant activity) consists of using fuel burning equipment that is capable of burning at least 500kg of fuel in an hour.<br>(2) The relevant activity does not include burning fuel for—<br>(a) carrying out an activity to which another section applies or would apply if it were carried out within a stated threshold under that section; or<br>(b) operating a stand-by generator for fewer than 200 hours in a year; or<br>(c) operating mobile equipment to respond, or for training to respond, to an emergency. |
| 16 | Extractive and screening activities | (1) Extractive and screening activities (the *relevant activity*) consists of any of the following—<br>(a) dredging a total of 1000t or more of material from the bed of naturally occurring surface waters, in a year;<br>(b) extracting, other than by dredging, material from a wild river area;<br>(c) extracting, other than by dredging, a total of 5000t or more of material, in a year, from an area other than a wild river area;<br>*Examples—*<br>extracting material for excavating a bund between existing waters and an artificial waterway being constructed on dry |

| ERA Number | ERA Name | Description |
|---|---|---|
| | | land<br>extracting virgin rock from a quarry<br>extracting rock, that has been previously broken, from a stockpile on the site from which the rock was originally extracted<br>(d) screening 50t or more of material, in a year, in a wild river area;<br>(e) screening 5000t or more of material, in a year, other than in a wild river area.<br>(2) The relevant activity does not include—<br>(a) extracting material under an environmental authority (chapter 5A activities) or environmental authority (mining activities); or<br>(b) extracting material from a wild river area if—<br>(i) the primary purpose of extracting the material is not to gain the material; and<br>(ii) no more than 1500m3 of materials is extracted or the surface area from which the material is extracted is less than 5200m2; or<br>(c) extracting material from a road reserve in a wild river area if—<br>(i) the material is to be used for constructing or maintaining a road; and<br>(ii) no more than 5000t of material is extracted in the relevant year; or<br>(d) extracting material from a road reserve, other than in a wild river area, if—<br>(i) the material is to be used for constructing or maintaining a road; and<br>(ii) the surface area from which the material is extracted is less than 10000m2; or<br>(e) extracting material from a place for constructing a road or railway at the place; or<br>*Examples—*<br>cutting and filling land for constructing a road or railway<br>extracting material for constructing a tunnel for a road or railway<br>(f) extracting material from a place, other than by dredging, for constructing the foundations of a building at the place; or<br>(g) extracting material for reshaping land if—<br>(i) reshaping the land does not involve blasting; and<br>(ii) the material is not removed from the site from which it is extracted; or<br>*Example—*<br>cutting and filling land for creating building lots<br>(h) screening material on the site from which it has been extracted in the course of carrying out an activity mentioned in paragraphs (a) to (g). |

| ERA Number | ERA Name | Description |
|---|---|---|
| 18 | Boilermaking or engineering | (1) Boilermaking or engineering (the *relevant activity*) consists of boilermaking, assembling, building or manufacturing a total of 200t or more of metal product in a year.<br>*metal product* includes agricultural equipment, electrical machines, heavy machinery, motor vehicles, trains and trams. |
| 31 | Mineral processing | (1) Mineral processing (the *relevant activity*) consists of processing, in a year, a total of 1000t or more of coke or mineral products.<br>(2) In the following table, the aggregate environmental score for the relevant activity is the score stated opposite the threshold within which the relevant activity is carried out. |
| 33 | Crushing, milling, grinding or screening | (1) Crushing, milling, grinding or screening (the ***relevant activity***) consists of crushing, grinding, milling or screening more than 5000t of material in a year.<br>(2) The activity includes crushing waste, other than putrescibles waste, to extract resources for reuse or recycling.<br>(3) The relevant activity does not include—<br>(a) crushing, grinding, milling or screening—<br>(i) grain crops; or<br>(ii) other agricultural products on a farm for use on the farm; or<br>(b) an activity to which section 16, 55 or 61 would apply, if the activity were carried out within a stated threshold under that section. |
| 38 | Surface coating | (1) Surface coating (the *relevant activity*) consists of using, in a year, 1t or more of surface coating materials for—<br>(a) anodising, electroplating, enamelling or galvanizing; or<br>(b) coating or painting or powder coating.<br>(2) The relevant activity does not include—<br>(a) coating a surface using only a paintbrush, roller or sponge; or<br>(b) coating or painting for marking pavements or roads; or<br>(c) coating a surface in association with carrying out an activity to which section 17, 21, 48, 49 or 54 applies. |
| 43 | Concrete batching | (1) Concrete batching consists of producing 200t or more of concrete or concrete products in a year, by mixing cement with sand, rock, aggregate or other similar materials. |

| ERA Number | ERA Name | Description |
|---|---|---|
| 60 | Waste disposal | (1) Waste disposal (the *relevant activity*) consists of only 1 of the following—<br>(a) operating a facility for disposing of—<br>(i) only regulated waste; or<br>(ii) regulated waste and any, or any combination, of the following—<br>(A) general waste;<br>(B) limited regulated waste;<br>(C) if the facility is in a scheduled area—no more than 5t of untreated clinical waste in a year;<br>(b) operating a facility for disposing of, in a year, 50t or more of waste consisting of—<br>(i) only general waste; or<br>(ii) general waste and either, or a combination, of the following—<br>(A) a quantity of limited regulated waste that is no more than 10% of the total amount of waste received at the facility in a year;<br>(B) if the facility is in a scheduled area—no more than 5t of untreated clinical waste.<br>(2) The relevant activity does not include using clean earthen material as fill. |
| 63 | Sewage treatment | Sewage treatment (the *relevant activity*) consists of—<br>(a) operating 1 or more sewage treatment works at a site that have a total daily peak design capacity of at least 21EP; or<br>(b) operating a sewage pumping station with a total design capacity of more than 40KL in an hour, if the operation of the pumping station is not an essential part of the operation of sewage treatment works to which paragraph (a) applies.<br>(2) The relevant activity does not include—<br>(a) carrying out works, other than operating a sewage pumping station mentioned in subsection (1)(b), involving only infrastructure for the collection of sewage, including for example, pipes; or<br>(b) carrying out works involving either of the following—<br>(i) operating or maintaining composting toilets;<br>(ii) treating or recycling greywater. |

| ERA Number | ERA Name | Description |
|---|---|---|
| 64 | Water treatment | (1) Water treatment (the *relevant activity*) consists of carrying out any of the following activities in a way that allows waste, whether treated or untreated, to be released into the environment—<br>(a) desalinating 0.5ML or more of water in a day;<br>(b) treating 10ML or more of raw water in a day;<br>(c) carrying out advanced treatment of 5ML or more of water in a day.<br>(2) The relevant activity does not include—<br>(a) treating water in a way that allows liquid or solid waste to be released only to the following—<br>(i) a local government's sewerage infrastructure;<br>(ii) a facility mentioned in section 56, 58, 60 or 61; or<br>(b) treating water if the only treatment is disinfection or fluoridation; or<br>(c) treating water in association with carrying out an activity to which section 55, 56, 60, 61 or 63 applies. |

## V.2.2 CHPP and Mine Infrastructure

### V.2.2.1 Coal Handling and Preparation Plant and Mine Infrastructure

Sized raw coal will be transferred from the ROM facilities via conveyors to the multi-module CHPP, where it will be washed. All coal mined and placed through the ROMs will be processed to produce a 9.5% ash export thermal product. A tailings storage facility (TSF) is required for the fine rejects (referred to as tailings) for approximately the first five years of operation after which an in-pit option is being explored. The coarse rejects from the CHPP will be placed in designated locations within the open cut pit (as backfill).

The mine infrastructure will include:

- Main workshop; stores; administration buildings, security building, emergency services building; tyre bay; ancillary mining vehicle workshop; and vehicle wash facilities;
- A Light Industrial Area (LIA) incorporating mine support activities such as, rail freight unloading and bunkering, welding shops, light vehicle servicing, specialist maintenance contractors' workshops and offices, warehousing, bulk fuel and other mine consumables storage, tyre fitting and repair, training and conference centres;
- TLO facility and rail loop;
- Raw water dams and environment dams;
- Construction accommodation village and operational accommodation village;
- Mine access roads;
- General waste landfill;
- Quarry/borrow pits;
- Fuel, oil, and explosives storage facilities;
- Creek diversions, drainage channels and levee bunds;

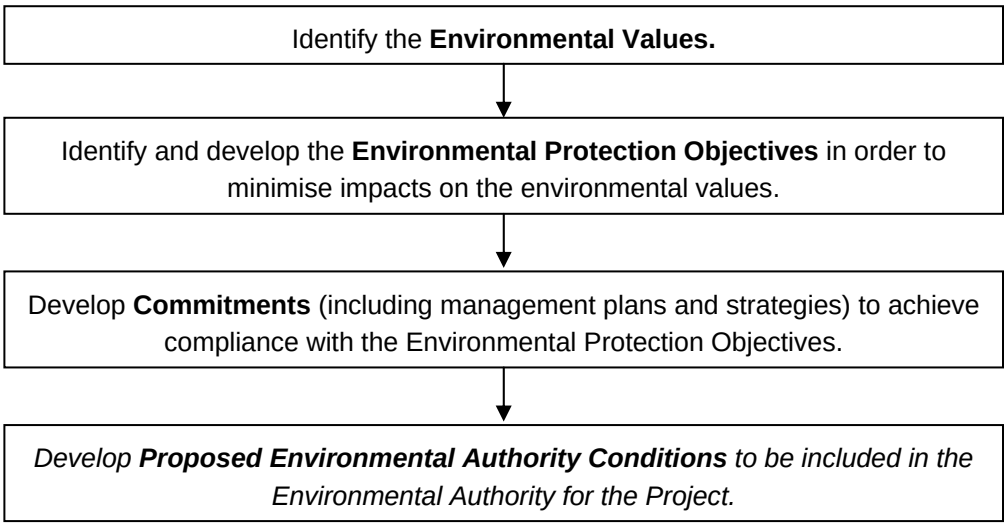
- Water and wastewater systems;
- Water treatment plant and sewage treatment plant;
- Electrical systems;
- Communications systems;
- Conveyors; and
- Stockpile areas.

Figure V-4 above shows the location of all the above key components of the Project, including the six open cut pits.

## V.3 Environmental Values, Impacts, Commitments, and Draft Conditions

### V.3.1 Content of the Section

This EM Plan was compiled by following the process outlined in the Guidelines published by DERM. This process is shown below.




The guiding definitions for the terms that are used throughout the EM Plan are as follows:

**Environmental Values**: *Section 9* of the EP Act describes an Environmental Value as:

1. *a quality or physical characteristic of the environment that is conducive to ecological health or public amenity or safety; or*
2. *another quality of the environment identified and declared to be an environmental value under an environmental protection policy or regulation."*

**Environmental Protection Objectives:** Describe the key elements of the environment and the outcomes to be protected in order to minimise impacts on the environmental values.

**Control Strategies:** Provide a contextual framework for the proposed Environmental Authority conditions and describe the strategies proposed to meet the environmental protection objectives.

**Proposed Environmental Authority Conditions:** These are draft conditions containing measurable indicators and standards that are proposed to be included in the Environmental Authority to protect identified environmental values that may be impacted on by the Project.

**Indicators:** These are the indicators by which the level of achievement of the environmental protection objectives can be determined, in a measurable and auditable way.

**Standards:** These are numerical standards for each of the indicators by which adequate levels of achievement of the environmental protection objectives and protection of the environmental values can be determined.

Words and phrases used throughout this EM Plan are defined in Section 5, Definitions, except where identified in the EP Act or subordinate legislation. Where a word or term is not defined, the ordinary English meaning applies, and regard should be given to the Macquarie Dictionary.

## V.3.2 General Conditions

There are a number of general issues that do not relate to environmental values or control strategies, but are to be included in the Environmental Authority. Conditions of the Environmental Authority are proposed here for '*Schedule A – General Conditions'*.

### V.3.2.1 Proposed Environmental Authority Conditions:

Schedule A – General Conditions

**Department Interest: General Environment**

**A1 Financial assurance**

Provide a financial assurance in the amount and form required by the administering authority prior to the commencement of activities proposed under this environmental authority.

Note: The calculation of financial assurance for condition (A1) must be in accordance with Guideline 17 and may include a performance discount. The amount is defined as the maximum total rehabilitation cost for complete rehabilitation of all disturbed areas, which may vary on an annual basis due to progressive rehabilitation. The amount required for the financial assurance must be the highest Total Rehabilitation Cost calculated for any year of the Plan of Operations and calculated using the formula: (Financial Assurance = Highest Total Annual Rehabilitation Cost x Percentage Required)

**A2** The financial assurance is to remain in force until the administering authority is satisfied that no claim on the assurance is likely.

*Note: Where progressive rehabilitation is completed and acceptable to the administering authority, progressive reductions to the amount of financial assurance will be applicable where rehabilitation has been completed in accordance with the acceptance criteria defined within this environmental authority.*

**A3 Maintenance of measures, plant and equipment**

The environmental authority holder must ensure that:

a) All measures, plant and equipment necessary to ensure compliance with the conditions of this environmental authority are installed;

b) Such measures, plant and equipment are maintained in a proper condition; and

c) Such measures, plant and equipment are operated in a proper manner.

**A4 Monitoring**

Record, compile and keep for a minimum of five years all monitoring results required by this environmental authority and make available for inspection all or any of these records upon request by the administering authority.

**A5** Where monitoring is a requirement of this environmental authority, ensure that a competent person(s) conducts all monitoring.

**A6 Storage and handling of flammable and combustible materials**

Spillage of all flammable and combustible liquids must be contained within an on-site containment system and controlled in a manner that prevents environmental harm (other than trivial harm) and maintained in accordance with Section 5.8 of *AS 1940—Storage and Handling of Flammable and Combustible Liquids of 2004*.

**A7 Definitions**

Words and phrases used throughout the environmental authority are defined on P5 Definitions, within this document. Where a definition for a term used in the environmental authority is sought and the term is not defined within the environmental authority, the definitions in the *Environmental Protection Act 1994*, its Regulations and Environmental Protection Policies must be used.

**A8 Notification of emergencies, incidents and exceptions**

All reasonable actions are to be taken to minimise environmental harm, or the risk thereof, resulting from any emergency, incident or circumstances not in accordance with the conditions of this environmental authority.

**A9** As soon as practicable after becoming aware of any emergency, incident or information about circumstances which result or may result in environmental harm not in accordance with the conditions of this environmental authority, the administering authority must be notified in writing.

**A10** Not more than ten (10) business days following the initial notification of an emergency, incident or information about circumstances which result or may result in environmental harm, written advice must be provided to the administering authority in relation to:

a) Proposed actions to prevent a recurrence of the emergency or incident;

b) The outcomes of actions taken at the time to prevent or minimise environmental harm; and

c) Proposed actions to respond to the information about circumstances which result or may result in environmental harm.

**A11** As soon as practicable, but not more than six (6) weeks following the conduct of any environmental monitoring performed in relation to the emergency or incident, which results in the release of contaminants not in accordance, or reasonably expected to be not in accordance with the conditions of this environmental authority, written advice must be provided of the results of any such monitoring performed to the administering authority.

## V.3.3 Air Quality

### V.3.3.1 Background

Emissions from the Alpha Coal Project (Mine) are generated primarily from activities that move overburden and coal. The dust emissions from mine-related activities include total suspended particulates (TSP), particulate matter less than 10 micrometres (µm) in diameter ($PM_{10}$), particulate matter less than 2.5 µm in diameter ($PM_{2.5}$), and dust deposition.

Emissions to atmosphere that result from the combustion of diesel fuel include nitrogen dioxide, $PM_{10}$, $PM_{2.5}$, sulphur dioxide, and trace quantities of volatile organic compounds. Impacts from mobile equipment as a result of the Alpha Coal Project (Mine) are limited as:

- Large volumes of traffic (greater than 10,000 vehicles per day) are required to impact local air quality[1]; and
- Emissions from tailpipes only impact ambient air quality within 200 m of the road centreline[2].

Due to the scale of estimated on site vehicle use, and the proximity of the sensitive receptors to the Project vehicular emissions are not considered to be emitted in sufficient quantities to significantly impact on air quality at sensitive receptor locations.

The region surrounding the Alpha Coal Project (Mine) is predominantly rural in character supporting cattle grazing. Dust emission sources in the surrounding region will generally consist of activities such as cultivation, harvesting, mustering and other stock movements or farming related transport.

The prevailing wind direction is from the east through to northeast. The wind speed reaches a maximum of 6.6 metres per second (m/s) from the east, with an average wind speed of 2.6 m/s. The site is characterised by occasional light winds from the southeast and very infrequent winds from the west. Sensitive receptors near the project site comprise homesteads to the north, east and south of the mine (Figure V-8).

Due to the absence of site-specific data, estimates of background levels of dust used in the assessment of the Ensham Central Project EIS have been adopted for particulate matter concentrations. Site-specific dust deposition monitoring (data provided by the Proponent) was conducted at four locations during 2009, with measurements being adopted as background levels as shown in Table V-5 below.

[1] Environmental Protection UK, 2010. 'Development Control: Planning for Air Quality (2010 Update)'. Available online at http://www.environmental-protection.org.uk/assets/library/documents/Air_Quality_Guidance_2010_(final2).pdf. Last accessed 12/04/11

[2] Highways Agency, 2007. 'Design Manual for Roads and Bridges – Environmental Assessment – Environmental Assessment Techniques – Air Quality'. V11 S3 Part 1. Available online at http://www.dft.gov.uk/ha/standards/dmrb/vol11/section3/ha20707.pdf. Last accessed 12/04/11

Table V-5 Background Particulate Levels

| (1) Air Quality Indicator | (2) Averaging Period | (3) Background Level | (4) Source |
|---|---|---|---|
| TSP | Annual | 28 µg/m$^3$ | Ensham Central Project EIS |
| $PM_{10}$ | 24-hour | 27 µg/m$^3$ | Ensham Central Project EIS |
| $PM_{2.5}$ | 24-hour | 5.4 µg/m$^3$ | Ensham Central Project EIS |
| | Annual | 2.8 µg/m$^3$ | Ensham Central Project EIS |
| Dust Deposition | Monthly | 68 mg/m$^2$/day | Proponent |

### V.3.3.2 Environmental Value

The environmental values of the air environment to be enhanced or protected are:

- The qualities that make the air environment suitable for the life, health and wellbeing of humans; and
- The aesthetic environment.

### V.3.3.3 Potential Impacts on the Environmental Value

Potential impacts of dust emissions in the air as a result of mining activities include;

- Health impacts from particulate matter; and
- Impacts on amenity.

Dust emission sources associated with the Alpha Coal Project (Mine) include (but may not be limited to):

- Construction Phase:
- Clearing of vegetation;
- Infrastructure construction (processing area, haul roads etc);
- Topsoil disturbance and removal;
- Transport of materials to site; and
- Onsite quarrying activities.
- Operational Phase:
- Graders;
- Scrapers;
- Dozers operating on overburden, interburden and coal;
- Blasting;
- In-pit crushing and conveying (IPCC);
- Front end loading (FEL) of material to trucks;
- Excavators and shovels;
- Truck dumping of material;

- Loading and unloading of stockpiles;
- Draglines;
- Transport of material (overburden, coal, rejects);
- Conveying of coal to ROM and CHPP;
- Wind erosion from the product stockpiling area, exposed surfaces and tailings dam;
- The train load-out;
- Rehabilitation; and
- Transfer points.

#### V.3.3.3.1 Potential health impacts from particulate matter

Ground-level concentrations of TSP, $PM_{10}$, $PM_{2.5}$ and dust deposition, as a result of mine operations, have been predicted at each of the nine off-site receptor locations as well as for the proposed on-site accommodation village. The assessment has been completed for dust emissions associated with mining activities at these receptor locations for six years of the mine life (years 5, 10, 15, 20, 25, 30).

The results of the dispersion modelling indicate that air quality at location of receptors 8 and 9 located to the south of the mine lease, will be most affected by dust emissions from the site. The air quality impacts predicted by the dispersion model can only be validated by comparing predicted concentrations against observational data which is currently unavailable.

The results of the dispersion modelling indicate that:

- Emissions of dust from the Alpha Coal Project (Mine) (excluding ambient background dust sources) are predicted to result in elevated levels of particulate matter that exceed the EPP (Air) objective of 50 µg/m3 for the 24-hour average ground-level concentration of PM10 at receptor locations 1, 4, 8, 9, and 12. The frequency of days that exceed the criteria are predicted to range between 5% and 40% of all days in the year at these locations with receptors to the south of the mine site (receptor 8 and receptor 9) and those to the north (receptor 1) most affected.
- During the life of the mine, the ground-level concentration of PM2.5 is predicted to exceed the EPP (Air) objective of 25 µg/m3 for the 24-hour average ground-level concentration at receptors 1, 4, 8, 9 and 12. The annual average concentration of PM2.5 is not predicted to exceed the EPP (Air) objective of 8 µg/m3 at any sensitive receptor location with the exception of Receptor 8, and Receptor 9 in year five.
- With the exception of receptor 8, ground-level concentrations of TSP are not predicted to exceed the EPP (Air) objective of 90 µg/m3 for the annual average at any sensitive receptor location.
- Ground-level concentrations of dust deposition are not predicted to exceed the relevant mine goals at any of the receptor locations included in the dispersion modelling.

Mitigation measures for the Alpha Coal Project (Mine) have been proposed and are provided in Section V.3.3.7. Several of these measures have been incorporated into the air quality modelling, such as the engineering controls and dust suppression measures, which are predicted to reduce the impacts from the site. Other measures may need to be implemented during Project operation, such as best practice operational procedures and the rehabilitation strategy.

The proposed ambient operational monitoring programme will be used to assess compliance against the Project goals and the effectiveness of the proposed control measures.

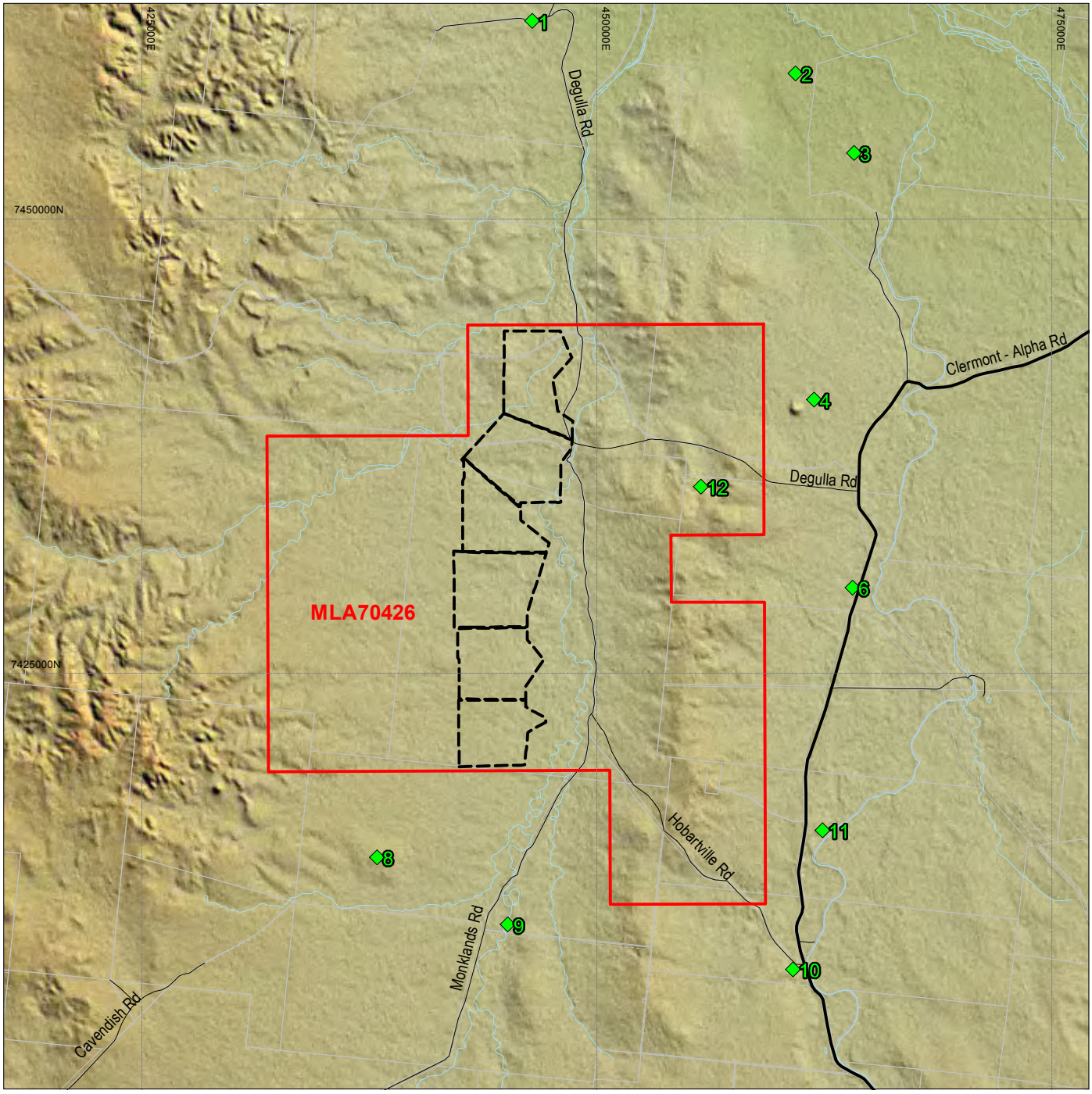
### V.3.3.3.2 Potential amenity impacts

Amenity impacts from dust are usually associated with coarse particles and particles larger than $PM_{10}$. The impact of dust from a nearby mine on local amenity depends on the distance from the mine site and climatic conditions such as wind (NSW, Department of Health).

Concerns about amenity from mine site dust often relate to "visibility" of dust plumes and dust sources. Visible dust is usually due to short-term episodes of high emissions, such as from blasting.

Other amenity impacts include dust depositing on fabrics (such as washing) or on house roofs, and the transport of dust from roofs to water tanks, during rain.

Dust deposition impacts from the Project are predicted to be within the Project air quality goal of 4 $g/m^2$/month (or 140 $mg/m^2$/day) at all sensitive receptor locations. However dust deposition at receptor locations to the south of the mine site may approach approximately 65% of the Project goal.




Mining Lease Application (MLA70426) Boundary

Mine Pit Extents

Sensitive Receptor Location

Source: See Copyright Details below and for full disclosure Please Refer to the SEIS ***Volume 2, Appendix B***

0 3.75 7.5km

Scale 1:325 000 (A4)

Datum: GDA94, MGA Zone55

N W E S

HANCOCK PROSPECTING PTY LTD

Alpha Coal Project
Supplementary Environmental Impact Statement

# ALPHA COAL PROJECT (MINE)
# SENSITIVE RECEPTOR LOCATIONS

Job Number | 4262 6680
Revision | B
Date | 06-06-2011

Figure: V-10

File No: 42626680-g-2051b.wor

### V.3.3.4 Greenhouse Gases

The following sources would contribute to direct and indirect greenhouse gas emissions from the Project:

- Fugitive emissions of coal seam gas (CSG) from the open cut mining of coal (direct emission);
- Fuel (diesel) consumption in heavy equipment and light vehicles (direct emission);
- Combustion of explosives used in blasting (direct emission); and
- Electricity consumption in plant and machinery (indirect emission).

The National Greenhouse Accounts together with site-specific data on coal seam gas content of the target coal seams were used to estimate the greenhouse gas emissions from the Project.

In total, the project is estimated to result in approximately 24.5 Mt $CO_2$-e of direct and indirect greenhouse gases over its life, or average of 0.766 Mt $CO_2$-e on an annual basis. The annual greenhouse gas emissions for the project represent 0.13% of Australia's 2008 greenhouse gas emissions.

### V.3.3.5 Environmental Protection Objectives

The environmental protection objectives for air quality are:

- To minimise the impacts of mine-derived dust on sensitive receivers within and beyond the boundaries of the mining lease; and
- To implement energy efficiency initiatives.

### V.3.3.6 Performance Criteria

The performance criteria for air quality are:

- Compliance with the requirements of the Project's environmental authority;
- Dust and particulate monitoring in accordance with the control strategies outlined below; and
- The number of substantiated dust complaints from the community.

The EPP (Air) objectives and Queensland DERM guideline for TSP, $PM_{10}$, $PM_{2.5}$ and dust deposition are included in Table V-6**.**

**Table V-6 Summary of project goals for particulate matter**

| Pollutant | Averaging Period | Objective or Goal | Jurisdiction |
|---|---|---|---|
| TSP | Annual | 90 µg/m$^3$ | EPP (Air) |
| $PM_{10}$ | 24-hour | 50 µg/m$^3$ | EPP (Air)(1) |
| $PM_{2.5}$ | 24-hour | 25 µg/m$^3$ | EPP (Air) |
| | Annual | 8 µg/m$^3$ | EPP (Air) |
| Dust Deposition | Monthly | 140 mg/m$^2$/day | Queensland DERM |

Note (1): five exceedences allowed per year

### V.3.3.7 Control Strategies

Control of ambient levels of dust as a result of the operation of Alpha Coal Project (Mine) may be achieved through reduction of source generation. This may be achieved using several management measures, including:

- Engineering control measures (partially included in the dispersion modelling);
- Dust suppression measures (partially included in the dispersion modelling);
- Rehabilitation of exposed surfaces (excluded from the dispersion modelling); and
- Operational procedures (excluded from the dispersion modelling).

#### V.3.3.7.1 *Engineering Control Measures*

The Proponent has designed engineering control measures into the project, where appropriate and technically possible. Controls incorporated in the dispersion modelling, that will be implemented on-site, include:

- In-Pit Crushing and Conveying (IPCC).

Additional control measures will be considered for application at the site that may further reduce dust emissions include:

- Enclosure of transfer points and sizing stations;
- Roof on overland conveyors;
- Belt washing and belt scrapers to minimise dust from the return conveyors;
- Reduced drop height from stackers to stockpiles; and
- Enclosure of raw coal surge bins.

#### V.3.3.7.2 *Dust Suppression Measures*

Dust suppression measures primarily include the application of water to control dust emissions. Measures that will be implemented include:

- Watering of haul roads (2 litres/$m^2$/hour of water applied);

Additional dust suppression measures will be considered for application at the site that may further reduce dust emissions include:

- Watering of ROM stockpiles using water sprays as required,
  - For example, when dust is visibly observed as being generated from stockpiles due to stacking and reclaiming activities, or as a result of wind speed dependant emissions;
- Water sprays on stacker/reclaimer units;
- Water sprays at conveyor transfer points; and
- Optimal moisture content of product coal and reject material as they leave the CHPP which avoids the need for supplementary watering.

In the event that adverse conditions are encountered during operation of Alpha Coal Project, additional dust suppression measures may have to be implemented. The circumstances where this might be required include pre-strip and overburden dumping operations in the northern and southern pits and during construction of the CHPP and associated infrastructure. The requirements for these additional dust suppression measures will be determined through the Operational and On-Site Meteorological Monitoring Program, detailed in Section 3.3.8.

### V.3.3.7.3 *Rehabilitation of Exposed Surfaces*

Rehabilitation of exposed surfaces will be undertaken progressively as mining and stockpiling activities are completed. A detailed rehabilitation plan will be developed for the Project, which will include the use of locally available fast-growing temporary cover material to accelerate the effectiveness of dust controls. Improving the effectiveness and time for rehabilitation measures will result in reduced dust emissions from exposed areas.

### V.3.3.7.4 *Operational Procedures*

Operational procedures set out how the Project is to be operated in order to meet targets for air quality performance. In relation to air quality, the following operational procedures will be implemented in order to meet targets for air quality performance:

- Maintenance of water spray equipment and engineering controls to minimise dust emissions;
- Sufficient number of watering trucks to allow for continuation of dust suppression when one or more truck is out of service;
- Monitoring of ambient air quality in the vicinity of the mine (see Section V.3.3.8);
- Manage topsoil stripping so that dust does not become a safety hazard or severe nuisance;
- Restrict land disturbance to that necessary for the operation and minimise the area of land disturbed at any one time;
- Maintain a register of dust complaints;
- Investigate all complaints about dust promptly and take appropriate action to reduce dust nuisance; and
- Review dust monitoring data to identify trends and implement corrective actions if necessary.

In addition, the following operational procedures may be incorporated into the site operations:

- Implementation of an appropriate speed limit for light vehicles on unsealed roads;
- Product coal supplied for coal transport to have a coal-surface water content designed to reduce dust emissions during rail transport; and
- Avoid burning cleared vegetation.

### V.3.3.7.5 *Prevention and Mitigation of Worst Case Impacts*

Due to the varying depths of pit activities, particular consideration will be paid to operations that are close to the natural surface level, such as truck and shovel operations and overburden dumping. To prevent worst-case conditions from occurring, mine planning will give consideration to implementing additional dust control measures for operations that are close to the natural surface level.

These could include watering of truck and shovel operations that are close to the ends of the northern and southern most pits.

### V.3.3.7.6 *Greenhouse Gas*

The following greenhouse gas emission management control strategies will be implemented:

- Plant and equipment:
  - Energy efficiency ratings will be investigated, with higher ratings the preferred option;
  - Plant and equipment will be regularly serviced and maintained according to manufacturers recommendations; and

– Plant and equipment will be operated in an appropriate manner.

- Blasting activities will be optimised to minimise double handling;
- A GHG inventory will be maintained from the beginning of the construction phase, and the reporting requirement to the Greenhouse and Energy Data Officer will be filed annually (per the NGER legislation).

### V.3.3.8 Monitoring

The outcomes of the ambient monitoring program outlined below and in Table V-7 will be used by the Proponent to determine whether the mine's operations are contributing to excessive dust levels at nearby sensitive receptors. The Proponent will take action to avoid adverse impacts on air quality at nearby receptor locations. The monitoring data will be used to provide an indication of excessive off-site dust levels that may be attributable to the mine's operations in order that appropriate and effective corrective actions can be identified and implemented.

It will also allow validation of the dispersion modelling undertaken to predict the impacts.

#### V.3.3.8.1 *Monitoring Standards*

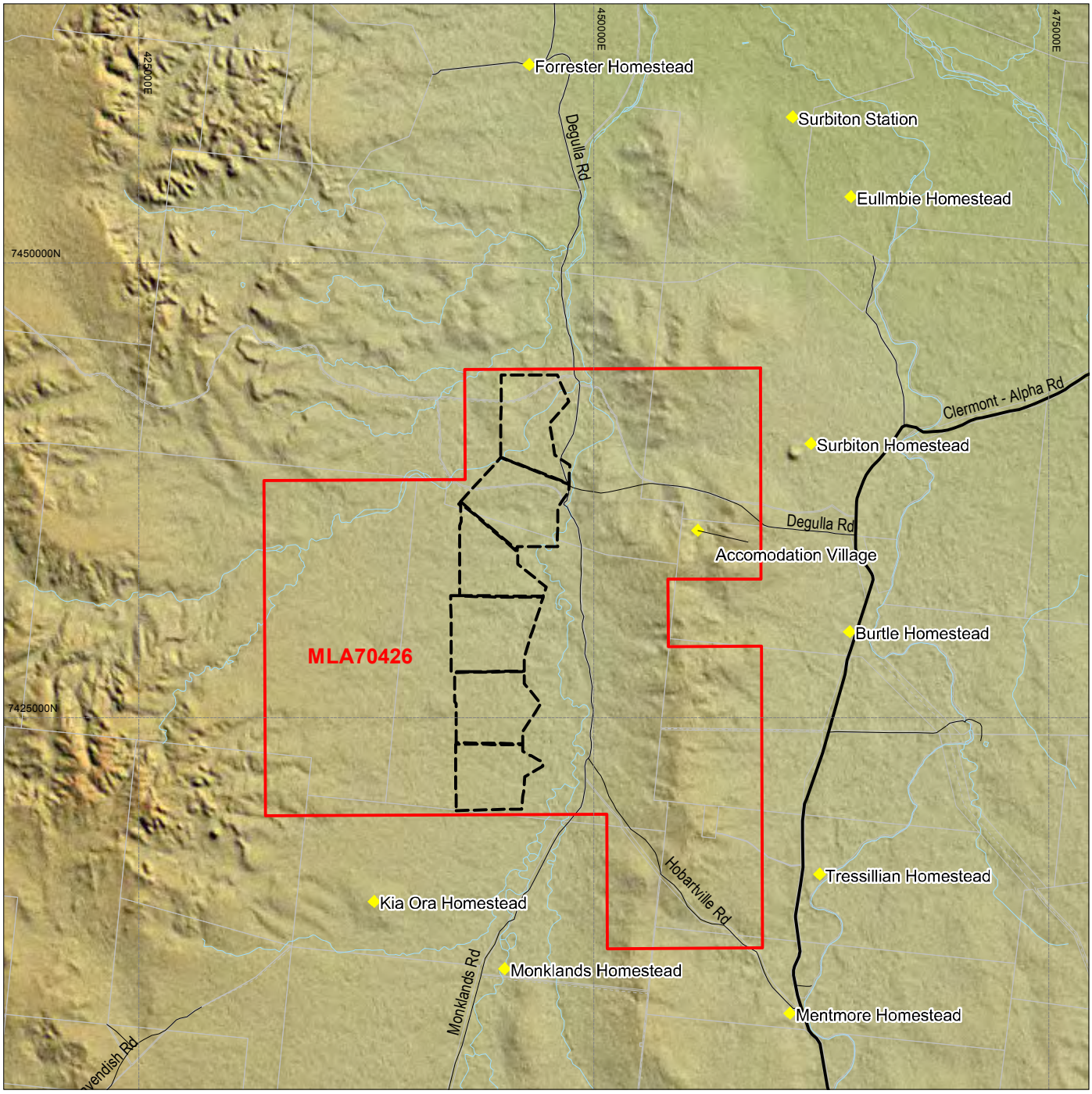
Ambient air monitoring will be conducted in accordance with and/or in consideration of:

- AS/NZS 3580.1.1:2007, Methods for sampling and analysis of ambient air – Guide to siting air monitoring equipment;
- AS/NZS 3580.9.10:2006, Methods for sampling and analysis of ambient air Method 9.10: Determination of suspended particulate matter—$PM_{2.5}$ low volume sampler— Gravimetric method;
- AS/NZS 3580.9.9:2006, Determination of suspended particulate matter – $PM_{10}$ Low volume sampler – Gravimetric method;
- AS/NZS 3580.10.1:2003, Methods for sampling and analysis of ambient air – Determination of ambient air - Determination of suspended particulate matter – Deposited matter – Gravimetric method;
- Queensland Government, Air Quality Sampling Manual; and
- A method determined in consultation with the QLD DERM.

#### V.3.3.8.2 *Monitoring Locations*

The precise location of monitoring equipment will be dependent on siting requirements of the instrumentation to be implemented at each site.

Presented in Figure V-11 and Table V-7 are the proposed monitoring locations for the Project which are approximate and subject to field inspection. The proposed monitoring locations correspond to receptor locations and the on-site Accommodation Village which are locations where human exposure is likely. The revision of the site monitoring program may be warranted based on future development within the regional airshed.




Mining Lease Application (MLA70426) Boundary

Mine Pit Extents

Proposed Monitoring Locations

Source: See Copyright Details below and for full disclosure Please Refer to the SEIS ***Volume 2, Appendix B***

0 3.75 7.5km

Scale 1:325 000 (A4)

Datum: GDA94, MGA Zone55

N W E S

**HANCOCK** PROSPECTING PTY LTD

Alpha Coal Project
Supplementary Environmental Impact Statement

# ALPHA COAL PROJECT (MINE) PROPOSED AIR QUALITY MONITORING LOCATIONS

| | |
|---|---|
| Job Number | 4262 6680 |
| Revision | B |
| Date | 06-06-2011 |

Figure: V-11

File No: 42626680-g-2052b.wor

**Table V-7 Proposed monitoring locations (indicative only)**

| Location | Receptor ID | Description |
|---|---|---|
| 1 | Receptor 1 | Forrester Homestead |
| 2 | Receptor 2 | Surbiton Station |
| 3 | Receptor 3 | Eullmbie Homestead |
| 4 | Receptor 4 | Surbiton Homestead |
| 6 | Receptor 6 | Burtle Homestead |
| 8 | Receptor 8 | Kia Ora Homestead |
| 9 | Receptor 9 | Monklands Homestead |
| 10 | Receptor 10 | Mentmore Homestead |
| 11 | Receptor 11 | Tressillian Homestead |
| 12 | Receptor 12 | Alpha Coal Project Accommodation Village |

* Monitoring locations are indicative only. Actual siting of the monitoring stations will depend on the availability of suitable locations.

#### V.3.3.8.3 *Ambient Air Monitoring Program*

Presented in Table V-8 is a summary of the proposed frequency of monitoring for particulates and dust deposition.

Monitoring of particulates is proposed to be undertaken using the TEOM sampling methodology at the specified locations. Dust deposition gauges will be used to monitor dust nuisance.

**Table V-8 Pollutant and frequency of monitoring at specified locations (Indicative only)**

| ID | Description | $PM_{10}$ | Dust Deposition |
|---|---|---|---|
| 1 | Forrester Homestead | Continuous | Monthly |
| 2 | Surbiton Station | -- | Monthly |
| 3 | Eullmbie Homestead | -- | Monthly |
| 4 | Surbiton Homestead | -- | Monthly |
| 6 | Burtle Homestead | -- | Monthly |
| 8 | Kia Ora Homestead | -- | Monthly |
| 9 | Monklands Homestead | Continuous | Monthly |
| 10 | Mentmore Homestead | -- | Monthly |
| 11 | Tressillian Homestead | -- | Monthly |
| 12 | Alpha Coal Project Accommodation Village | Continuous | Monthly |

-- = not applicable

Monitoring of ambient particulate concentrations and rates of dust deposition will commence as soon as possible in order to establish a representative baseline prior to the commencement of construction and operation. Although not considered as representative as a validation study, monitored ambient particulate concentrations, during construction (particularly of the box cut) and operation, will provide insight to the relative level of conservatism inherent in the dispersion modelling. Based on the results of the dispersion modelling, the effective management of mine-related dust as determined by measurements of dust at locations 8 (Kia Ora Homestead), 9 (Monklands Homestead) and the 12 (Alpha Coal Project Accommodation Village) will lead to improved air quality outcomes at other receptor locations.

#### V.3.3.8.4 *Operational and On-Site Meteorological Monitoring Program*

Presented in Table V-9 is a summary of the frequency of monitoring of on-site meteorology for the purposes of minimising off-site impacts at sensitive receptor locations.

It is noted that due to the prevailing wind direction and the relative location of receptors and mining activities, the Accommodation Village is not predicted to be the most affective sensitive receptor. Thus air quality within the Accommodation Village will not be representative of worst-case impacts which is predicted to occur to the south of the mine reflected at monitoring location 9 (Figure V-11).

Meteorological monitoring is proposed to include (as a minimum) wind speed, wind direction, relative humidity, and air temperature.

**Table V-9 Operational meteorological monitoring program**

| ID | $PM_{10}$ | Dust Deposition | Meteorology |
|---|---|---|---|
| 1 | Continuous | Monthly | Continuous |
| 9 | Continuous | Monthly | Continuous |
| 12 | Continuous | Monthly | Continuous |
| CHPP | -- | -- | Continuous |

-- = not applicable

It should be noted that on-site meteorological monitoring will be undertaken at the CHPP but this is not marked in Figure V-11 and Table V-8 as no particulate monitoring is proposed at this location.

Due to the level of impacts predicted at the location of receptors 8 and 9 in the SEIS, particular attention will be afforded to the species and meteorological monitoring data from the corresponding monitoring location 9 (Figure V-10). If the data indicates that the project goals are being exceeded by Project activities, the mitigation of local dust emission will be considered. This could include the incorporation of actions based upon real time pollutant and meteorological monitoring data.

### V.3.3.9 Commitments

- The Project will achieve and maintain the level of dust control outlined in the environmental authority.
- The Project will meet the ambient air monitoring program requirements.
- The Project will investigate all substantiated dust complaints.
- The Project will implement corrective action resulting from substantiated complaint investigations as required.
- All monitoring and sampling techniques will be consistent with the DERM's Air Quality Sampling Manual and applicable Australian Standards.
- The Project will investigate energy efficiency ratings of plant and equipment, with preference given to plant and equipment of higher energy efficiency rating.
- The Project will maintain plant and equipment in a proper condition.
- A greenhouse gas inventory will be maintained from construction onwards with reporting requirements to the Greenhouse and Energy Data Officer filled annually (as per the NGER legislation).

### V.3.3.10 Proposed Environmental Authority Conditions

**Department Interest: Air**

**B1** When requested by the administering authority or as a result of a complaint (which is neither frivolous nor vexatious nor based on mistaken belief in the opinion of the authorised officer), dust and particulate monitoring must be undertaken, and the results thereof notified to the administering authority within fourteen (14) days following completion of monitoring. Monitoring must be carried out at a place(s) relevant to the potentially affected dust sensitive place. Dust and particulate matter must not exceed the following levels when measured at any sensitive or commercial place:

a) Dust deposition of 140 milligrams per square metre per day based on a monthly average, when monitored in accordance with Australian Standard AS 3580.10.1:2003 (or more recent editions); and

b) A concentration of total particulate matter suspended in the atmosphere of 90 micrograms per cubic metre over a 1 year averaging time, when monitored in accordance with Australian/New Zealand Standard AS/NZS 3580.9.3:2003 (or the most recent editions); and

c) A concentration of particulate matter with an aerodynamic diameter of less than 10 micrometre (µm) ($PM_{10}$) suspended in the atmosphere of 50 micrograms per cubic metre over a 24 hour averaging time, at a sensitive or commercial place in proximity to the site, when monitored in accordance with:

   i. Australian Standard AS 3580.9.6:2003 (or more recent editions) Ambient air - Particulate matter - Determination of suspended particulate $PM_{10}$ high-volume sampler with size-selective inlet - Gravimetric method; or

   ii. any alternative method of monitoring $PM_{10}$ which may be permitted by the Air Quality Sampling Manual as published from time to time by the administering authority.

**Background dust and particulate matter monitoring**

**B2** The holder of the environmental authority must develop and implement a background dust and particulate matter monitoring program. The program must be able to detect a significant change to dust levels to sensitive receptors due to activities that are part of the project.

**B3** The program must include, but not be limited to, the details as specified in Table V-10 – Background dust and particulate matter monitoring.

**B4** The holder of the environmental authority must report the results and analysis of dust and particulate matter monitoring to the administering authority on request.

**Table V-10 Background dust and particulate matter monitoring**

| Air quality determination | Monitoring point location (GDA94) | Monitoring point description |
|---|---|---|
| A concentration of particulate matter with an aerodynamic diameter of less than 10 micrometre (µm) ($PM_{10}$) suspended in the atmosphere over a 24 hour averaging time | (To be provided by Proponent) | (To be provided by Proponent) |
| Concentration of particulate matter suspended in the atmosphere in micrograms per cubic metre over a 24 hr averaging time | (To be provided by Proponent) | (To be provided by Proponent) |
| Deposited dust | (To be provided by Proponent) | (To be provided by Proponent) |
| Meteorological data (including but not limited to wind speed and direction, humidity, temperature and precipitation) | (To be provided by Proponent) | (To be provided by Proponent) |
| Siting of monitoring equipment | (To be provided by Proponent) | (To be provided by Proponent) |

Note: *Details necessary to complete all tables to be provided by the Proponent prior to issue of this Environmental Authority.*

## V.3.4 Water Resources

### V.3.4.1 Background

#### V.3.4.1.1 *Surface Water Resources*

The Project area is located within the Sandy Creek catchment, forming the south-westerly portion of the Belyando River system, which is part of the Burdekin Basin. In the context of the Belyando River and Burdekin River catchments the Project site is high in the headwaters of these catchments.

The Sandy Creek catchment is bounded by the Great Dividing Range (GDR) to the west and a north-south line of low hills to the east and extends to the south of the Capricorn Highway and northward to around Wendouree. The Sandy Creek catchment to the junction with the Belyando River covers an area of approximately 7,700 $km^2$ and the MLA area covers approximately 337 $km^2$.

Five key streams have been identified within the Project area, with all other streams located being tributaries of these key streams. These streams are Rocky Creek, Little Sandy Creek, Sandy Creek, Spring Creek and Lagoon Creek. All are ephemeral, upland, freshwater streams. Within the Project area, Sandy Creek, Lagoon Creek and a portion of Spring Creek are declared watercourses under the *Water Act 2000*. Lagoon Creek flows into Sandy Creek, which then flows into the Belyando River, approximately 100 km north of the Project area.

Lagoon Creek is the primary valley drainage feature through the Project area. The topography across the Project area varies between 290 to 400 m AHD and is generally undulating, with no prominent features of steep relief. The typical elevation across the areas proposed for active mining is between 300 to 350 m AHD.

Stream flow in the local watercourses is ephemeral with periods up to 80% of the time with no stream flow. Baseflow recession in the watercourses after rainfall events is limited to short duration. The mean annual rainfall is approximately 500 mm/year, and the mean annual evaporation is approximately 2,300 mm/year. The mean annual runoff is estimated to be 17 mm/year (which is approximately 3 to 4% of rainfall). Substantially higher runoff rates occur during storm events and from above average wet season rainfall. The 1 in 100 Average Recurrence Interval (ARI) annual rainfall is estimated to be approximately 1,300 mm based on historical rainfall data.

Existing catchment land use is generally limited to low intensity grazing and is an existing degree of disturbance for the watercourse environmental values.

There are no existing surface water licences that allow use of water from the watercourse within close proximity to the Project area. The closest existing surface water licence is Licence Number 48434F approximately 175 km downstream of the Project.

The existing watercourses have relatively small low flow (active) channels with bank-full capacity typically limited to 2 year ARI events. Lagoon Creek has a confined floodplain that can extend up to 4 km wide in extreme floods. Sandy Creek and Spring Creek have alluvial fan floodplains which can allow flood flows to disperse and flow overland directly to Lagoon Creek in large to extreme flood events. Murdering Lagoon, a modified ox-bow lake, located in Lagoon Creek. This water body does not appear to be sustained by groundwater as the groundwater levels are typically greater than 10 m below the creek bed levels. No areas of surface spring flows supplemented or sustained by groundwater have been identified on MLA 70426.

#### V.3.4.1.2 *Surface water quality data*

Surface water quality data for the watercourses through the Project is limited. Water quality data for the adjacent and similar Native Companion Creek catchment (to the east) along with surface water sampling surveys, undertaken between October 2010 and February 2011, have formed the preliminary basis to characterise existing water quality conditions.

Seven field surveys were carried out when flow and weather permitted.

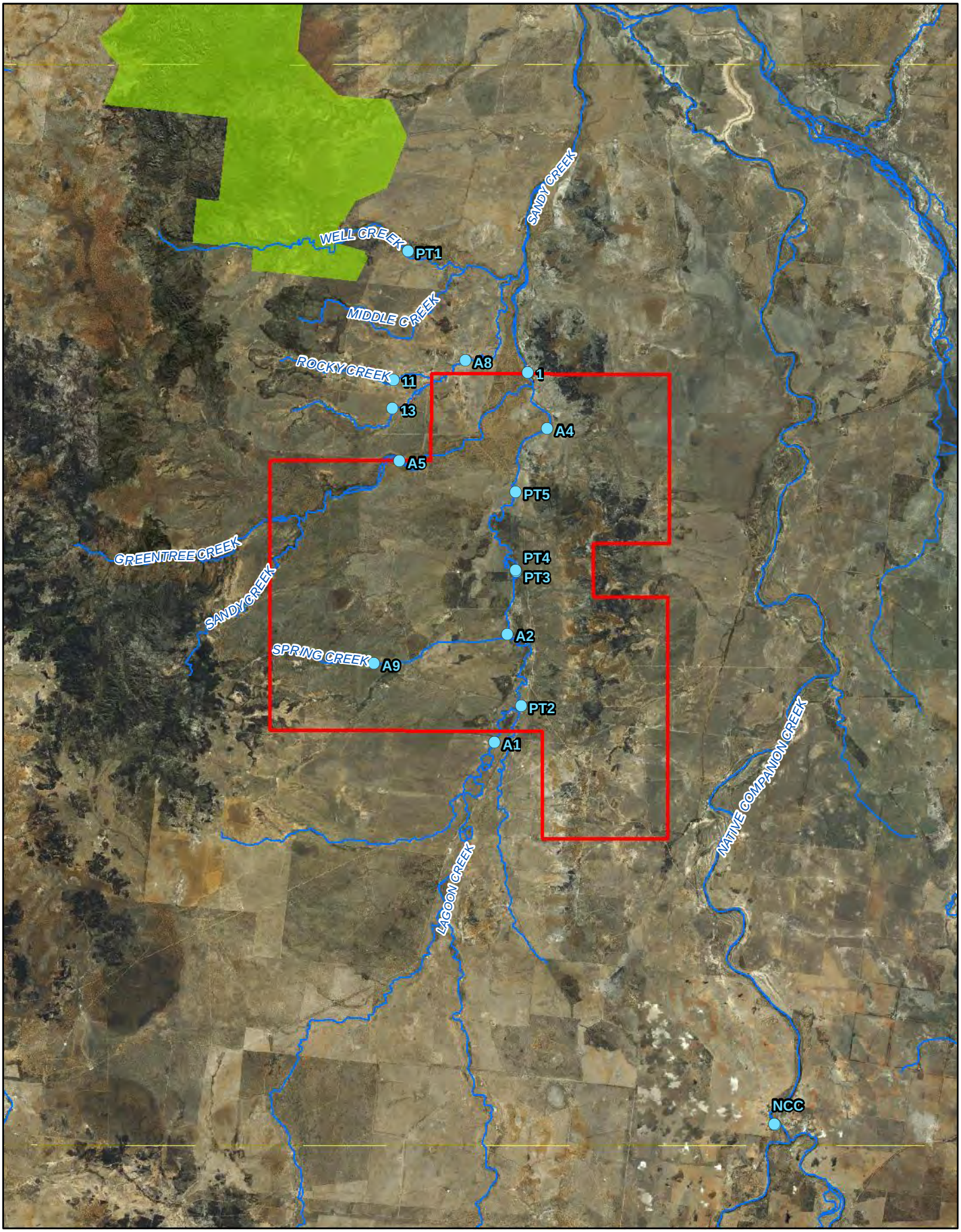
The characteristics and locations of the surface water quality monitoring points are presented in Table V-11 and on Figure V-12.

The comprehensive baseline surface water quality monitoring program specific to the watercourses through the Project area is being implemented and includes other local watercourses around the Project for reference site monitoring. Sediment sampling and Murdering Lagoon monitoring will be carried out in a near future.

Table V-12 and Table V-13 summarise the water quality data collected for, respectively, Native Companion Creek and the field survey.

## Table V-11 Characteristics of the surface water quality monitoring points

| Number | Monitoring site | Code | Coordinates | | Comment |
|---|---|---|---|---|---|
| | | | Easting | Northing | |
| Lagoon Creek | | | | | |
| 1 | Lagoon Creek upstream outside MLA | A1 | 447250 | 7418923 | For conditions prior to entering the mine site |
| 2 | Lagoon Creek, upstream | PT2 | 449098 | 7421413 | For conditions prior t to disturbance from mine activities |
| 3 | Lagoon Creek Spring Creek downstream | A2 | 448159 | 7426371 | For conditions after point of discharge from the final SRD |
| 4 | Lagoon Creek upstream of road | PT3 | 448750 | 7430651 | For conditions prior to the road crossing Lagoon Creek |
| 5 | Lagoon Creek downstream of road | PT4 | 448721 | 7430763 | For conditions after the road crossing Lagoon Creek |
| 6 | Lagoon Creek downstream | PT5 | 448723 | 7436108 | For conditions along Lagoon Creek |
| 7 | Lagoon Creek downstream | A4 | 450868 | 7440441 | For conditions along Lagoon Creek |
| 8 | Lagoon Creek downstream | 1 | 449531 | 7444304 | For conditions on exit of the mine site |
| Sandy Creek | | | | | |
| 9 | Sandy Creek upstream | (A5) | 440746 | 7438237 | For conditions prior to the creek diversion and disturbance from mine activities |
| Rocky Creek | | | | | |
| 10 | Rocky Creek Upstream | (11) | 440351 | 7443800 | For conditions prior to entering the mine site |
| Little Sandy Creek | | | | | |
| 11 | Little Sandy Creek upstream | (13) | 440262 | 7441831 | For conditions prior to entering the mine site |
| 12 | Little Sandy and Rocky Creek downstream | (A8) | 445276 | 7445135 | For conditions of LSC and RC after exiting the mine site |
| Spring Creek | | | | | |
| 13 | Spring Creek upstream | (A9) | 438989 | 7424345 | For conditions prior to disturbance from mine activities |
| Native Companion Creek | | | | | |
| 14 | Native Companion Creek | (NCC) | 470132 | 7384603 | Reference site |
| Well Creek | | | | | |
| 15 | Well Creek | (PT1) | 441888 | 7429149 | Reference site |




Water Quality Monitoring Sites
Watercourse
Parkland
Mining Lease Application (MLA70426) Boundary

Source: See Copyright Details below and for full disclosure Please Refer to the SEIS *Volume 2, appendix B*.

0 2.5 5 10 Km

Scale 1:350,000 (A4)

Datum: GDA94, MGA Zone55

N W E S

HANCOCK PROSPECTING PTY LTD

Alpha Coal Project
Supplementary Environmental Impact Statement

# ALPHA COAL PROJECT (MINE) WATER QUALITY AND SEDIMENT MONITORING SITES

| | |
|---|---|
| Job Number | 4262 6680 |
| Revision | A |
| Date | 18-04-2011 |

Figure: V-12

File No: \\AUBNEF\proj\H\Hancock_Coal\2123204A_HANCOCK_COAL_FEASIBILITY_STUD\10_GIS\Projects\Drawings_Figures_Sketches\2123204A_GIS_F029_A1.mxd

## Table V-12 Surface water quality data – Native Companion Creek

| Month | Date | Jan | Feb | Mar | Apr | May | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Number of samples taken/month during the indicated date range | | 8 | 8 | 8 | 4 | 5 | 1 | 6 | 3 | 2 | 10 | 8 |
| Flow (ML) | 1970–2010 | 10,663.12 | 10,549.41 | 2,277.14 | 11,854.45 | 4,346.77 | 499.44 | 115.51 | 176.45 | 783.70 | 841.67 | 2853.35 |
| pH | 1970–2010 | 7.14 | 7.05 | 7.41 | 7.31 | 7.19 | 7.41 | 7.41 | 7.58 | 7.73 | 7.28 | 7.28 |
| Conductivity (uS/cm) | 1978–2010 | 105.50 | 95.84 | 171.64 | 170.48 | 191.50 | 290.00 | 178.33 | 213.80 | 119.00 | 134.23 | 208.15 |
| Turbidity (NTU) | 1987–2010 | 282.00 | 762.50 | 250.40 | 131.45 | 89.93 | 179.00 | 50.60 | 170.50 | 590.00 | 229.75 | 302.35 |
| Total Nitrogen (mg/L) | 1998–2010 | 0.89 | 1.24 | 1.16 | NE | 0.31 | NE | NE | NE | NE | 0.85 | 1.40 |
| Organic Nitrogen (mg/L) | 1995–2010 | NE | 1.11 | 0.92 | 1.08 | 1.29 | 1.24 | 0.66 | 1.24 | 1.05 | 1.41 | 1.47 |
| Nitrate + nitrite as N (mg/L) | 1995–2010 | 0.05 | 0.11 | 0.08 | 0.01 | 0.00 | 0.19 | 0.06 | 0.01 | 0.67 | 0.04 | 0.06 |
| Ammonia as N (mg/L) | 1995–2010 | 0.05 | 0.05 | 0.06 | 0.02 | 0.02 | 0.10 | 0.06 | 0.03 | 0.24 | 0.04 | 0.03 |
| % DO saturation | 1995–2010 | 59.08 | 86.44 | 70.95 | 52.18 | 80.29 | 59.56 | 94.45 | 101.59 | 68.48 | 65.48 | 78.88 |
| Total Phosphorus (mg/L) | 1994–2010 | 0.20 | 0.33 | 0.21 | 0.20 | 0.13 | 0.10 | 0.03 | 0.17 | 0.29 | 0.23 | 0.22 |
| Total Reacted Phosphorus (mg/L) | 1995–2010 | 0.02 | 0.04 | 0.01 | 0.00 | 0.00 | 0.00 | 0.01 | 0.00 | 0.02 | 0.02 | 0.02 |
| Colour True (Hazen units) | 1991–2010 | 24.75 | 56.25 | 80.60 | 49.50 | 31.67 | 9.00 | 11.00 | 88.50 | 36.00 | 15.67 | 42.17 |
| Water Temperature (°C) | 1973–2010 | 26.49 | 25.77 | 27.91 | 24.40 | 20.02 | 10.80 | 19.37 | 21.33 | 24.60 | 26.64 | 30.88 |
| Total Alkalinity (mg/L) | 1970–2010 | 39.13 | 40.92 | 72.51 | 70.20 | 76.88 | 114.40 | 72.30 | 56.03 | 111.09 | 58.12 | 82.88 |
| Hardness (mg/L) | 1970–2010 | 31.13 | 32.43 | 59.72 | 57.84 | 61.15 | 98.25 | 58.25 | 67.88 | 82.20 | 48.33 | 69.25 |
| Total Dissolved Solids (mg/L) | 1970–2010 | 69.25 | 67.26 | 109.95 | 99.95 | 121.03 | 157.94 | 108.59 | 124.85 | 156.92 | 86.96 | 120.97 |
| Total Dissolved Ions (mg/L) | 1970–2010 | 80.76 | 79.91 | 139.67 | 134.81 | 152.26 | 226.08 | 142.70 | 171.03 | 213.73 | 114.36 | 165.30 |
| Total Suspended Solids (mg/L) | 1973–2010 | 404.88 | 595.50 | 207.50 | 211.00 | 55.25 | 56.00 | 219.80 | 35.00 | 92.00 | 246.33 | 237.00 |
| Calcium (mg/L) | 1970–2010 | 7.35 | 7.48 | 14.56 | 12.78 | 14.64 | 22.90 | 13.57 | 15.50 | 19.80 | 11.98 | 15.35 |

| Month | Date | Jan | Feb | Mar | Apr | May | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Chloride (mg/L) | 1970–2010 | 5.74 | 5.52 | 9.94 | 12.43 | 12.93 | 22.20 | 13.21 | 13.32 | 19.24 | 9.08 | 16.54 |
| Magnesium (mg/L) | 1970–2010 | 3.09 | 3.33 | 5.69 | 6.30 | 6.02 | 10.00 | 5.95 | 7.03 | 8.00 | 4.50 | 7.53 |
| Nitrate (mg/L) | 1976–2010 | 1.16 | 0.87 | 1.66 | 2.10 | 2.28 | 0.00 | 3.84 | 0.68 | 1.96 | 2.12 | 2.52 |
| Sulphate (mg/L) | 1974–2010 | 3.47 | 1.53 | 2.30 | 1.22 | 3.11 | 1.30 | 3.97 | 6.94 | 3.42 | 2.85 | 1.36 |
| Aluminium (mg/L) | 1991–2010 | 0.56 | 1.05 | 0.11 | 0.05 | 0.06 | 0.00 | 0.01 | 0.15 | 0.03 | 0.02 | 0.04 |
| Boron (mg/L) | 1973–2010 | 0.06 | 0.05 | 0.06 | 0.05 | 0.06 | 0.10 | 0.06 | 0.10 | 0.00 | 0.04 | 0.05 |
| Copper (mg/L | 1991–2010 | 0.04 | 0.04 | 0.02 | 0.02 | 0.02 | 0.04 | 0.01 | 0.07 | 0.01 | 0.02 | 0.01 |
| Fluoride (mg/L) | 1970–2010 | 0.15 | 0.10 | 0.16 | 0.18 | 0.26 | 0.22 | 0.21 | 0.18 | 0.17 | 0.25 | 0.24 |
| Iron (mg/L) | 1973–2010 | 1.00 | 0.59 | 0.55 | 0.44 | 0.11 | 0.00 | 0.71 | 0.26 | 0.05 | 0.31 | 0.14 |
| Manganese (mg/L) | 1983–2010 | 0.02 | 0.02 | 0.02 | 0.01 | 0.00 | 0.00 | 0.00 | 0.01 | 0.01 | 0.00 | 0.00 |
| Zinc (mg/L) | 1991–2010 | 0.07 | 0.02 | 0.01 | 0.03 | 0.00 | 0.00 | 0.01 | 0.02 | 0.01 | 0.02 | 0.01 |

Notes: All metals and metalloids data are for dissolved metals, unless indicated otherwise.

Values in red text indicate exceedances compared to guideline values
NE: Not established

*: ANZECC values for livestock drinking water quality

**: Irrigation water quality guidelines
NM: Not Measured

## Table V-13 Surface water quality data – Field survey

### Water quality – Median

| Parameters | Unit | 1 | 11 | 13 | A1 | A2 | A4 | A5 | A8 | A9 | Native | PT1 | PT2 | PT3 | PT4 | PT5 | Applied | Guideline | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Velocity | m/s | 0.23 | 0.46 | 0.16 | 0.44 | 0.4 | 0.34 | 0.23 | 0.38 | 0.36 | ND | 0.31 | 0.21 | 0.05 | 0.12 | 0.28 | NA | NE | NE |
| Temperature | °C | 23.20 | 25.41 | 24.09 | 25.65 | 30.65 | 26.79 | 26.50 | 22.05 | 26.40 | 21.70 | 23.89 | 26.00 | 25.10 | 26.43 | 23.80 | NA | NE | NE |
| pH | pH | 6.92 | 7.49 | 7.25 | 7.45 | 7.54 | 7.24 | 7.37 | 7.34 | 7.64 | 7.19 | 7.19 | 7.41 | 7.20 | 7.45 | 7.12 | OWOG | 6.5 | 7.5 |
| Conductivity | µS/cm | 152.6 | 176.1 | 238.0 | 132.1 | 178.3 | 142.3 | 91.4 | 152.8 | 133.7 | 160.6 | 108.1 | 114.7 | 132.6 | 192.5 | 123.7 | OWOG | NE | 710 |
| Dissolved Oxygen | % | 70.9 | 96.5 | 61.7 | 71.1 | 83.3 | 67.1 | 79.2 | 76 | 95.95 | 64.15 | 49.8 | 60.8 | 56.0 | 62.1 | 20.6 | OWOG | 90 | 110 |
| Turbidity | NTU | 135.9 | 61.9 | 120.1 | 109.5 | 37.0 | 142.1 | 100.0 | 182.4 | 208.0 | 212.0 | 168.1 | 103.8 | 118.3 | 64.7 | 59.0 | OWOG | 2 | 15 |
| Suspended Solids | mg/L | 35 | 78 | 21 | 20 | 24 | 34.5 | 12 | 27 | 47 | 33 | 34 | 29 | 36 | 35 | 24 | NA | NE | NE |
| Nitrite + Nitrate as N | mg/L | 0.03 | 0.015 | 0.01 | 0.02 | 0.01 | 0.015 | 0.02 | 0.03 | 0.02 | 0.02 | 0.02 | 0.015 | 0.03 | 0.015 | 0.01 | OWOG | NE | 0.015 |
| Ammonia as N | mg/L | 0.04 | 0.02 | 0.03 | 0.025 | 0.02 | 0.03 | 0.04 | 0.015 | 0.02 | 0.05 | 0.03 | 0.03 | 0.04 | 0.035 | 0.04 | OWOG | NE | 0.010 |
| Chlorophyll-a | mg/m³ | 2 | 2 | 1 | 1.5 | 2 | 1 | 1 | 1 | 1 | 4 | 1.5 | 2 | 2 | 1 | 1 | OWOG | NE | NE |
| Phosphorus (total) | mg/L | 0.08 | 0.06 | 0.06 | 0.04 | 0.1 | 0.085 | 0.01 | 0.055 | 0.11 | 0.2 | 0.095 | 0.04 | 0.01 | 0.07 | 0.08 | OWOG | NE | 0.030 |
| FRC | mg/L | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.015 | 0.01 | 0.02 | 0.05 | 0.025 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | OWOG | NE | 0.015 |
| Total Nitrogen as N | mg/L | 0.9 | 0.55 | 0.7 | 0.95 | 0.7 | 1 | 0.6 | 0.7 | 0.8 | 0.7 | 0.95 | 0.8 | 0.4 | 0.8 | 0.7 | OWOG | NE | 0.25 |

Notes: All metals and metalloids data are for dissolved metals, unless indicated otherwise.

Values in red text indicate exceedances compared to guideline values
NE: Not established

*: ANZECC values for livestock drinking water quality

**: Irrigation water quality guidelines
NM: Not Measured

**Water quality – 95th Percentile**

| Parameters | Unit | 1 | 11 | 13 | A1 | A2 | A4 | A5 | A8 | A9 | Native | PT1 | PT2 | PT3 | PT4 | PT5 | Applied guideline | Guideline Min | Guideline Max |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Total Alkalinity | mg/L | 55.80 | 67.85 | 95.80 | 94.00 | 92.80 | 73.65 | 45.60 | 67.65 | 74.00 | 99.10 | 49.60 | 100.40 | 95.20 | 96.40 | 82.60 | ANZECC | 60** | 0 |
| Calcium | mg/L | 10.60 | 10.00 | 12.00 | 18.95 | 19.00 | 14.70 | 7.60 | 11.00 | 12.30 | 16.30 | 8.95 | 21.60 | 19.80 | 19.85 | 18.00 | ANZECC | NE | 1000* |
| Chloride | mg/L | 15.20 | 12.85 | 14.60 | 12.25 | 12.80 | 15.10 | 15.60 | 13.60 | 15.40 | 13.60 | 5.95 | 15.40 | 13.20 | 13.55 | 18.80 | NA | NE | NE |
| Fluoride | mg/L | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.20 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | NA | NE | NE |
| Magnesium | mg/L | 5.80 | 8.00 | 9.00 | 8.40 | 8.80 | 6.85 | 5.00 | 8.00 | 7.60 | 6.70 | 3.95 | 9.00 | 8.80 | 8.85 | 7.60 | ANZECC | NE | 2000* |
| Potassium | mg/L | 7.80 | 6.70 | 6.80 | 8.00 | 8.80 | 8.00 | 7.60 | 6.00 | 8.90 | 7.00 | 9.95 | 9.00 | 8.80 | 8.85 | 8.00 | NA | NE | NE |
| Sodium | mg/L | 11.80 | 10.85 | 22.40 | 11.95 | 12.40 | 14.40 | 11.00 | 16.20 | 10.90 | 19.40 | 3.95 | 12.80 | 12.60 | 12.70 | 15.00 | NA | NE | NE |
| Sulphate | mg/L | 2.00 | 1.00 | 1.80 | 1.85 | 1.00 | 1.85 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 2.00 | 1.00 | 1.00 | 2.70 | ANZECC | NE | 1000* |
| Aluminium | mg/L | 0.422 | 0.335 | 0.520 | 0.393 | 0.986 | 5.593 | 0.448 | 0.396 | 0.438 | 1.948 | 0.558 | 0.350 | 0.838 | 0.938 | 0.924 | ANZECC | NE | 0.055 |
| Arsenic | mg/L | 0.001 | 0.001 | 0.001 | 0.002 | 0.002 | 0.002 | 0.001 | 0.001 | 0.001 | 0.003 | 0.001 | 0.001 | 0.002 | 0.002 | 0.002 | ANZECC | NE | 0.024 |
| Barium | mg/L | 0.060 | 0.096 | 0.171 | 0.082 | 0.058 | 0.060 | 0.051 | 0.113 | 0.044 | 0.147 | 0.022 | 0.081 | 0.076 | 0.083 | 0.074 | NA | NE | NE |
| Beryllium | mg/L | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | NA | NA | NE | NE |
| Boron | mg/L | 0.050 | 0.050 | 0.070 | 0.067 | 0.092 | 0.084 | 0.058 | 0.058 | 0.050 | 0.050 | 0.050 | 0.100 | 0.094 | 0.098 | 0.085 | ANZECC | NE | 0.37 |

| Parameters | Unit | 1 | 11 | 13 | A1 | A2 | A4 | A5 | A8 | A9 | Native | PT1 | PT2 | PT3 | PT4 | PT5 | Applied guideline | Guideline Min | Guideline Max |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Cadmium | mg/L | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 | ANZECC | NE | 0.2 |
| Chromium | mg/L | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.004 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | ANZECC | NE | 0.001 |
| Cobalt | mg/L | 0.002 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | NA | NE | NE |
| Copper | mg/L | 0.002 | 0.002 | 0.004 | 0.003 | 0.002 | 0.003 | 0.002 | 0.002 | 0.002 | 0.002 | 0.002 | 0.002 | 0.005 | 0.002 | 0.002 | ANZECC | NE | 0.0014 |
| Iron | mg/L | 1.244 | 0.434 | 0.500 | 2.022 | 1.076 | 2.618 | 1.054 | 0.388 | 0.590 | 1.370 | 0.339 | 1.178 | 1.167 | 1.065 | 1.061 | NA | NE | NE |
| Lead | mg/L | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | ANZECC | NE | 0.0034 |
| Manganese | mg/L | 0.198 | 0.036 | 0.129 | 0.085 | 0.049 | 0.091 | 0.113 | 0.038 | 0.012 | 0.161 | 0.036 | 0.314 | 0.171 | 0.186 | 0.314 | ANZECC | NE | 1.9 |
| Mercury | mg/L | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 | ANZECC | NE | 0.6 |
| Molybdenum | mg/L | | | | | | | | | | | | 0.001 | 0.001 | 0.001 | 0.001 | NA | NE | NE |
| Nickel | mg/L | 0.002 | 0.002 | 0.003 | 0.002 | 0.002 | 0.004 | 0.002 | 0.002 | 0.002 | 0.002 | 0.002 | 0.002 | 0.003 | 0.003 | 0.002 | ANZECC | NE | 0.011 |
| Selenium | mg/L | | | | | | | | | | | | 0.010 | 0.010 | 0.010 | 0.010 | ANZECC | NE | 0.011 |
| Silver | mg/L | | | | | | | | | | | | 0.001 | 0.001 | 0.001 | 0.001 | ANZECC | NE | $5.10^{-5}$ |
| Uranium | mg/L | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | NA | NE | NE |

| Parameters | Unit | 1 | 11 | 13 | A1 | A2 | A4 | A5 | A8 | A9 | Native | PT1 | PT2 | PT3 | PT4 | PT5 | Applied guideline | Guideline Min | Guideline Max |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Vanadium | mg/L | 0.010 | 0.010 | 0.010 | 0.010 | 0.010 | 0.010 | 0.010 | 0.010 | 0.010 | 0.010 | 0.010 | 0.010 | 0.010 | 0.010 | 0.010 | NA | NE | NE |
| Zinc | mg/L | 0.006 | 0.007 | 0.014 | 0.005 | 0.005 | 0.023 | 0.055 | 0.042 | 0.915 | 0.005 | 0.156 | 0.026 | 0.058 | 0.029 | 0.101 | ANZECC | NE | 0.008 |
| Aluminium (total) | mg/L | 2.562 | 0.976 | 1.528 | 4.025 | 2.306 | 3.684 | 0.798 | 1.144 | 0.558 | 3.350 | 9.468 | 0.478 | 0.752 | 2.188 | 4.865 | NA | NE | NE |
| Arsenic (total) | mg/L | 0.002 | 0.001 | 0.001 | 0.002 | 0.002 | 0.002 | 0.002 | 0.001 | 0.002 | 0.003 | 0.001 | 0.002 | 0.002 | 0.002 | 0.003 | NA | NE | NE |
| Barium (total) | mg/L | 0.076 | 0.109 | 0.197 | 0.102 | 0.067 | 0.079 | 0.064 | 0.133 | 0.058 | 0.164 | 0.027 | 0.093 | 0.073 | 0.074 | 0.080 | NA | NE | NE |
| Beryllium (total) | mg/L | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | NA | NE | NE |
| Boron (total) | mg/L | 0.060 | 0.050 | 0.076 | 0.076 | 0.076 | 0.067 | 0.050 | 0.058 | 0.001 | 0.050 | 0.050 | 0.088 | 0.074 | 0.075 | 0.064 | NA | NE | NE |
| Cadmium (total) | mg/L | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 | NA | NE | NE |
| Chromium (total) | mg/L | 0.001 | 0.001 | 0.002 | 0.005 | 0.001 | 0.004 | 0.001 | 0.001 | 0.001 | 0.003 | 0.008 | 0.001 | 0.001 | 0.001 | 0.005 | NA | NE | NE |
| Cobalt (total) | mg/L | 0.002 | 0.001 | 0.002 | 0.002 | 0.001 | 0.002 | 0.001 | 0.002 | 0.001 | 0.001 | 0.002 | 0.003 | 0.001 | 0.001 | 0.002 | NA | NE | NE |
| Copper (total) | mg/L | 0.004 | 0.005 | 0.005 | 0.004 | 0.003 | 0.005 | 0.040 | 0.004 | 0.003 | 0.004 | 0.006 | 0.003 | 0.003 | 0.003 | 0.004 | NA | NE | NE |
| Iron (total) | mg/L | 5.160 | 2.150 | 2.536 | 4.944 | 1.608 | 5.895 | 2.168 | 1.560 | 2.929 | 3.280 | 6.807 | 2.365 | 1.740 | 1.783 | 5.508 | NA | NE | NE |
| Lead (total) | mg/L | 0.002 | 0.002 | 0.002 | 0.003 | 0.002 | 0.002 | 0.001 | 0.002 | 0.001 | 0.002 | 0.003 | 0.002 | 0.002 | 0.002 | 0.002 | NA | NE | NE |

| Parameters | Unit | 1 | 11 | 13 | A1 | A2 | A4 | A5 | A8 | A9 | Native | PT1 | PT2 | PT3 | PT4 | PT5 | Applied guideline | Guideline Min | Guideline Max |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Manganese (total) | mg/L | 0.223 | 0.110 | 0.220 | 0.234 | 0.070 | 0.099 | 0.140 | 0.125 | 0.037 | 0.170 | 0.080 | 0.279 | 0.100 | 0.090 | 0.342 | NA | NE | NE |
| Mercury (total) | mg/L | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 | NA | NE | NE |
| Molybdenum (total) | mg/L | | | | | | | | | | | | 0.001 | 0.001 | 0.001 | 0.001 | NA | NE | NE |
| Nickel (total) | mg/L | 0.004 | 0.003 | 0.004 | 0.004 | 0.002 | 0.004 | 0.002 | 0.003 | 0.003 | 0.004 | 0.006 | 0.002 | 0.002 | 0.002 | 0.003 | NA | NE | NE |
| Selenium (total) | mg/L | | | | | | | | | | | | 0.010 | 0.010 | 0.010 | 0.010 | ANZECC | NE | NE |
| Silver (total) | mg/L | | | | | | | | | | | | 0.001 | 0.002 | 0.001 | 0.001 | ANZECC | NE | NE |
| Uranium (total) | mg/L | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | ANZECC | NE | NE |
| Vanadium (total) | mg/L | 0.010 | 0.010 | 0.010 | 0.010 | 0.010 | 0.010 | 0.010 | 0.010 | 0.010 | 0.010 | 0.010 | 0.010 | 0.010 | 0.010 | 0.010 | ANZECC | NE | NE |
| Zinc (total) | mg/L | 0.014 | 0.005 | 0.031 | 0.006 | 0.007 | 0.005 | 0.005 | 0.009 | 0.010 | 0.008 | 0.014 | 0.014 | 0.015 | 0.012 | 0.015 | ANZECC | NE | NE |
| TPH C6-C9 | µg/L | <20 | <20 | <20 | <20 | 6.00 | <20 | <20 | <20 | <20 | <20 | <20 | <20 | <20 | <20 | <20 | NA | NE | NE |
| TPH C10 - C36 | µg/L | <50 | <50 | <50 | <50 | 0.00 | <50 | <50 | <50 | <50 | <50 | <51 | <50 | <50 | <50 | <50 | NA | NE | NE |
| Oil & Grease | mg/L | 6.00 | 6.00 | 6.00 | 6.00 | <50 | 6.00 | 6.00 | 6.00 | 6.00 | 6.00 | 6.00 | 7.00 | <5 | <5 | <5 | NA | NE | NE |

Notes: All metals and metalloids data are for dissolved metals, unless indicated otherwise.
Values in red text indicate exceedances compared to guideline values
NE: Not established
*: ANZECC values for livestock drinking water quality
**: Irrigation water quality guidelines
NM: Not Measured

#### V.3.4.1.3 *Data collection and laboratory testing Quality Assurance and Quality Control*

All procedures for collecting, labelling, transporting and storing samples and necessary ancillary field data and constituent were carried out in accordance with the Australian Standard 5667.6 (1998) and DERM Monitoring and Sampling Manual 2009. The following was also carried out:

- decontamination of reused sampling equipment involved a thorough rinse in distilled water
- blind duplicates were taken and analysed to assess the precision and repeatability of the primary laboratory
- primary samples and blind duplicate samples were stored in an ice-cooled esky during site works and during transport to the laboratory. To ensure the integrity of the samples from collection to receipt by the analytical laboratory, samples were sent by courier to the laboratories with accompanying “chain of custody” (CoC) documentation

A NATA accredited laboratory was used to perform the required analysis for this study. The laboratory’s Quality Control (QC) statement reports the following:

- Matrix spike and surrogate spike were performed to assess the accuracy of the results provided. According to the guidelines, sample results are qualified when a matrix spike recovery is below or above the QA acceptance criteria of 70 - 130 percent recovery and when a surrogate spike recovery meets the prescribed control limits. From the QC report, all matrix spike results were within the QA acceptance criteria except for TPH results which may be biased low. No activity involving oil and grease has been identified within the MLA at the time of the sampling, therefore despite the probability that TPH concentration might have underestimated the assessment with regards to TPH remains valid.
- All surrogate spikes met the prescribed control limits.
- Laboratory’s blank met the quality control (QC) acceptance criteria as no detectable concentrations of the respective target compounds were found in the blank.
- Holding times for suspended solids, reactive phosphorus and chlorophyll ‘a’ analysis were often exceeded.

No laboratory result, QA or QC were provided for round 1. While the reported results were assumed acceptable for this report, their accuracy could not be verified.

#### V.3.4.1.4 *Water quality findings*

Water quality findings are based on:

- For the physico-chemical parameters, guidelines values were compared to the median value of the collected data.
- For toxicants, guidelines values were compared to the 95% as per the ANZECC and QWQG recommendations.

The available water quality data compared against relevant trigger values for the EV identified the following existing water quality conditions:

- pH was consistently within the guideline range;
- Dissolved oxygen (DO) saturation is almost consistently below the preferred guideline range (at least 90% saturation);

- The low percentage of dissolved oxygen appears to be a consistent feature of the water bodies in the Project regions and therefore the water within the Project area does not generally conform to the ANZECC guideline;
- Turbidity is high;
- The high turbidity is typical of ephemeral streams which are characterised by short periods of flow (Smith et al, 2004) and for catchments exhibiting natural erosion and impacting land use that can increase erosion. This finding is consistent with geochemistry investigations undertaken for the EIS which show that clay subsurface materials are dispersive (refer Volume 5, Appendix J of the EIS) and surface soils investigations (refer Volume 2, Section 5 of the EIS) that found localised areas, primarily within the Rhi and Dunrobin soil mapping units along minor drainage lines which originate from the upper slopes exhibit moderately to severe sheet and gully erosion;
- Nutrient concentrations (N, P) are elevated relative to guideline trigger values.
- The source of elevated nutrients is likely attributable to grazing land use and erosion in the catchment. All soils present on the Project site are considered largely deficient of major soil nutrients (refer Volume 2, Section 5 of the EIS), erosion alone may not be the dominant influence on nutrient levels in the local surface waters. In streams, decay of organic matter is also a potential source of elevated nutrients. The exceedence of the guideline values for nutrient concentrations does not necessarily indicate that the levels are unsustainable or unnatural. Rather it draws attention to the limited scientific data available to characterise natural concentrations, speciation, and variability of nutrients in ephemeral streams and emphasises the need for the Project to maintain reference site water quality monitoring; and
- Some metalloid toxicant concentrations in the surface water data exceed the identified trigger values for protection of aquatic ecosystems, including copper, zinc, and aluminium. Not all of the available water quality sample results exceeded the identified trigger value for zinc while copper and aluminium concentrations consistently exceeded the identified trigger value.
- The elevated soluble concentrations of these metals in the local surface water are inferred to be directly attributable to erosion of natural sediments from the catchment and the high turbidity observations. Multi-element analyses in the geochemistry investigations undertaken for the EIS (refer Volume 5, Appendix J) show that clay subsurface materials have copper concentrations of 20-30 mg/kg, zinc concentrations of 40-110 mg/kg, and aluminium concentrations of 60,000 - 100,000 mg/kg. Distilled water extracts of geochemistry investigation samples reported copper concentrations up to 0.004 mg/L, zinc concentrations of 0.02 to 0.09 mg/L, and aluminium concentrations of 0.08 to 2 mg/L.
- The available water quality data did not identify any concerns with water quality required for livestock drinking water supply

These findings confirms that the most appropriate ecosystem condition for the receiving waters in the vicinity of Project, is ‘slightly to moderately disturbed system’

The monitoring and sampling for metals concentrations will be maintained as part of the reference site water quality monitoring program.

The inferred Surface Water EVs for sustainable geomorphologic conditions of the watercourses include:

- Low flow (active) channels are shallow and typically have sandy (mobile) bed sediment and alluvial clay banks;

- Meandering of the low flow (active) channel occurs within a relatively linear floodplain corridor;
- The western areas of Sandy Creek and Spring Creek are a source that sustain sediment supply to the streams;
- Lagoon Creek, which is the main valley drainage feature, is a sediment store during small flow events and sediment source during large and extreme floods;
- The floodplains of watercourses limit the flow energy in the low flow (active) channels during flood events and are an important influence for the dynamic equilibrium of the channel stability; and
- There is evidence of historical migration of the active channels of Sandy Creek and Spring Creek across their respective alluvial fan floodplains.

The stream flows have high turbidity which may be attributable to catchment and in-stream erosion and dispersive clays are present in the catchment below the topsoil horizon. It is evident that existing land use has some influence on the existing turbidity levels. The clay sub-soils have natural metal mineralisation particularly for copper, zinc and aluminium, and combined with the evidence of high turbidity are a likely influence on slightly elevated metal concentrations in stream flow quality.

#### V.3.4.1.5 *Derived local values*

The development of local guidelines is promoted as it was observed that multiple parameters measured in Native Companion Creek and the recent surface water field sampling showed regular exceedances of the ANZECC (2000) and QWQG trigger values.

Nine of the sampling sites meets all the QWQG's reference site's criteria The QWQG's methodology to derive local values from reference site was applied to the collected data set. The selected monitoring sites are listed in Table V-14. Sites 1, PT3, PT4, PT5, A4 and A8 did not comply with the first condition listed below as soil disturbance activities were reported upstream of these points.

**Table V-14 Selected reference sites**

| Conditions | 11 | 13 | A1 | A2 | A5 | A9 | NCC | PT1 | PT2 |
|---|---|---|---|---|---|---|---|---|---|
| No intensive agriculture within 20 km upstream (irrigation, widespread soil disturbance, use of agrochemicals and pine plantations). Dry-land grazing does not fall into this category. | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| No major extractive industry within 20 km upstream. | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| No major urban area (>5,000 population) within 20 km upstream. | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| No significant point source wastewater discharge within 20 km upstream. | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Seasonal flow regime not greatly altered. | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |

It should be noted that the number of sampling event collected to date is not sufficient to be statistically representative as at least 12 events would need to be sampled to establish local values. In addition according to the QWQG, at least 8 events should be sampled to establish interim values. Therefore, the number of data sets was not sufficient to establish interim values as per the legislation requirements. However, as further data is currently collected and the number of events (7) is quite close to the requirement (8), local values were derived to establish which parameters require local values, and demonstrate the logic and method that will be applied to calculate final local values.

The local values, presented in Table V-15 are considered low reliability interim values. Interim local values for toxicants are presented in Table V-16.

## Table V-15 Interim local values for physico-chemical parameters

| Parameters | Local value | Comment | Monitoring frequency |
|---|---|---|---|
| pH | 6.5-7.5 * | Based on 80$^{th}$ % of sampling results | Daily during release with the first sample taken within two hours of the commencement of release |
| Turbidity (NTU) | 207 * | Based on 80$^{th}$ % of sampling results | |
| Electrical conductivity ($\mu S.cm^{-1}$) | 250 * | Based on ANZECC guidelines | |
| Total Suspended solids (mg/L) | 123 * | Based on 80$^{th}$ % of sampling results | |
| Dissolved Oxygen (%) | 55.1 *<br>85 * | Based on 80$^{th}$ % of sampling results | |
| Sulphate (mg/L) | 1.3 * | Based on 80$^{th}$ % of sampling results | |
| Ammonia (mg/L) | 0.05 * | Based on 80$^{th}$ % of sampling results | |

*: local trigger values to be developed prior to notification of the draft EA

## Table V-16 Interim local values for toxicants

| Parameters | Local values | Rational |
|---|---|---|
| Total Phosphorus (mg P/L) | 0.21 * | Based on 80$^{th}$ % of sampling results |
| Total Nitrogen (mg N/L) | 0.91 * | Based on 80$^{th}$ % of sampling results |
| Calcium (mg/L) | 14.20 * | Based on 80$^{th}$ % of sampling results |
| Nitrite + Nitrate (mg N /L) | 0.076 * | Based on 80$^{th}$ % of sampling results |
| Fluoride (mg/L) | 0.1 * | For aquatic ecosystem protection, based on LOR for PC titrator |
| Aluminium (mg/L) | 0.65 * | Based on 80$^{th}$ % of sampling results |
| Arsenic (mg/L) | 0.001 * | For aquatic ecosystem protection, based on LOR for ICPMS |
| Boron (mg/L) | 0.001 * | For aquatic ecosystem protection based on LOR for ICPMS |
| Cadmium (µg/L) | 0.1 * | For aquatic ecosystem protection based on LOR for ICPMS |
| Chromium (mg/L) | 0.001 * | ANZECC 95% SMD value for aquatic ecosystem protection based on LOR for ICPMS |
| Copper (mg/L) | 0.002* | Based on 80$^{th}$ % of sampling results |
| Cobalt (mg/L) | 0.001 * | For aquatic ecosystem protection, based on LOR for ICPMS |
| Iron (mg/L) | 1.19 * | Based on 80$^{th}$ % of sampling results |
| Lead (µg/L) | 1 * | For aquatic ecosystem protection, based on LOR for ICPMS |
| Manganese (mg/L) | 0.13 * | Based on 80$^{th}$ % of sampling results |
| Mercury (µg/L) | 0.1 * | For aquatic ecosystem protection, based on LOR for CV FIMS |
| Molybdenum (mg/L) | 0.001 * | For aquatic ecosystem protection, based on LOR for ICPMS |
| Nickel (mg/L) | 0.002 * | ANZECC 95% SMD value for aquatic ecosystem protection |
| Selenium (mg/L) | 0.010 * | For aquatic ecosystem protection, based on LOR for ICPMS |

| Parameters | Local values | Rational |
|---|---|---|
| Silver (mg/L) | 0.001 * | For aquatic ecosystem protection, based on LOR for ICPMS |
| Zinc (mg/L) | 0.14 * | Based on 80$^{th}$ % of sampling results |
| Vanadium (mg/L) | 0.01 * | For aquatic ecosystem protection, based on LOR for ICPMS |
| Uranium | 0.001 * | For aquatic ecosystem protection, based on LOR for ICPMS |
| TPH (C6-C9) (mg/L) | 20 * | Based on analytical LOR (ALS method EP080/071) |
| TPH (C6-C9) (mg/L) | 100 * | Based on analytical LOR (ALS method EP080/071) |

*: local trigger values to be developed prior to notification of the draft EA

All metals and metalloids must be measured as total (unfiltered) and dissolved (filtered). Trigger levels for metal/metalloids apply if dissolved results exceed trigger.

Following the baseline monitoring, it is recommended to update site specific local values. Specific local values should be established for Murdering Lagoon as soon as the data becomes available.

### V.3.4.2 End-of-pipe discharge limits - Discussion

#### *V.3.4.2.1.1 Flow trigger*

It is proposed to adopt a flow trigger based on one third of the 1 in 2 year ARI peak flood flow for Lagoon Creek. The Flooding Technical Report (SEIS Volume 2, Appendix K) indicates that the 1 in 2 year ARI peak flood flow for Lagoon Creek is ~30 $m^3/s$. Therefore, a practical flow trigger for controlled releases from the Alpha Project is 10 $m^3/s$.

For events with flows exceeding 10 $m^3/s$, Native Companion Creek Violet Grove gauge station data shows that flow recession periods, after the flow falls below 10 $m^3/s$, extends typically for two to five days. Therefore, the 10 $m^3/s$ flow trigger allows sufficient post-event flushing of the creek.

#### V.3.4.2.2 *End-of-pipe contaminant release rationale*

End-of-pipe (EOP) contaminant release limits for pH, electrical conductivity, TSS, and sulphate have been proposed. These limits have been developed based on a high dilution ratio of 1:10 and calculated using the formula below (example provided for EC).

*Upstream flow x Upstream EC + Discharge flow x Discharge (EOP) EC = (Upstream flow Discharge flow) x Downstream Target EC.*

The available data from the DERM gauge at Violet Grove on Native Companion Creek for EC versus flow (~5,445 readings) indicates that when streamflow exceeds the proposed flow trigger of 10 $m^3/s$, EC is approximately 220 µS/cm. With an upstream EC of 220 µS/cm, the calculated EOP contaminant release limit is 2,020 µS/cm.

Therefore, a discharge level of 2,000 µS/cm, will not cause receiving water EC levels to exceed the maximum receiving water trigger level of 400 µS/cm.

The available data from the DERM Violet Grove gauge shows that the maximum TSS level recorded has been 1,500 mg/L. Analysis of the available data on TSS versus flow for the site shows that TSS levels are highly variable with flow. Therefore, a conservative approach was adopted and the maximum reading (~862 mg/L) above 10 $m^3/s$ was used as the upstream value for the calculation. A contaminant limit of 7,242 mg/L was obtained.

It is expected that the sediment dams would achieved a lower TSS level. Therefore, based on professional experience it is proposed to adopt a TSS level of 2,000 mg/L to ensure an appropriate level of protection of the aquatic ecosystem.

The available data from the DERM Violet Grove gauge shows that the maximum sulphate level recorded has been 17 mg/L. Analysis of the available data on sulphate versus flow for the site shows that sulphate levels are highly variable with flow. Accordingly the release limit equivalent to the maximum recorded. Therefore, a conservative approach was adopted and the maximum reading (~4 mg/L) above 10 $m^3$/s was used as the upstream value for the calculation. A contaminant limit of 163 mg/L was obtained.

#### V.3.4.2.3 *Groundwater Resources*

The Alpha Coal deposit lies on the eastern side of the Galilee Basin. The geology consists of gently westerly dipping (generally <1º dip) sediments of Permian age, overlain by Tertiary and Quaternary sediments. Permian sedimentary deposits at site comprise the Bandanna Formation and the underlying Colinlea Sandstone. The Bandanna Formation hosts the A and B coal seams, while the Colinlea Sandstone hosts the target C and D coal seams.

From a groundwater perspective, major hydrostratigraphic boundaries occur within MLA 70426 at the base of weathering, beyond which groundwater is often encountered under confined conditions in the B-C and C-D sandstone interburden, the coal seam aquifers, and at the base of the D coal seam. The sandstone unit directly below the D coal seam and above the E coal seam (D-E Sandstone) will be depressurisation (to facilitate safe mining conditions), while the overlying sandstone (B-C sandstone, C-D sandstone, and C and D coal seams) will need to be locally dewatered in order for mining to occur safely.

Below the D-E sandstone the Colinlea sandstone coarsens with increasing depth. The sub-E sandstone (between the E and F coal seams) and sub-F sandstone (below the F coal seam and to the base of the Colinlea Sandstone) are, where sufficiently thick, regarded as containing significant groundwater resources.

Perched seasonal water tables, with limited sustainable groundwater potential, can occur within the clay-rich Tertiary sediments and restricted Quaternary alluvium deposits across MLA 70426.

A review of the Nature Conservation and Cultural Heritage reports indicated that there are no recognised Groundwater Dependent Ecosystems (GDEs) within the study area. A palustrine wetland (modified ox-bow lake) has been identified within the Lagoon Creek drainage feature. Available groundwater level data indicates that the ox-bow lake is separated from the groundwater table by ~ 10 m unsaturated zone (Additional details are included in Volume 2 Appendix N).

### V.3.4.3 Environmental Values

#### V.3.4.3.1 *Surface Water Environmental Values*

Legislative basis for the water quality management in Queensland is the Environmental Protection (Water) Policy 2009 (EPP Water). The EPP Water includes a process for determining environmental values (or uses) of waterways and corresponding water quality objectives. According to the EPP Water, the surface water environmental values potentially affected by the Project include the:

- • biological integrity of the water courses;
- • suitability of the water for agricultural uses;
- • suitability of the water for supply as drinking water;

- • suitability of the water for recreational use;
- • suitability of the water for industrial use; and
- • cultural and spiritual values.

However, Environmental Values (EVs) for the watercourses through and downstream of the Project area are not defined in the Schedules to the Environmental Protection Policy (Water) (2009). Detailed investigations undertaken to prepare the SEIS have identified site environmental values, as follow.

***Biological integrity***

Surface aquatic flora and fauna of the watercourses associated with the Project were monitored as part of the baseline studies undertaken for the Project. The aquatic flora and fauna assemblages associated with the Project watercourses are generally typical of the region. Preliminary identification of environmental values has been undertaken based on the EIS studies including aquatic ecology studies. The studies identified that the existing catchments have some level of disturbance, aquatic fauna are limited to hardy species that tolerate variable water quality, and macro invertebrate assemblages are not pristine.

The surface water can be considered to have environmental values relevant to biological integrity.

***Agricultural and Industrial use***

Agricultural use of surface water in the Project area is primarily related to livestock watering. The land capability and suitability assessment conducted for the Project supports the existing use of cattle grazing as being the most suitable agricultural use for the area.

There are few existing (licensed) beneficial uses of surface water that utilise surface water from the existing watercourses, however the Water Resource (Burdekin Basin) Plan 2007 (Burdekin Basin WRP) has provisions to make water available in the Belyando-Suttor sub-catchment to support growth in irrigated agriculture. Although the watercourse stream flows through the Project site are ephemeral and are not sufficiently reliable to sustain permanent water supply, the infrequent flow periods have some value to supplement other water sources for livestock drinking supply. Therefore the surface water can be considered to have environmental values relevant to stock watering.

Due to the ephemeral nature of the creeks within the MLA, there is no known environmental value in relation to industrial use of surface water within the Project area.

***Recreational use***

Due to the ephemeral nature of the creeks within the MLA, there is no known environmental value in relation to recreational use of surface water within the Project area.

***Drinking water***

The environmental values in relation to drinking water were assessed against quality parameters contained in the Australian Drinking Water Quality Guidelines (NHMRC & ARMCANZ, 2004). The results of the monitoring undertaken to date indicate that there are a number of water quality parameters that are exceeded in the Project area. These include: Turbidity, Aluminium, Iron, Zinc, etc. Therefore the surface water cannot be considered to have environmental values relevant to drinking water.

***Cultural and spiritual values***

There is no known environmental value in relation to cultural and spiritual values of surface water within the Project area.

***Summary of environmental values***

The primary environmental values applicable to surface water are considered to be biological integrity and agricultural uses. These values are applicable due to the importance of surface water to the local surface aquatic ecosystems and remnant riparian vegetation, and the potential use of the creeks as sources of water for agricultural use.

The identified Surface Water EVs for protection of water quality and quantity include:

- Biological integrity of slight to moderately disturbed ecosystems;
- Cultural and spiritual values; and
- Suitability for primary industry uses, including irrigation and stock drinking water.

#### V.3.4.3.2 *Groundwater Environmental Values*

During the hydrogeological studies conducted during the compilation of the EIS and SEIS groundwater was assessed for the following Environmental Values (EVs):

- Agricultural purposes - groundwater in the Project area is used extensively as stock watering supply and, based on current usage patterns, groundwater has an EV of agricultural purposes, specifically stock watering of beef cattle and horses; and
- Drinking water supply – through a bore survey, groundwater in the area has been identified as suitable for potable use. Each farm visited during the bore survey identified a “house” bore, which is used for domestic purposes.

The main EVs for groundwater in the MLA area is, therefore, domestic use,

### V.3.4.4 Potential Impacts on the Environmental Values

#### V.3.4.4.1 *Surface Water Impacts*

The potential impacts on surface water values include:

- Impacts on hydrology (stream flows in the local water courses);
- Impact on surface water quality;
- Impacts on flooding; and
- Impacts on stream stability (stream morphology).

The potential impacts on surface water hydrology can include reduced stream flows as a result of isolating the mine water management system catchments from the natural watercourse catchments. Containment of the disturbed mine area catchments within the mine water management system will be an essential requirement to protect against potential impacts on surface water quality. Another potential impact may include the redistribution of flows from diverted catchments, which may cause an increased runoff response rate. An example of such a scenario is Spring Creek, which currently terminates before its confluence with Lagoon Creek, dispersing its flows across a wide area.

The potential impacts on surface water quality include:

- Increased catchment surface erosion due to land disturbance during the construction phase, operational phase, and post closure phases (if rehabilitation is not successful);
- Stream channel erosion and destabilisation if stream diversions are not adequately designed, or rehabilitated, or if flood protection levee banks place too much constriction on the flood plain corridor;

- Uncontrolled or non-compliant release of contaminated mine water; and
- Water management incidents, including spills, poor storage of contaminating substances, or if the mine water management system is not adequately maintained and operated.

The consequent effects of potential uncontrolled impacts on surface water quality can include:

- Increased turbidity;
- Increased or reduced sediment bed load and consequent physical impact on aquatic ecosystems;
- Increased salinity; including sulphates, chloride, and sodium concentrations with consequent impacts causing physical-chemical stress on aquatic ecosystems, and impact on macro invertebrate communities. If salinity, or the concentrations of salt species is excessively increased, the surface water quality may impact on environmental values for primary industry and livestock drinking water supply;
- Increased dissolved metals concentrations and consequent toxic effects on aquatic biota;
- Elevated nutrient concentrations and consequent effects on eutrophication of downstream water-bodies; and
- Release of imported (unnatural) contaminants that do not occur naturally such as chemicals and pesticides and consequent toxicity effects on aquatic biota or long term effects for bio-accumulation in aquatic biota.

The combination or the proposed stream diversions and flood protection levee banks can potentially impact on flood levels along Lagoon Creek. Changes in design flood peak water levels may not necessarily be a concern in a remote area, providing that third party infrastructure and facilities are not impacted and the Project design accommodates the design flood levels.

The potential impacts of stream diversion and/or floodplain constriction can include instability of stream channel with consequent impacts including:

- Excessive erosion leading to water quality impacts, unsustainable downstream sediment loads, and impacts on aquatic ecosystems; and
- Excessive lateral migration of the stream channel with risk to valuable infrastructure, riparian vegetation loss, and impacts on terrestrial ecosystems near the stream.

The most common causes of impacts due to stream diversion design can include:

- Diversion channels that are too short and / or steep relative to the original stream;
- Channel dimensions not matching the original channel resulting in change of the bank-full flood capacity of the channel which modifies the frequency and energy of bank-full flood events and floodplain interaction;
- Channel meander design not compatible with the expected channel flow energy and substrate conditions;
- Channel substrates that are markedly different to the original stream resulting in either poor rehabilitation of the stream, and / or greater vulnerability to erosion; and
- Excessive constriction of the floodplain corridor resulting in concentration of floodplain flow and higher energy in the stream channel.

#### V.3.4.4.2 *Groundwater Impacts*

A summary of potential impacts of mining activities on the groundwater resources, including EVs, has been compiled based on the data compiled in EIS Section 12.9 and post EIS groundwater studies, including a bore survey.

**Impact Summary**

- Groundwater level decline (due to depressurisation of confined aquifers) resulting in reduced available drawdown and higher heads within bores (which can result in decreased bore yield depending on pump type), and the alteration to groundwater flow patterns and gradients;
- Based on groundwater model predictions, a decline in groundwater levels of 5 m or less may be experienced at distances up to 10 km from the MDL boundaries (along strike);
- Artificial recharge can result in downward seepage that causes mounding (alteration of groundwater patterns and possible waterlogged areas) and offsite contaminant migration via shallow groundwater flow to the surface water system;
- A final void resulting in a groundwater sink (due to negative climate balance) that will permanently alter local groundwater flow patterns, drawing groundwater flow toward the void;
- The post-mining (final void) groundwater flow patterns will be toward the final void, which will limit the potential for offsite movement of potentially contaminated groundwater; however the greatest potential for offsite contaminant migration (in groundwater) would remain as localised seepage from the proposed TSF that can potentially enter the surface water drainage system (i.e. Lagoon Creek).

The potential impacts on environmental values due to groundwater drawdown are assessed as:

  - Groundwater level drawdown in existing groundwater bores has the potential to impact on the yield of groundwater supply bores, both domestic and for agricultural purposes (stock watering) by causing material interference to bores (e.g. by limiting the available drawdown in the bore, or by drawing the water level down below the existing pump intake); and
  - The presence of the open-cut mine will result in a zone of influence that will alter groundwater flow directions towards the mining pit and will reduce shallow groundwater resources (perched water tables and alluvium aquifers as described in SEIS Volume 2, Appendix N), which could impact on vegetation communities.

**Mitigation of seepage**

The current TSF design includes lining of the base and installation of under drainage in order to mitigate seepage risks. All mine infrastructure water and waste storage facilities will be designed and constructed, according to industry norms, to include seepage mitigation. The existing groundwater monitoring network has been enhanced (SEIS Volume 2, Appendix N) to allow for the monitoring of groundwater level and quality and any departures from natural fluctuations (such as potential seepage adjacent (down gradient) of the proposed TSF. Fourteen (14) additional monitoring bores are to be constructed adjacent and down gradient of selected mine infrastructure (with the potential to alter groundwater resources) at least 6 months prior to mining.

The groundwater monitoring network, installed during the compilation of the EIS, has been and will be enhanced to monitor the potential impacts of the mine infrastructure on the groundwater resources to the east of Lagoon Creek. The existing and proposed monitoring points are included in Table V-40.

**Summary of Impacts on Groundwater Environmental Values**

The groundwater Environmental Values (EV's) were identified as:

- Domestic purposes – groundwater samples collected during the bore survey (SEIS Volume 2, Appendix N) from "house" bores, which are used for the supply of domestic use groundwater, were compared to the Australian Drinking Water Guidelines. The only exceedances above the guidelines were, electrical conductivity, with all bore samples exceeding the 100 µS/cm guideline value. The remaining results indicate the groundwater is suitable for use for drinking purposes.
- Agricultural purposes - groundwater use in the Project area, based on the bore survey results, indicates that the majority of groundwater extracted in the Project area is used for stock watering;
- Cultural and spiritual values – permanent or semi-permanent surface water features that are maintained to some degree by groundwater flow may have cultural significance in an area where surface water is normally ephemeral; and
- Surface water features that may receive baseflow from shallow alluvium or perched groundwater are generally accessed by cattle for drinking water supply. Based on existing land use and interaction of cattle with waterways, it is interpreted that surface water features in the area would have an EV applicable to moderately disturbed waters.

The potential impacts of mining activities on the groundwater resources, and recognised EVs, are:

- The envisaged or predicted decline in groundwater levels (potentiometric pressures in the confined D-E sands) as a result in mine dewatering (C-D sands due to open pit mining to the D coal seam) and depressurisation of the D-E sands.
- Potential alteration in groundwater quality, due to possible poor quality seepage from water and waste storage facilities, will be limited as groundwater will flow towards the final void and not off site.

The impacts of reduced groundwater levels on the EVs include:

- Reduced groundwater sourced baseflow to creeks and other surface water features;
- Alteration in groundwater flow patterns, resulting in the potential for losing streams and reduced surface water flow and water for biological integrity of the aquatic ecosystems; and
- Decrease in bore production.

These impacts are to be assessed over time through optimum monitoring programs and mitigated through the make-good commitment, including the provision of alternative water supplies to affected water resources.

### V.3.4.5 Environmental Protection Objectives

The environmental protection objectives for surface water values are as follows:

- To maintain the existing chemical, physical and biological integrity of downstream water quality to protect aquatic ecosystems and suitability of water for irrigation and livestock drinking water supply;
- Prevent excessive erosion and contain sediment laden runoff;
- Contain contaminated mine waters from all disturbed areas with sufficient storage capacity to limit the potential for overflow to the environment (i.e. risk based design criteria for containment capacity);
- Control all active discharges of waters from the mine water management system, including timing controlled by flow rates in the receiving waters, rate of discharge is controlled and measurable, and discharge waters comply with end-of-pipe discharge criteria;
- Monitor and assess the impacts the controlled discharges;
- Allow clean undisturbed natural catchment areas to drain passively to the watercourses;
- Segregate and manage mine water streams according to their quality;
- Design, construct, maintain, and monitor stream diversions to achieve geomorphologic stability with dynamic equilibrium similar to the existing watercourse characteristics;
- Ensure the mine has an appropriate level of protection to the extent that residual risks of extreme floods over the life of the Project are low;
- Ensure flood levels upstream and downstream of the MLA do not pose increased risk to the access or functionality of third party infrastructure and facilities; and
- Water management required for mine closure is passive, low maintenance, and designed to meet water quality objectives and sustainable rates of sediment transport to waterways.

#### Groundwater Objectives

The environmental protection objectives for groundwater are to:

- Ensure the Project does not detrimentally impact on the availability and suitability of groundwater for domestic and agricultural use (stock watering).
- Protect cultural heritage or spiritual values associated with surface water features that are maintained by groundwater (if any).
- Mine infrastructure will be designed and constructed to manage any potential seepage from water and waste storage facilities in order to minimise the potential impact on groundwater aquifers during the life of the mine and after mining ceases.
- Ensure no impact on the major recharge mechanism, diffuse recharge in the Great Dividing Range, such that there will be continued recharge for the life of the mine and after mining ceases.
- Utilise groundwater intersected during mining for mining activities and operations, so as to limit the need to import or diminish water resources outside of the mine area. and

- Recycle and reuse of groundwater extracted during mining.

### V.3.4.6 Performance Criteria

The performance criteria for surface water values are:

- The residual impacts of erosion are contained upstream of where runoff enters the watercourses;
- An erosion and sediment control plan is prepared, implemented, and monitored for all surface disturbance areas. The erosion and sediment control plan will be prepared prior to commencement of construction;
- All surfaces disturbed by construction that will be outside the catchments of the operational phase mine water management system are rehabilitated;
- Runoff from all disturbed areas across the mine site during the operational phase is contained by a mine water management system;
- Clean (undisturbed) catchment areas are diverted to bypass the mine water management system;
- All active (controlled) discharges comply with the Environmental Authority criteria, including discharge location, timing, quantity, and quality;
- Stream flow upstream of the licensed controlled discharge location is monitored and controlled discharges only occur when stream flow reaches the trigger level specified in the environmental authority;
- Water quality at the downstream monitoring point is monitored during controlled discharges and complies with Environmental Authority water quality criteria for receiving waters;
- The mine water management system is operated and maintained to provide sufficient storage capacity to limit the probability of overflow to criteria specified in the Environmental Authority;
- The storage capacity of the mine water management system is reviewed annually;
- The hazard category of all dams is reviewed annually;
- All significant and high hazard category dams are licensed as Regulated Dams, and designed, constructed, operated, and maintained to the criteria required for Regulated Dams;
- Mandatory Reporting Levels are specified and marked for all Regulated Dams that can overflow to outside the extents of the mine water management system;
- Minimum level of flood protection for the mine pits is for 1,000 year ARI flood events;
- Flood protection levees are licensed, and maintained as Regulated structures throughout the mine life;
- The length of stream diversion channels is not less than the original stream reach length;
- The longitudinal bed level gradient of stream diversion channels is not steeper than bed level gradient of the original stream;
- Stream diversion design limits the channel velocity, stream power, and shear stress to conform with DERM and ACARP guidelines, or less than 20% increase above existing stream hydraulic parameters where guidelines are not applicable;
- Stream diversion rehabilitation is compatible with the geological substrates along the stream diversion;
- Dispersive soils are not left exposed on the stream diversion bed, banks, or floodplain areas;

- Stream diversion and flood protection design provides sufficient floodplain corridor width to allow safe passage of extreme floods;
- Stream diversions are licensed. Stream diversions are maintained in accordance with licence conditions; and
- Mine closure runoff quality meets the water quality objectives for the identified surface water environmental values.

The performance criteria for groundwater resources are:

- There will be no adverse changes to groundwater quality, outside the predicted zone of influence around the mine, as a direct result of the mine project;
- Alteration of recharge to the Colinlea Sandstone unit is to be kept to a minimum;
- No alteration of the diffuse recharge areas along the Great Dividing Range so as to ensure recharge during the life of the mine and after mining ceases;
- A final void will remain at the end of mining to ensure the zone of influence, both groundwater level changes and hydrochemistry, will be managed and maintained and after mining ceases
- Landholders concerns over impacts on their water supplies are dealt with in a timely and prompt manner.

### V.3.4.7 Control Strategies

#### V.3.4.7.1 *Surface Water Control Strategies*

An Erosion and Sediment Control Plan (ESCP) will be prepared prior to construction. The ESCP will be tailored to suit the specific construction activities and associated hazards for construction. Controls will be established to a standard consistent with Institution of Engineers Australia Erosion and Sediment control guidelines. Implementation of the ESCP is to be monitored. The monitoring shall include monitoring of the erosion and sediment control devices, works, and water quality monitoring. Deficiencies identified from monitoring shall be rectified.

The ESCP will include:

- Identification of soil and water management issues, including existing site conditions, soil and climatic data, erosion prone areas, location of the nearest and other relevant environmentally sensitive areas.
- Clear understanding and application of proposed control measures including the following actions - minimise disturbance, provide temporary and permanent drainage measures as early possible, identification of suitable erosion and sediment controls for the site, implement effective revegetation.
- Drawings to accompany the ESCP identifying the development and staging of works of temporary erosion and sediment control measures, including measures to cope with heavy rainfall events to aid in limiting unforseen construction delays due to wet weather.
- Compliance with the recognised approval processes.
- Maintain and supervise implementation of the ESCP, and undertake scheduled inspections of the implementation of the ESCP.
- Undertake monitoring of the effectiveness of the ESCP including diary notes/logbook entries of control techniques used on-site, and water quality sampling both upstream and downstream of disturbed areas.

Erosion and sediment controls include:

- Maintain channel equilibrium for the key hydraulic parameters, including velocity, stream power and shear stress.
- Where these hydraulic parameters exceed the accepted values, be it reference values or guideline values, then these are mitigated by increasing roughness of the channel and associated flood plain by means of vegetation, locally dumped rock and introduction of pools. No structural mitigation will be applied as this is deemed unsustainable.
- Where possible, avoid disturbance to natural watercourses and riparian areas, and reinstate any disturbed areas.
- Reduce or limit overland flow runoff volume and velocity by minimising catchment size, increasing flowpath length, and providing for water infiltration into soils.
- During the construction phase, early planning and construction of temporary drainage systems will minimise erosion and avoid delays in initial earthworks.
- Diversion of upslope water to reduce on-site erosion by limiting catchment size, thereby reducing total volume of contaminated runoff requiring treatment and reduced downtime following prolonged rain events.
- Install permanent drainage structures as early as possible, including stabilised drainage outlets.

The construction schedule will be strategically sequenced to enable early construction of the operational phase infrastructure that can assist to control sediment loss (e.g. drainage, levee banks and dams).

A mine water management system will be implemented to provide holistic control of a wide range of potential surface water impacts through the following strategies:

- Ensuring that all disturbed surfaces that have potential to generate contaminated mine water are within the extents of the mine water management system. This will contain all potentially contaminated mine water;
- Reusing mine water from the mine water management system to supply the mine operations water demands. This will ensure that storage capacity can be continually maintained to provide capacity to contain heavy rainfall events;
- Controls enforced through environmental authority conditions to ensure sufficient storage is provided to cater for extreme wet season rainfall events; and
- Controlled discharges are compliant with controlled discharge criteria that have been developed to protect the downstream environment. The controlled discharge criteria include:
  - that controlled discharges are only allowed when Lagoon Creek has sufficient flow,
  - a limit on the rate of discharge to ensure sufficient dilution,
  - end-of-pipe water quality limits, and
  - that downstream salinity (EC) will be less than 400 µS/cm and consistent with other water quality objectives for the downstream environmental values.
  - The discharge rate will be limited to 10% of the receiving stream upstream flow. Or, in other words the minimum volumetric dilution of the discharge will be 1:10. This is an essential element that will be used to control the loading of the discharge relative to the stream flow to remain below the recommended downstream maximum EC.

### Water Management Objectives

In line with leading industry practice, the objectives of the water management system design for the Project are to:

- Provide for the separation and diversion of clean water away from the mine site.
- Minimise the volume of pit water (surface runoff draining to pit and groundwater seepage) generated by the Project.
- Avoid the need for discharge of contaminated water under normal operating conditions through preferential onsite reuse of contaminated water stores.
- Provide sufficient onsite storage to give an acceptable level of risk of accidental off-site discharge of contaminated water during significant rainfall events (no unplanned discharge under modelled historical conditions).
- Provide sufficient onsite storage to settle coarse suspended solids from dirty water (from overburden dumps and other disturbed areas) during significant rainfall events, through the application of the relevant guideline sediment dam storage capacity.
- Provide the flexibility to preferentially reuse sediment dam water onsite or release it to the creek, depending on the site water balance, stored water quality, and natural flows in the creek.

### Water Management System

Five water classifications have been nominated for the mine site, as described below:

- **Process water management system** – managing process water that has been used in the coal handling and processing plant (CHPP). This includes the tailings storage facility, decant dam and return water system (for reuse in the CHPP).
- **Clean water system** – separating clean runoff from undisturbed areas from the contaminated and dirty water management systems, and diverting it to the creek system. This type of water has low turbidity and low salinity.
- **Contaminated water management system** – managing runoff from the open pit and other areas that could contribute contaminants, such as the MIA, CHPP, coal stockpiles and dump stations.
- **Dirty water management system** – treating runoff from overburden dumps and other disturbed areas that could contain sediment.
- **Groundwater management system** – groundwater will be extracted from the aquifer(s) using a borefield to minimise seepage into the pit. Bore water will be stored in environmental dams for onsite reuse.

### Clean Water System

Clean water runoff from undisturbed catchments will be diverted around the mine site.

The clean water system comprises:

- Diversion of Lagoon Creek, Sandy Creek and Spring Creek. Levees will be provided parallel to the diversion drains and creek to control flow and prevent waters entering the pit area and the adjacent tenement. The design criteria for pit flood immunity is the 3,000 year ARI storm event (equivalent to 1% chance of failure over the 30 year life of the mine).
- Highwall dams, levees and additional intermediate diversion drains west of the pit to capture and divert water runoff from undisturbed catchments.

- Raw water dam to store water imported to the site.
- A pump and pipeline system from the raw water dam to deliver stored water to either:
  - CHPP (for processing of ROM coal into product coal)
  - MIA (for vehicle wash and workshop)
  - ROM dump and transfer stations (for dust suppression via sprayers)
  - Water treatment plant (for potable applications).

Clean water runoff from the rehabilitated spoil dumps will runoff to Lagoon Creek at completion of mining. Water from rehabilitated areas will be released once rehabilitation success criteria are met.

### Creek Diversions and Levees

The Project comprises three diversions:

- Lagoon Creek Diversion:
  - the Lagoon Creek diversion comprises the diversion of the active channel only, to another location within the natural flood plain. The 9.6 km long diversion channel is designed to connect the existing upstream and downstream natural active channels, while providing a degree of meandering to replicate the existing channel. The excavated channel is a combination of the active (2 year ARI flows) and high flow (50 year ARI flows) channel but, similar to the existing active channel does not feature a separately distinguishable low flow section set into the high flow channel
  - a levee situated on the west (left) bank of Lagoon Creek through the MLA, will provide flood immunity of up to 3000 year ARI. The topography on Lagoon Creek's right (east) bank rises rapidly and therefore mine infrastructure on the east bank is unaffected by the floods
  - the Lagoon Creek diversion will allow unimpeded access to coal reserves. The route allows adequate offsets between the diverted creek and proposed mining operations, reducing any impact that the mining operations will have on the water flow in Lagoon Creek. The diversion is anticipated to provide a stable and sustainable creek alignment for Lagoon Creek into the future.
- North Western diversion (Sandy Creek):
  - the north western diversion totals 25.5 km in length, of which Sandy Creek comprises 11 km. The remaining length of the channel captures overland flows and discharge from unnamed creeks. The most northern section of this diversion channel is located just inside the perimeter of the MLA and includes an additional levee on its left bank, to avoid flood waters from this diversion affecting the adjacent property. The diversion is designed with a high flow channel to 50 year ARI and includes a low flow channel sized to 2 year ARI. This diversion rejoins the original Sandy Creek some 100 m before the confluence with Lagoon Creek
  - a flood levee is located adjacent to, and on the mine side of the diversion channel and provides flood immunity to the mine to 3000 year ARI. In the event of floods exceeding 50 year ARI, flood water will rise against the levee and temporarily inundate the immediately adjacent (upstream) land. No third party properties are affected
  - additional levees may be included between the diversion and the MLA boundary to avoid break out of flows from the diversion to adjacent third party properties, and similarly to protect the Alpha infrastructure from adjacent creeks (e.g. Little and Rocky Creek).
  - The corridor reserved for the diversion and levees is set at 240 m width from the MLA boundary, which provides an additional 90 m to 100 m of width between the levee toe and the pit high wall. Current available geotechnical and geological data suggests that this distance is

sufficient to ensure stability of the diversion and levees. Should further investigation determine that the corridor is not wide enough and diversion / levee stability may be compromised, then the mine pit strike length may be reduced.

- Southern diversion (Spring Creek):
  - the south western diversion totals 11.2 km in length, of which Spring Creek comprises 10 km, running parallel to the south-west MLA boundary. The diversion is designed with a high flow channel to 50 year ARI and an active channel to 2 year ARI. This diversion channel joins Lagoon Creek some 150 m inside the upstream boundary of the MLA boundary. As for the north western diversion, an additional levee is provided between the diversion channel and the MLA boundary to avoid breakout of flood waters onto the adjacent tenement
  - a flood levee is located adjacent to, and on the mine side of the diversion channel and provides flood immunity to the mine to 3000 year ARI. In the event of floods exceeding 50 year ARI, flood water will rise against the levee and temporarily inundate the immediately adjacent (upstream) land. No third party properties are affected.
  - The corridor reserved for the diversion and levees is set at 240 m width from the MLA boundary, which provides an additional 100 m to 110 m of width between the levee toe and the pit high wall. Current available geotechnical and geological data suggests that this distance is sufficient to ensure stability of the diversion and levees. Should further investigation determine that the corridor is not wide enough and diversion / levee stability may be compromised, then the mine pit strike length may be reduced.

Each of the above mentioned diversions will be designed and constructed in accordance with the Queensland Government Natural Resources and Water, Central West Water Management and Use Regional Guideline: Watercourse Diversions – Central Queensland Mining Industry, (2008)

### Contaminated Water Management System

While water will be carefully managed to minimise the volume discharging to the open mine pits, some water will make its way into the pits either via direct rainfall, runoff from and seepage through overburden dumps, or small undisturbed catchments upslope of pits within the pre-strip area.

The contaminated water management system comprises:

- Small sumps in the pit floor to collect and contain local surface water runoff from the pit floor, high wall, low wall and end walls.
- Pit dewatering pumps and associated dewatering pipelines to transfer pit water to the nearest pit dewatering dam, if necessary via a small staging dam.
- A drainage system to convey runoff from disturbed areas to the nearest environmental dam.
- Environmental and pit dewatering dams to store and contain contaminated water from the above sources. Care has been taken in the location of storages and the layout of the drainage system to minimise the areas draining to these dams, so as to minimise the storage requirements and reduce the risk of uncontrolled spilling during rainfall events.
- A return water pump and pipeline ‘backbone’ system connecting the environmental and pit dewatering dams to deliver stored water to either:
  - other environmental dams (west of Lagoon Creek)
  - a nearby truck fill station (for haul road dust suppression)
  - the CHPP
  - the tailings decant dam.

- A borefield to minimise groundwater seepage into the pit and provide water for use in the mine processes.

Water captured in the contaminated water management system will be used as a priority to meet demands in order to minimise the volume of stored water and therefore the risk of off-site discharge. Imported water will only be used to meet demands when there is a water deficit or high quality water is required.

During extended wet periods, surplus contaminated water will be stored in-pit once the pit dewatering dams have reached their capacity.

### Dirty Water Management System

Dirty water runoff from disturbed areas, such as overburden dumps, will be captured in sediment dams to encourage suspended solids to settle. Following settling, water in sediment dams will be either transferred to environmental dams for onsite reuse, or released to Lagoon Creek depending on the site water balance, quality of the stored water and the release criteria. It is envisaged that sediment dam water will be reused onsite during dry and median periods, and only released to the creek during prolonged wet periods when there is not adequate capacity in environmental dams to store additional water.

If sediment dam water is released to Lagoon Creek, release would occur at one of four (proposed) licensed discharge points. Discharge would only take place if water quality discharge criteria is met, and would not exceed 20% of the flow in Lagoon Creek.

In the event that sediment dams fill to capacity during large storm events, they will overflow to the pit (via the pit haul roads).

Sediment dams will allow time for coarse sediments to settle and, if necessary, allow a suitable flocculent to be added to remove fine or dispersive sediment to meet allowable turbidity discharge limits. As runoff from overburden dumps could potentially have elevated salinity and/or metals, provision will be made for a manually operated valve on all outlet pipes to prevent discharge if water quality is unsuitable. Additional capacity has also been provided in the ‘reuse zone’ of sediment dams to cater for this water.

The dirty water management system comprises:

- A drainage system to convey runoff from the overburden dump to the nearest sediment dam.
- Sediment dams to capture water from the overburden dump.
- A pump and pipeline system to transfer captured water to the ‘final’ sediment dams which can either release water to the creek, or to environmental dams for onsite reuse (where a free draining discharge pipe is not practical).
- Four ‘final’ sediment dams located immediately west of the main haul road. These dams have the provision to discharge to Lagoon Creek via gravity outlet pipes beneath the main haul road, and will be the only release points from the dirty water management system to the creek.
- Stream flow gauging station to determine and record stream flows in Lagoon Creek upstream of the site.
- The discharge of water from the ‘final’ sediment dams to Lagoon Creek will only take place during periods of natural flow events. Discharge should not exceed 20% of the flow in Lagoon Creek, as measured at the gauging station.

Sediment dams are to be maintained in a drawn-down state as much as practical, so that sufficient capacity is available in the 'settling zone' to capture water from subsequent storm events. If sediment dam water is to be reused onsite, it will be transferred to environmental dams for storage.

### Water Management Plan

The mine water management system will be documented in a Water Management Plan as defined by the DERM guidelines. The mine water management system will be maintained to match the mine plan. Risk assessment of potential failure of the infrastructure required for the mine water management will be undertaken and maintained in a risk register. Contingency plans shall be developed for system critical (high risk) infrastructure for which failure would lead to increased risk of uncontrolled discharges or non-compliant discharges.

Annual audits of the storage of hazardous materials will be undertaken.

Annual assessment of hazard category of mine dams will be undertaken by suitably qualified and experienced professionals (as defined by DERM). The design and construction of Regulated Dams (including flood protection levees) shall be certified by a suitably qualified and experienced professional engineer. Annual surveillance inspections of Regulated Dams will be undertaken and certified by a suitably qualified and experienced professional engineer (RPEQ).

The detailed design of stream diversion and flood protection levee works shall include:

- Detailed hydraulic modelling to mitigate flood hydraulic impacts and demonstrate the adequacy of the floodplain corridor for safe passage of extreme floods;
- Geotechnical investigations to confirm the suitability of materials for the levee and substrate conditions along the diversion;
- Rehabilitation design and specification; and
- Consultation with DERM to agree on the final design for approval (under the Water Act 2000)..

The diversion will be constructed and rehabilitated in accordance with the final detailed design plans and specifications.

### Stormwater Management

The proposed accommodation village and the light industrial area are the only Project facilities outside the active mine area that will require a stormwater management network and treatment devices. All other areas within the mine area (including mine, CHPP, MIA, tailings storage facility [TSF], and train load-out [TLO] facilities) will be serviced as part of the integrated mine water management system.

As the accommodation village will effectively be a small compact residential facility, the stormwater system will be designed in accordance with best practice design principles. Design will be undertaken in accordance with the Queensland Urban Drainage Manual (DERM 2007), Australian Runoff Quality – A guide to water sensitive urban design (2005), and requirements of the local Council. Planning for the accommodation village stormwater design will consider features such as rainwater tanks, swales, gross-pollutant traps, and basins to mitigate increases in peak flow and filter sediment and nutrients.

As for the accommodation village, the light industrial area stormwater system will also be designed in accordance with best practice design principles. Depending on the individual tenants, additional treatments could, for example, also include elements such as oil/water separators.

### V.3.4.7.2 *Groundwater specific control strategies*

#### Water Level Impacts

Under the *Water Act 2000* DERM has authority to direct the licensee to provide and maintain alternative water supplies for other holders of water entitlements who are materially impacted by the granting of a licence.

The project will develop alternate water supply agreements with landholders who will potentially be impacted by mine dewatering and aquifer depressurisation. Landholders who have groundwater supplies that are materially impacted by the operation, to a degree where groundwater is not able to be used for its pre-mining beneficial use (in terms of quality and/or quantity) will be provided with an alternate water supply of comparable yield and quality. The Proponent has made a commitment to make-good affected groundwater supplies.

The make-good commitment, to be mutually agreeable to the Proponent and the affected groundwater user, is envisaged to include:

- Details regarding the baseline data compiled during the bore survey of groundwater use (report included in SEIS Volume2, Appendix N);
- Access to groundwater monitoring data, trend analyses, and interpretation;
- Groundwater level data trends and comparison to Environmental Authority condition trigger values;
- Details regarding the groundwater monitoring network and dewatering scheme(s);
- A commitment that all groundwater monitoring will be conducted and assessed by a suitably qualified independent expert;
- Provision for the repair or replacement of damaged bores or water supply infrastructure, if the Proponent is deemed to have caused the damage;
- The replacement of diminished groundwater, same quality or better, and volume;
- A subsidy to cover additional costs associated with:
  - Larger or different pump types;
  - Pumping from deeper depths;
  - Additional water related infrastructure;
  - Additional power costs; and
  - Costs related to maintenance and spare parts for new larger or deeper set pumps.
- Financial provisions are to be made to ensure future costs (post closure) are covered;
- A dispute resolution system; and
- In the absence of agreement the provision for arbitration to settle the terms of agreement.

The make-good strategies to be put in place for groundwater level impacts were considered to include:

- Lowering pumps within an existing borehole, or supplying different pumps with a greater head capacity if required.

- Drilling new bores to a greater depth, e.g. to intersect the sub-E sands or deeper (sub-F) aquifers, which are not a target of dewatering by the operation and therefore are not predicted to be impacted to the degree predicted for the D-E sandstone and overlying sediments.
- The provision of replacement bores for affected landholders will be such that the new bores are able to continue to supply water for the maximum predicted impacts of mining on water level.

### Groundwater level impacts related to groundwater dependent ecosystems or vegetation communities

No groundwater dependant ecosystems have been recorded within the predicted area of impact of the operation. Groundwater level data from shallow and deeper groundwater monitoring bores (as detailed in SEIS Volume 2, Appendix N) indicate no hydraulic link between the surface water bodies and perched groundwater on site. As such declines in groundwater levels in the confined Colinlea Sandstone aquifers will not impact on any potential groundwater dependent ecosystems or vegetation communities.

Defined springs that are located to the north of MLA 70426 are outside the zone of predicted impacts from the operation.

Incidents of discrete perched water tables have been recorded (at depths of 0.5 to 1.5 m) in the weathered Tertiary laterite and saprolite and clay-rich Quaternary alluvium. Based on the low permeability of these sediments and the low gradients drawdown within the Tertiary units, resulting from open pit mining, would be limited (some 10 to 100 m) around the mine voids. Any perched water within these zones would report to the open pits. Vegetation communities which may obtain water from these perched water tables would be impacted. The impacts are, however, deemed negligible as the vegetation in the areas immediately surrounding the mine voids will be disturbed / removed due to mine infrastructure (surface water diversion levees, roads, easements, etc.).

### Groundwater level impacts related to reduced recharge

The proposed life of the mine TSF footprint is located to the east of Lagoon Creek, and off any economic coal and is also located close to the Coal Handling and Preparation Plant. Based on available large scale regional geological mapping the proposed TSF is located on the contact between the Colinlea Sandstone and the Joe Joe Formation.

Drilling for a geological and groundwater assessment has been conducted within and adjacent to the proposed TSF to allow for an assessment of the proposed TSF on recharge. Details of the TSF study are presented in SEIS Volume 2, Appendix N. The preliminary results of the reduction in groundwater levels as a result of reduced recharge in this area indicate that the reduction would be limited as the majority of recharge to the Colinlea Sandston is from the southwest.

Comments made based on the TSF study include that limited recharge potential to the underlying Colinlea Sandstone aquifers due to the thick clay-rich Tertiary cover, thin discontinuous Colinlea Sandstone aquifers (cross-sections indicate thin sub-E and sub-F sands), thick unsaturated zone (even though the site was subject to prolonged high rainfall events during 2010/2011), and no Colinlea Sandstone rock outcrop or shallow subcrop. This coincides with the conceptualisation, borne from the groundwater flow patterns recorded on site, from south west to north east, that groundwater recharge predominantly occurs to south west along the Great Dividing Range.

### Groundwater Quality Impacts

Controls will be implemented to prevent seepage and to manage seepage should it occur. Potential seepage from water and waste storage facilities will be monitored using down-gradient groundwater monitoring bores.

In the event of groundwater impact being identified, mitigation measures could include:

- Investigation of the integrity of the containment systems and potential areas/sources of seepage;
- Removal of the source of contamination and/or repair to the containment system, as required; and/or
- Installation of systems to intercept groundwater (e.g. interception trenches or bores).

Mine infrastructure, in particular the proposed TSF, will be designed and constructed in such a way that it does not adversely impact on the groundwater resources, in particular;

- Ensuring that there is the potential for leakage is minimise by the selection of the optimum lining materials and operating procedures.
- Prevents shallow seepage migration into any connected surface water systems.

### Mine Closure

Control strategies to be implemented prior to mine cessation, to facilitate mine closure from a groundwater perspective, include:

- Assess drawdown predictions from the groundwater model, to be refined every 3 years. This process will allow increasingly accurate predictions regarding potential impacts to local and regional groundwater resources.
- Ensure that the impacts of groundwater drawdown on existing groundwater users and other identified environmental values is minimised through cause identification, optimum responses (SEIS Volume 2, Appendix N), consultation and in the case of existing groundwater users, through the negotiation of alternative water supply agreements.
- Evaluate and assess the groundwater monitoring network, validity and enhancement, on an annual basis.
- Compilation and interrogation of long term groundwater monitoring data to facilitate long term impact predictions and assessment.
- Provision of agreements with landholders who are predicted to be affected after mining ceases for alternative water supplies or other agreed rectification measures.
- Strategies to ensure that any long term adverse impacts on water quality will be mitigated and managed.
- Mine infrastructure will be designed and constructed to manage any potential seepage from water and waste storage facilities in order to minimise the potential impact on groundwater aquifers during the life of the mine and after mining ceases.
- Ensure no impact on the major recharge mechanism, diffuse recharge in the Great Dividing Range, such that there will be continued recharge for the life of the mine and after mining ceases.

- Develop a final void management plan within 5 years of completion of mining.

### V.3.4.8 Monitoring

#### V.3.4.8.1 *Surface Water Quality*

A baseline monitoring program designed to collect additional background data and refine site specific trigger values was implemented from October 2010. Seven water sampling events were carried out when flow and weather permitted however no sediment sampling was performed. Murdering Lagoon (identified as a modified ox-bow lake in this study) has not yet been sampled.

An on-going monitoring program developed for the continuous monitoring of the watercourse water quality is to be implemented when the mine starts operating. This includes the control of discharges from the proposed release point for controlled discharges.

#### V.3.4.8.2 *Baseline Monitoring Program*

For the baseline monitoring program, two (2) reference sites and eight (8) baseline monitoring sites (refer Table V-17 and Figure V-13) will be monitored to collect data and derive site specific values for physio-chemical and biological parameters. The reference sites are sites that are subject to minimal / limited disturbance.

Table V-17 Proposed Receiving Water Reference and Baseline Monitoring

| Site number | Site description | Code | Coordinates | | Comment |
|---|---|---|---|---|---|
| | | | Easting | Northing | |
| **Well Creek – Cudmore National Park** | | | | | |
| 1 | Well Creek | WC | 437995 | 7454120 | Within the Cudmore National Park – pending access approval |
| **Native Companion Creek** | | | | | |
| 2 | Native Companion Creek | NCC | 466502 | 7392714 | Pending access approval |
| **Lagoon Creek** | | | | | |
| 3 | Lagoon Creek upstream | LCU | 447249.7 | 7418923 | For conditions prior to entering the mine site |
| 4 | Lagoon Creek lagoon | LCL | 448159 | 7426371 | Murdering Lagoon monitoring |
| 5 | Lagoon Creek, Sandy Creek downstream | LCSCD | 450868 | 7440441 | For conditions after exiting the mine site |
| 6 | Lagoon Creek, final SRD discharge | LCD | 449480.3 | 7444277 | For conditions downstream of the licensed controlled discharge location |
| **Sandy Creek** | | | | | |
| 7 | Sandy Creek upstream | SCU | 440745.8 | 7438237 | For conditions prior to entering the mine site |
| **Rocky Creek** | | | | | |
| 8 | Rocky Creek Upstream | RCU | 442215.1 | 7444155 | For conditions prior to entering the mine site |
| **Little Sandy Creek** | | | | | |
| 9 | Little Sandy Creek upstream | LSCU | 442378.4 | 7443298 | For conditions prior to entering the mine site |
| **Spring Creek** | | | | | |
| 10 | Spring Creek upstream | SPU | 438988.9 | 7424345 | For conditions prior to entering the mine site |

#### V.3.4.8.3 *Sampling Frequency – Reference and Baseline Monitoring*

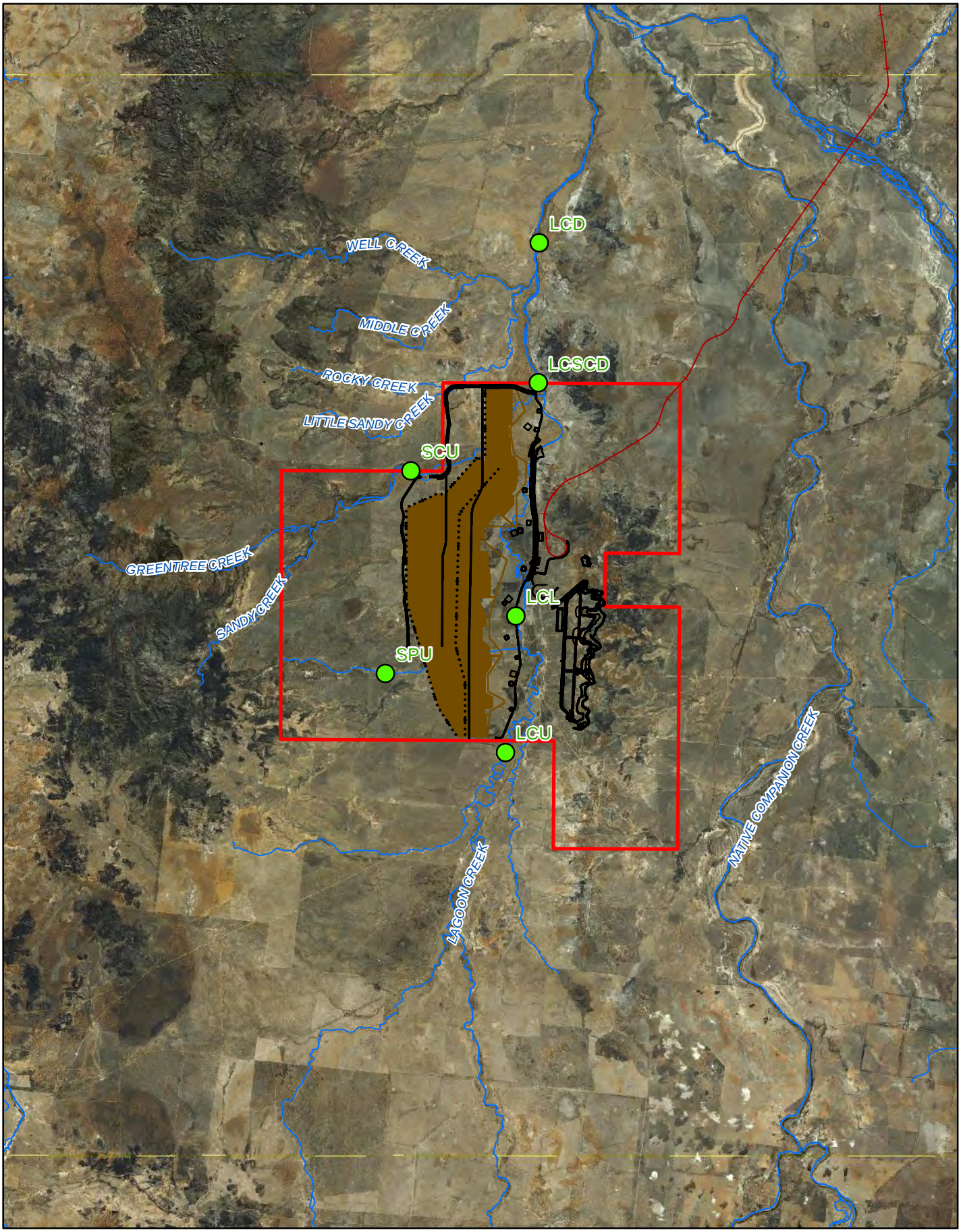
Monitoring will conform with requirements of the DERM Monitoring and Sampling Manual 2009 and ANZECC (2000) guidelines.

Sampling events will correspond with rainfall events that generate enough flow to trigger sampling.

A minimum of 18 samples will be collected at each site over at least 12 and preferably 24 months (in order to capture two complete annual cycles).

#### V.3.4.8.4 *Measurement Parameters – Reference and Baseline Monitoring*

Parameters, as listed in Table V-18, will be measured / analysed for the reference and baseline monitoring. The monitoring of flow will also be undertaken as part of the monitoring program (see Figure V-13).




Source: See Copyright Details below and for full disclosure Please Refer to the SEIS *Volume 2, appendix B*.

0 2.5 5 10 Km

Scale 1:350,000 (A4)

Datum: GDA94, MGA Zone55

N W E S

HANCOCK PROSPECTING PTY LTD

Alpha Coal Project
Supplementary Environmental Impact Statement

# ALPHA COAL PROJECT (MINE)
# MONITORING SITE LOCATIONS

| | |
|---|---|
| Job Number | 4262 6680 |
| Revision | A |
| Date | 18-04-2011 |

Figure: V-13

File No: \\AUBNEF\proj\H\Hancock_Coal\2123204A_HANCOCK_COAL_FEASIBILITY_STUD\10_GIS\Projects\Drawings_Figures_Sketches\2123204A_GIS_F030_A1.mxd

Table V-18 Recommended water quality parameters – reference and baseline monitoring

| Monitoring sample type | Water quality parameter | Sample frequency |
|---|---|---|
| Fully automated sampling stations | pH Temperature<br>EC Turbidity<br>DO TSS<br>Sulphate | At least daily when flow is detected and during release. During release, the first sample must be taken within two hours of the commencement of release. |
| Event Sampling | **Matrix: Water**<br>Electrical conductivity<br>pH<br>TSS<br>Turbidity<br>TN<br>TP<br>Chlorophyll a<br>Acidity<br>Alkalinity as $CaCO_3$<br>Major cation and anions<br>TPH<br><br>***Metals (total and dissolved):***<br>Aluminium (Al)<br>Arsenic (As)<br>Boron (B)<br>Cadmium (Cd)<br>Copper (Cu)<br>Cobalt (Co)<br>Chromium (Cr)<br>Iron (Fe)<br>Lead (Pb))<br>Nickel (Ni)<br>Zinc (Zn)<br>Mercury (Hg)<br>Uranium (U)<br>Vanadium (V)<br>Manganese (Mn) | **Matrix: Sediment**<br>Electrical conductivity<br>Acidity<br>Alkalinity as $CaCO_3$<br>Moisture<br>Particles sizing<br><br>***Metals (total for particles <63 µm and >63 µm and dissolved):***<br>Aluminium (Al)<br>Arsenic (As)<br>Boron (B)<br>Cadmium (Cd)<br>Copper (Cu)<br>Cobalt (Co)<br>Chromium (Cr)<br>Iron (Fe)<br>Lead (Pb)<br>Nickel (Ni)<br>Zinc (Zn)<br>Mercury (Hg)<br>Uranium (U)<br>Vanadium (V)<br>Manganese (Mn)<br><br>During and after major rainfall and flow events.<br><br>AND<br><br>At the commencement of release and thereafter weekly during release. |

### V.3.4.8.5 *On-going Monitoring Program*

The proposed on-going monitoring program will be implemented to allow effective water quality monitoring of the watercourses upstream and downstream of the mine site as well as the water quality of controlled discharges. It will form compliance monitoring and facilitate performance review of the various mitigation measures and plans implemented to protect the integrity of the water bodies within the Project area. The program is designed to demonstrate that the mine's water management operations are not causing, or have potential to cause environmental harm to surface water environmental values.

The proposed on-going monitoring locations are based on the following considerations:

- Representative of either high or low impact from mine activities;
- Accessibility during flow events; and
- Representative / indicative of the majority of the watercourse system.

The spatial independency of the sites will:

- Minimise the risk of falsely detecting a non-existent disturbance or environmental impact (i.e. false positive);
- Minimise the risk of missing an actual environmental impact (i.e. false negative); and
- Detect differences or changes that are environmentally significant.

The nominated water quality monitoring sites correspond to the three key streams identified within the Project area. The proposed water quality monitoring sites cover upstream and downstream locations relative to the mine tenure boundary.

Monitoring sites are outlined in Table V-19 and indicated on Figure V-13.

Table V-19 REMP Water quality and sediment site monitoring locations

| Site number | Site description | Code | Easting | Northing | Comment |
|---|---|---|---|---|---|
| **Lagoon Creek** | | | | | |
| 1 | Lagoon Creek upstream | LCU | 447249.7 | 7418923 | For conditions prior to entering the mine site |
| 2 | Lagoon Creek | LCL | 448159 | 7426371 | Murdering Lagoon monitoring |
| 3 | Lagoon Creek, Sandy Creek, downstream | LCSCD | 450868 | 7440441 | For conditions after exiting the mine site |
| 4 | Lagoon Creek final SRD discharge (10 km downstream of LCSCD) | LCD | 449557 | 7453981 | For conditions after point of discharge from the final SRD |
| **Sandy Creek** | | | | | |
| 5 | Sandy Creek upstream | SCU | 440745.8 | 7438237 | For conditions prior to entering the mine site |
| **Spring Creek** | | | | | |
| 6 | Spring Creek upstream | SPU | 438988.9 | 7424345 | For conditions prior to entering the mine site |

The existing groundwater monitoring network is to be enhanced and Table V-20 below indicates the location and description of the bores that will be constructed over time.

Table V-20 Additional groundwater monitoring network bores

| Monitoring Bore | Easting | Northing | Depth | Target |
|---|---|---|---|---|
| AlphaWest1 | 440,790 | 7,433,356 | 100 | Down dip |
| AlphaWest2 | 440,854 | 7,426,844 | 100 | Down dip |
| AlphaWest3 | 440,854 | 7,420,445 | 100 | Down dip |
| Landfill1 | 450,887 | 7,421,756 | 60 | Landfill site |
| Landfill2 | 450,887 | 7,421,689 | 50 | Landfill site |
| Landfill3 | 450,466 | 7,422,311 | 50 | Landfill site |
| MIA | 449,692 | 7,430,083 | 40 | Industrial area |
| CHPP1 | 449,081 | 7,431,729 | 40 | Preparation plant |
| CHPP2 | 449,378 | 7,432,279 | 40 | Preparation plant |
| EWT | 453,924 | 7,433,249 | 60 | Water storage dam |
| TLO1 | 449,583 | 7,432,593 | 40 | Train loading area |
| RWD1 | 455,689 | 7,436,471 | 50 | Water storage dam |
| ROM South | 447,811 | 7,427,598 | 30 | Coal storage |
| ROM North | 448,392 | 7,433,658 | 30 | Coal storage |

#### V.3.4.8.6 *Measurement Parameters – On-going Monitoring*

Monitoring parameters relevant to coal mine activities have been identified and are listed in Table V-21. Monitoring of flow will be required for monitoring site on Lagoon Creek upstream of the proposed controlled discharge location.

Table V-21 Water quality and sediment monitoring schedule – on-going monitoring

| Monitoring sample type | Water quality parameter | | Sampling frequency |
|---|---|---|---|
| Fully automated sampling stations | pH; EC; DO; Temperature; Turbidity, TSS, sulphate | | At least daily when flow is detected and during release. During release, the first sample must be taken within 2 hours of the commencement of release. |
| Event sampling | ***Water Matrix***<br>Electrical conductivity<br>pH<br>TSS<br>Turbidity<br>TN<br>TP<br>Chlorophyll a<br>Acidity<br>Alkalinity as $CaCO_3$<br>Major cation and anions<br>TPH<br><br>***Metals (total and dissolved):***<br>Aluminium (Al)<br>Arsenic (As)<br>Cadmium (Cd)<br>Copper (Cu)<br>Chromium (Cr)<br>Lead (Pb)<br>Nickel (Ni)<br>Zinc (Zn)<br>Mercury (Hg)<br>Uranium (U)<br>Vanadium(V)<br>Manganese (Mn) | ***Sediment Matrix***<br>Electrical conductivity<br>Acidity<br>Alkalinity as $CaCO_3$<br>Moisture<br>Particles sizing<br><br>***Metals (total for particles <63µm & >63 µm & dissolved):***<br>Aluminium (Al)<br>Arsenic (As)<br>Cadmium (Cd)<br>Copper (Cu)<br>Chromium (Cr)<br>Lead (Pb)<br>Nickel (Ni)<br>Zinc (Zn)<br>Mercury (Hg)<br>Uranium (U)<br>Vanadium (V)<br>Manganese (Mn) | Daily during and after major rainfall events, and at the commencement of release and weekly thereafter during release. |

## Creek Diversions

The recommended monitoring program for the Sandy, Spring and Lagoon Creek diversions is based on the "*Monitoring and Evaluation Program for Bowen Basin Diversions*" (ID&A, 2000) undertaken for the Australian Coal Association Research Program (ACARP). The total monitoring package for the diversions through their lifetime from pre-construction to licence relinquishment comprises four components as shown in Table V-19. The aim is for the diversions to be considered as a reach or stream operating in dynamic equilibrium in order to achieve diversion license relinquishment. Application for diversion license relinquishment will occur approximately 30 years after flow is initially diverted.

Table V-22 Diversion monitoring requirements

| Monitoring package components | Objective |
|---|---|
| 3. Baseline monitoring | To establish a baseline data set that can be used for comparison when applying for licence renewal and relinquishment. This occurs one year before construction and is to establish data that be used for comparison to assess the performance of the diversion. |
| 4. Construction monitoring | To demonstrate works have been undertaken to specification. |
| 5. Operations monitoring | To monitor and evaluate the diversion's performance to ensure it is operating in dynamic equilibrium. Occurs for ten years after construction. |
| 6. Relinquishment monitoring | To attain licence relinquishment by demonstrating the diversion is operating in dynamic equilibrium and not adversely impacting on adjoining reaches. Occurs the ten years after operations preceding application for relinquishment. |

### Baseline monitoring – creek diversions

Baseline monitoring will be undertaken prior to construction. The purpose of this stage is to establish a baseline data set that can be used for evaluating diversion performance during operation and relinquishment monitoring.

***Index of Diversion Condition***

Index of Diversion Condition (IDC) is a method of recording and monitoring the condition of diversions and the adjacent upstream and downstream reaches. It was developed for diversions as part of the ACARP program "Monitoring and Evaluation Program for Bowen Basin Diversions" (ID&A 2000). IDC provides a rapid assessment of the condition of diversions and adjoining stream reaches.

The purpose of the IDC is to flag potential management issues rather than provide a scientific assessment of a diversion or stream. It is an integrated suite of indicators that measures the geomorphic and riparian condition of a diversion and its upstream control and downstream reaches.

For the Baseline Monitoring Report, the upstream and downstream reaches are surveyed for the IDC. Within each reach, four transects, spaced reasonably evenly apart, are used to calculate the IDC. The indicators for the geomorphic index and riparian index are then assessed within each transect. The indicators for the geomorphic index and riparian index are listed below:

- Geomorphic Index indicators
- Width of high flow channel, active channel and low flow channel
- Bank condition
- Piping of banks
- Bed condition
- Spoil piles
- Recovery
- Instream structures
- Riparian Index indicators
- Width of riparian zone
- Structural intactness

- Regeneration
- Longitudinal continuity

Each indicator is assigned a score at each transect. The average scores for each indicator from the four transects are then used to calculate the overall score for the geomorphic index and riparian index in each reach. The sum of the geomorphic and riparian index is then calculated to determine the score for the IDC.

***Location of Monitoring Points***

Within each transect a photo monitoring point is established. Where practical, the photo monitoring points will be established at sites that are judged to be representative of the transect. The location of IDC transects and photo points will be established formally with a steel star picket. The star picket must then be located in the centre lower frame of each photograph for purpose of identification and orientation. Additional upstream and downstream photographs will also be taken from the stream bed adjacent to the star picket.

At each photo point GPS coordinates will be recorded to assist with future location. Details of all photographs will be recorded on a spreadsheet and added to the Monitoring Program Database.

***Vegetation***

The Project will be revegetated to improve erosion control. Vegetation contributes to erosion control in the following ways:

- Roots provide reinforcement and stability to watercourse bed and bank materials.
- Ground hugging vegetation shields bed and bank materials, providing direct protection from the erosive action of water.
- Vegetation can considerably reduce water velocity by contributing to the roughness of a watercourse.

The revegetation will consist of two main areas: a Riparian zone and a Terrestrial zone.

The Riparian zone will occupy an area 3 m either side of, and including, the active channel. It will be densely populated with endemic grasses, trees and shrubs. For functional purposes grasses, reeds, rushes, sedges and shrubs will be the focus of revegetation efforts as these have a greater impact on erosion than trees. Faunal habitats will also be constructed in the Riparian zone using hollow logs.

In addition to the Riparian Index assessment, riparian and terrestrial vegetation will be assessed in the upstream and downstream control reaches using detailed site assessment and Regional Ecosystem mapping. This will allow for future comparison with the diverted reach to identify key species absent from the diversion reach, but present in control reach, and to determine the success of the vegetation management plan, which aims to re-create a “natural” reach of channel that will be sustainable over the long term.

The Terrestrial zone will occupy the remainder of the high flow channel. It will be well grassed and sparsely populated with endemic trees and shrubs. This is consistent with the existing flood plain vegetation.

Areas external to the channels (earthworks not within the $Q_{100}$ inundation area) will be rehabilitated with topsoil and grass seeding.

***Flow Events***

The catchment including Lagoon Creek, Spring Creek, and Sandy Creek is an ungauged catchment and as such no baseline flow data is available. Peak flow rates for 2, 5, 10, 20, 50 and 100 year ARI

events were estimated from hydrologic modelling. These events have been modelled as part of the design process for the diversion. When flows occur during operation of the diversion, the flow height can be recorded and compared to those in the hydraulic model to determine the approximate ARI of the flow event.

Flow information will be an essential element of monitoring data when assessing monitoring results as part of licence relinquishment for diversions. Installing a station that monitors for both water quantity and quality is recommended.

***Monitoring Database***

All of the information collected from the baseline monitoring is collated into a monitoring database for comparison with future monitoring of the diversions. A summary of the baseline monitoring requirements is provided in Table V-23.

Table V-23 Baseline monitoring requirements

| Baseline monitoring undertaken | |
|---|---|
| Index of Diversion Condition | Photographs shall be taken to record the condition of the stream before works are initiated. Photographs shall be taken of the Control reach, the reach to be diverted and the Downstream reach. Photographs are to be taken from fixed points along the Control and Downstream reaches to allow future comparisons.<br>Refer to Appendix C of ACARP (2001) for an aerial photograph showing recommended photo locations and directions. Further details of fixed photo monitoring points are provided in Appendix C of ACARP – "Monitoring and Evaluation Program for Bowen Basin River Diversions". |
| Vegetation | The species, abundance and diversity of vegetation in the reach to be diverted will be recorded before the diversion in conducted. This information will be used for revegetating the new diversion and used for comparison during relinquishment monitoring. |
| Aerial Photographs | Take aerial photos displaying the existing condition of Lagoon, Spring and Sandy Creeks and also the location of the new diversion before works begin. The scale of the aerial photo should be sufficient to allow accurate measurements of the diversion and adjoining river or creek. Further details of aerial photographs are provided in ACARP (2001). |
| Flow Events | Information regarding the size and frequency of flow events may be assessed by checking debris marks and hydrologic data compiled as part of the engineering design process should there not be a flow gauging station. This will be a key part of the DERM assessment process as to what range of flow the diversion has been subjected to. |
| Survey | Cross-section and long-section surveys are required for all monitoring reaches. The sections generated will be included as part of the monitoring database and will be used to monitor the performance of the diversions during their operation by comparison with future sections. This will also contribute to relinquishment monitoring. |

## Construction Monitoring – Creek Diversions

Construction monitoring will be undertaken during and immediately after construction of each of the creek diversions. The purpose of this stage is to demonstrate that works have been undertaken to specification, which is expected to be a requirement in the licence conditions.

Construction monitoring requirements are shown in Table V-24.

Table V-24 Construction monitoring requirements

| Construction monitoring requirements | |
|---|---|
| Execution Outputs | An execution output database will be established to record descriptions of the construction activities completed. The date of activity completion will be noted along with details of any accompanying photographs. Construction activities not completed to specification will be recorded in the database along with an explanation and details of the modified design. |
| Photographs | Appropriate photographs will be taken during construction/rehabilitation and immediately after the work is finished. Photographs will be taken from fixed photo monitoring points (refer Appendix C of ACARP - "Monitoring and Evaluation Program for Bowen Basin River Diversions"). |
| Aerial Photographs | If practical, an aerial photo will be taken immediately after diversion construction or rehabilitation has been completed. These photographs would accurately display the extent of change and provide a baseline reference for changes that may occur in the future. |
| "Issued for Construction" Drawings | Design drawings issued to the contractor for construction are to be supplied. |
| "As Constructed" Drawings | As Constructed Drawings to be supplied upon completion of works. |

### Operational Monitoring – Creek Diversions

Operational monitoring is undertaken to ensure if the diversions are operating as expected. This will be quite a sensitive time for the diversions as they are new and have not had time to develop dynamic equilibriums. All of the monitoring results will consider the flow event/s experienced, as any event greater than a Q10 may result in large changes to the system, this event will need to be evaluated separate to this analysis.

The field data will be transferred into the IDC spreadsheet and added to the database established during baseline monitoring. The data can then be used to assist with comparing any changes.

Operational monitoring requirements are shown in Table V-25.

Table V-25 Operational monitoring requirements

| Operational monitoring requirements | | |
|---|---|---|
| Survival of Works | The survival of creeks' structures and works such as riprap and vegetation will be assessed during this phase of monitoring. Early detection of any damage is likely to increase the options for remedial action. | |
| Photographs | Appropriate photographs will be taken from fixed photo monitoring points along all of the reaches on an annual basis. Refer to Appendix C of ACARP - "Monitoring and Evaluation Program for Bowen Basin River Diversions" for more details. | |
| Aerial Photographs | Aerial photographs of the control reaches, diversion reaches and downstream reaches will be taken on an annual basis. | |
| Visual Assessment | The control reaches, diversion reaches and downstream reaches will be visually assessed using the IDC, which will be repeated in the following years after construction: 1st, 2nd, 5th, 10th, 15th, 20th years and after significant flow events. | |
| Index of Diversion Condition | Inspection would include assessment of: | |
| | • bank condition<br>• piping<br>• bed condition<br>• recovery<br>• proximity of spoil piles from bank | • stability of creek structures<br>• structural intactness of vegetation<br>• regeneration of vegetation<br>• longitudinal continuity of vegetation |
| Survey | Longitudinal section and cross section surveys will be conducted in the Control reaches, Diversion reaches and Downstream reaches. These surveys will be repeated every 5 years or after a major flood event (e.g. 20 year ARI event). Refer to Appendix C of ACARP - "Monitoring and Evaluation Program for Bowen Basin River Diversions" for more details. | |
| Flow events | Flow events shall be monitored to determine the size of events the diversions have carried. Refer to Appendix C of ACARP – "Monitoring and Evaluation Program for Bowen Basin River Diversions" for more details. | |

### Relinquishment Monitoring – Creek Diversions

The objective of this phase is to demonstrate that the diversions are operating as waterways in dynamic equilibrium and not having an adverse impact on adjoining reaches.

Relinquishment monitoring requirements are shown in Table V-26.

Table V-26 Relinquishment monitoring requirements

| Relinquishment monitoring requirements | |
|---|---|
| Survey | Long section and cross section surveys will be conducted during the first year of relinquishment monitoring. The surveys will include the Control reaches Diversion reaches and Downstream reaches.<br>Final long section and cross section surveys will be conducted prior to application for licence relinquishment. |
| Vegetation Assessment | Detailed vegetation assessment will be conducted during the first year of relinquishment monitoring to determine key species absent from the diversion reaches but present in control reaches where this is appropriate. The diversion reaches may therefore have different geomorphic and ecological characteristics than the reaches being replaced. |
| Photographs | Appropriate photographs will be taken from the fixed photo monitoring points in the control, diversion and downstream reaches. |
| Aerial Photographs | Aerial photos of diversions and controls, diversion and downstream reaches should continue to be taken on an annual basis. |
| Flow Events | Flow events will be monitored to determine the size of events the diversions have been subjected to. |

## Data Evaluation

Following a comprehensive comparison of monitoring data post construction with the baseline data, an evaluation of the results to distinguish if the diversion can attain a relinquishment licence will be undertaken. It is important that the data compared have occurred during similar flow events, as large flow events will affect data quite dramatically. If it is found the system does not achieved dynamic equilibrium, solutions will be identified and implemented to rectify the problem.

Relinquishment evaluation requirements are shown in Table V-27.

Table V-27 Relinquishment evaluation requirements

| Relinquishment evaluation requirements | |
|---|---|
| Survey | Quantitative assessment of data. Assess against flow data and baseline data. This survey will be compared to the 'as constructed' long sections to assess the changes in bed elevation. |
| Vegetation Assessment | Qualitative assessment of all data. Assess against flow data and baseline data. |
| Photographs | Qualitative assessment of all data. Assess against flow data and baseline data. Compare visually with previous photographs. |
| Aerial Photographs | Qualitative assessment of all data. Assess against flow data and baseline data. Compare with previous years to detect changes in vegetation and topography. |
| Stage 1 Evaluation | Survey data from baseline and operation monitoring will be compared with data from relinquishment monitoring. |
| Stage 2 Evaluation | All data will be evaluated and photographs collated for presentation to regulators. An example of relinquishment monitoring and evaluation is presented in Appendix F of ACARP – "Monitoring and Evaluation Program for Bowen Basin River Diversions". |

## Groundwater monitoring

Monitoring of groundwater will be undertaken to:

- Assess drawdown predictions from the groundwater model on an annual basis and provide data for model updates (to be conducted every 3 years). This process will allow increasingly accurate predictions regarding potential impacts to local and regional groundwater resources;
- Ensure that the impacts of groundwater drawdown on existing groundwater users and other identified environmental values is minimised through cause identification, response implementation, consultation and in the case of existing groundwater users, through the negotiation of alternative water supply agreements;
- Assess and validate the groundwater monitoring network, and guide appropriate expansion of the monitoring network during the life of the mine;
- Assess compliance with Water Licence and EA conditions; and
- Where issues of non-conformance have been recorded, the monitoring will allow for an assessment of mitigation and remediation measures installed.

As a water licence will be required for dewatering for the Project, groundwater monitoring, assessment, and reporting will be required for compliance with the licence conditions.

## Groundwater Assessment and Monitoring Program

Groundwater monitoring will be undertaken in the existing and expanded groundwater monitoring network to allow assessment of the potential groundwater level and groundwater quality impacts on the local and regional groundwater regimes. The groundwater monitoring will be required as part of the terms of any water licence issued for the mine and all monitoring results will be assessed and compiled in regular reports, in accordance with typical water licence terms.

The groundwater monitoring program will include:

- Monthly groundwater level and quarterly groundwater quality monitoring. Sampling will be undertaken in accordance with the current edition of the Department of Environment and Resource Management's Water Quality Sampling Manual, or subsequent updated versions;
- Annual reporting of groundwater level and groundwater quality results; and
- Notification to the regulating authority within one month of receiving water quality analysis results, should any parameters tested exceed agreed trigger levels (see comment regarding trigger levels below).

Additional groundwater monitoring bores will be established up and down gradient of mining infrastructure, which could potentially act as sources of potential contaminants. A conceptual layout of the groundwater monitoring network is presented in Figure V-14.

The current ongoing baseline groundwater quality monitoring, required to increase current hydrochemistry data, includes:

- Field parameters, pH and electrical conductivity (EC);
- Major cations and ions, including total dissolved solids (TDS), calcium, magnesium, potassium, sodium, chloride, sulphate, alkalinity (hydroxide, carbonate, bicarbonate, total), and fluoride;
- Metals/metalloids, including aluminium, arsenic, boron, cadmium, chromium, cobalt, copper, iron, lead, mercury, manganese, molybdenum, nickel, selenium, silver, uranium, and zinc;
- Nutrients (total N, $NO_x$, ammonia, phosphorous); and
- Total Petroleum Hydrocarbons (TPH) at selected monitoring points;

It is anticipated that the parameter list will be modified based on the compilation of at least 12 separate sampling data sets. This will allow for the establishment of ambient hydrochemistry and recognition of natural fluctuations and seasonal trends.

The groundwater level monitoring will include:

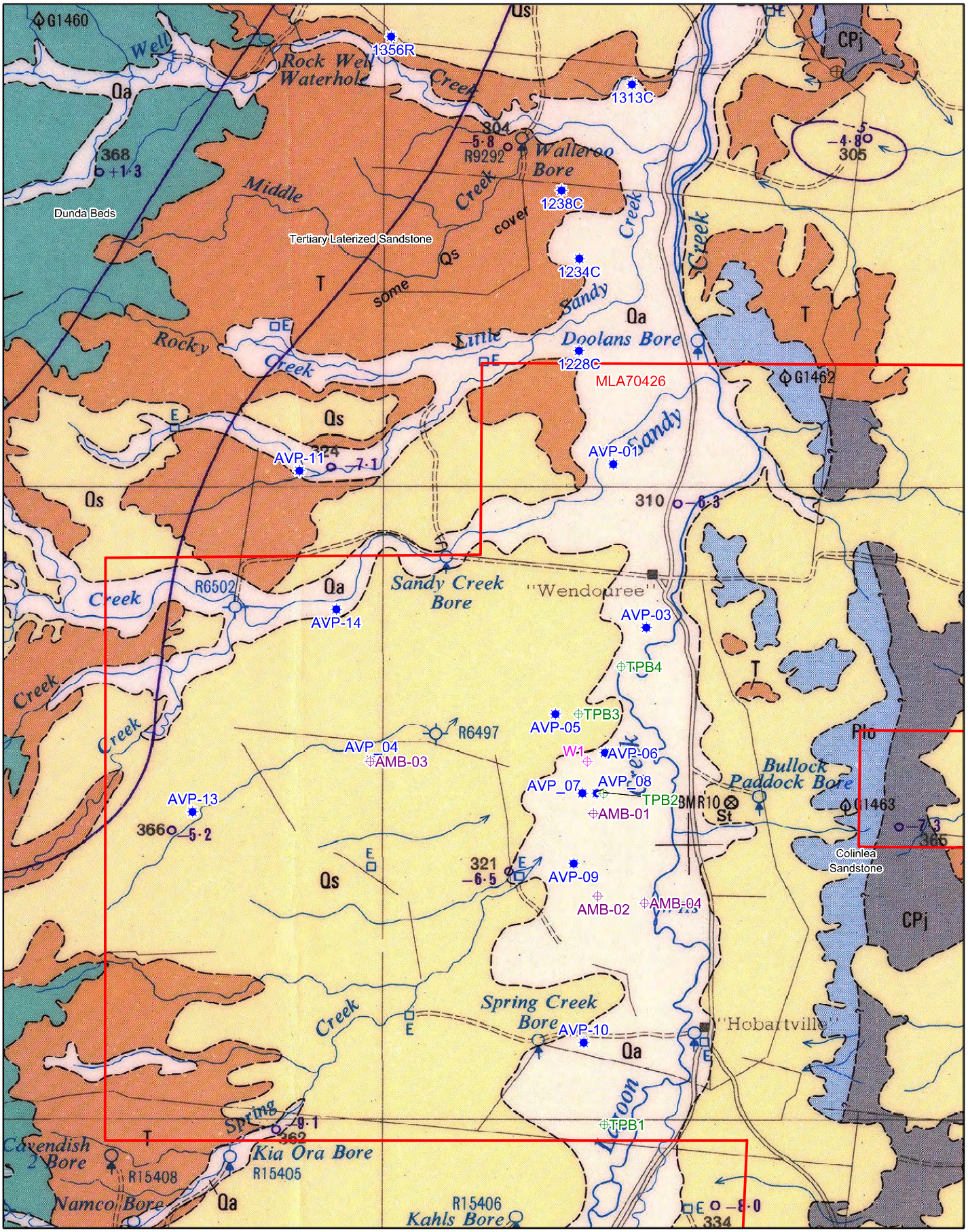
- All standpipe groundwater monitoring bores are or will be equipped with automated groundwater level monitoring loggers, set to record groundwater level data at a minimum 12 hour intervals. This data will be compiled on a monthly basis;
- Groundwater level trends and natural fluctuations will be determined; and
- Trigger Levels will be proposed and discussed with DERM.

Once sufficient groundwater quality and level data (from a statistical perspective) has been compiled trigger levels will be determined. These trigger levels will be based on arithmetic mean and standard deviations, set to facilitate in assessing possible mine related impacts on the groundwater resources.

Should trigger levels be exceeded, investigations will be undertaken to establish:

- Whether actual environmental harm has occurred;
- If required, immediate measures that should be taken to reduce the potential for environmental harm; and
- Long-term mitigation measures required to address any existing contamination, and to prevent recurrence of contamination.

The trigger levels will be determined by the Proponent before the commencement of mining and forwarded to DERM for approval. The trigger levels for water level and water quality will be mutually agreed and approved by DERM.




Mining Lease Application (MLA70426) Boundary

AVP-01 Vibrating Wire Piezometer (VWP) Bore Site with datalogger and rain gauge

AMB-01 Standpipe Monitoring Bore

1338DG Test Site (AGC 1983)

W1 Test Site (Longworth & McKenzie 1984)

Source: See Copyright Details below and for full disclosure Please Refer to the SEIS ***Volume 2, Appendix B***

0 2 4km

Scale 1:150 000 (A4)

Datum: GDA94, MGA Zone55

N W E S

**HANCOCK** PROSPECTING PTY LTD

Alpha Coal Project
Supplementary Environmental Impact Statement

# ALPHA COAL PROJECT (MINE) GROUNDWATER MONITORING BORE LOCATIONS

| | |
|---|---|
| Job Number | 4262 6680 |
| Revision | B |
| Date | 07-06-2011 |

Figure: V-14

File No: 42626680-g-2055b.wor

### V.3.4.9 Commitments

The following points provide a summary of surface water and groundwater commitments that HPPL will undertake as part of the Project:

- The Proponent will provide a flood levee around the mine pits and associated works areas, providing 3000 years ARI flood immunity.
- The Proponent will install a Sewage Treatment Plant to treat sewage waste to Class A effluent quality.
- The Proponent will implement a Water Management System to manage water flows onto, within and from the site in order to safeguard mine operations and protect downstream water quality.
- The Proponent will design the Water Management System and associated infrastructure in accordance with the criteria outlined.
- The Proponent will progressively rehabilitate the surface of the tailings storage facility as soon as the final tailings discharge operation is complete within each cell and sufficient drainage / drying has occurred.
- The Proponent will implement all creek diversions prior to the commencement of mining.
- The Proponent will undertake an assessment of existing riparian and aquatic vegetation as part of the detailed design process for creek diversions and will undertake to vegetate the new diversion channels and adjacent levees with the same native species of riparian and aquatic plants to contribute towards the stability of the creek diversions.
- The Proponent will prioritise the reuse of water captured in the contaminated water management system in order to minimise the requirement to import water.
- All controlled discharges will comply with the Environmental Authority criteria for controlled discharges.
- The Proponent will continue implementing a baseline water monitoring program in order to collect site-specific background water quality data.
- The Proponent will implement an ongoing water monitoring program in order to identify any changes in downstream surface water quality that might be attributable to the Project.
- The Proponent will implement a creek diversion monitoring program in order to collect sufficient data necessary to direct ongoing management and to facilitate the successful surrender of the diversion licenses.
- The Proponent will develop and implement an Erosion and Sediment Control Plan, to be in place prior to commencement of construction works.
- The Proponent will develop and implement a Receiving Environment Monitoring Plan, to be in place prior to commencement of mining activities.
- The Proponent will install water flow and water quality gauging stations in order to monitor water quality in the Project area to establish a baseline water quality.
- The Proponent will install water flow and water quality gauging stations to monitor the local and site specific water quality in watercourses and dams to facilitate adequate management of water qualities and if deemed required, determine acceptable release parameters.

### Groundwater Commitments

- The existing groundwater monitoring network will be expanded over time to allow for groundwater impact evaluation across the site, as mining expands to the west over time.
- Groundwater monitoring and sampling is being and will continue to be conducted by a suitable qualified and experienced professional in accordance with the current edition of the DERM Water Quality Sampling Manual, or subsequent updated versions; and the AS/NZS 5667.11:1998 Australian/New Zealand Standard for water quality – sampling Part 11; guidance on sampling groundwater.
- An annual review of the monitoring data will be conducted. The review will be conducted by a suitably qualified and experienced hydrogeologist and will include assessment of groundwater level and quality data, and the suitability of the monitoring network.
- All groundwater-based complaints will be investigated and a register kept of the nature of the complaint, the results of assessment, and any actions taken. The register will be made available to the regulating authority upon request.

## V.3.4.10 Proposed Environmental Authority Conditions

### V.3.4.10.1 *Surface Water*

### Contaminant release

**W1** Contaminants that will or have the potential to cause serious or material environmental harm must not be released directly or indirectly to any waters except as permitted under the conditions of this environmental authority.

**W2** The release of contaminants to waters must only occur from the release points specified in Table V-28 to this environmental authority.

Table V-28 Contaminant release points, sources and receiving waters

| Release Point (RP) | Northing (GDA94) | Easting (GDA94) | Contaminant Source and Location | Monitoring Point | Receiving waters description |
|---|---|---|---|---|---|
| SD1a | 447833.212E | 7421245.759N | Sediment Dam SD1a | Spillway or outlet works at discharge point into creek | Lagoon Creek |
| SD2b | 448272.883E | 7426055.228N | Sediment Dam SD2b | | |
| SD4b | 448697.600E | 7434017.172N | Sediment Dam SD4b | | |
| SD6b | 449801.265E | 7442445.707N | Sediment Dam SD6b | | |

*Note (*) location to be confirmed after detailed design of the dam outlet*

**W3** The release of contaminants to waters must not exceed the interim contaminant release limits stated in Table V-30 when measured at the monitoring points specified in Table V-29 for each quality characteristic.

Table V-29 Interim Contaminant Release Limits

| Quality Characteristic | Release Limits for all Release Points | Monitoring frequency |
|---|---|---|
| pH | 6.5 (minimum)*<br>8 (maximum) | Daily during release with the first sample taken within two hours of the commencement of release |
| Total suspended solids (mg/L) | 2000 (maximum)* | |
| Electrical conductivity (µS/cm) | 2000 (maximum)* | |
| Sulphate (mg/L) | 165 (maximum)* | |

**W4** The release of contaminants to waters from the release points must be monitored at the locations specified in Table V-29 for each quality characteristics and at the frequency specified in Table V-30 and Table V-31.

Table V-30 Interim Release Contaminant Trigger Investigation Levels

| Parameters | Trigger limits | Rational | Monitoring Frequency |
|---|---|---|---|
| Ammonia (mg/L) | 0.09 (maximum)* | Based on ammonia readings from field sampling and NCC historical data | Commencement of release and thereafter weekly during |
| Nitrate (mg N /L) | 9.0 (maximum)* | Based on nitrate readings from field sampling and NCC historical data | |
| Fluoride (mg/L) | 2000 (maximum)* | Protection of livestock and short term irrigation guideline | |
| Aluminium (mg/L) | 2 (maximum)* | Based on aluminium readings from field sampling and NCC historical data | |
| Arsenic (mg/L) | 0.013 (maximum)* | For aquatic ecosystem protection, based on SMD guidelines | |
| Boron (mg/L) | 0.037 (maximum)* | For aquatic ecosystem protection, based on SMD guidelines | |
| Cadmium (µg/L) | 0.2 (maximum)* | For aquatic ecosystem protection, based on SMD guidelines | |
| Chromium (mg/L) | 0.001 (maximum)* | For aquatic ecosystem protection based on LOR for ICPMS | |
| Copper (mg/L) | 0.006 (maximum)* | Based on copper readings from field sampling and NCC historical data | |
| Cobalt (mg/L) | 0.001 (maximum)* | For aquatic ecosystem protection, based on LOR for ICPMS | |
| Iron (mg/L) | 2.3 (maximum)* | Based on iron readings from field sampling and NCC historical data | |
| Lead (µg/L) | 3.4 (maximum)* | For aquatic ecosystem protection, based on SMD guidelines | |
| Manganese (mg/L) | 1900 (maximum)* | For aquatic ecosystem protection, based on SMD guidelines | |
| Mercury (µg/L) | 0.1 (maximum)* | For aquatic ecosystem protection, based on LOR for CV FIMS | |
| Molybdenum (mg/L) | 0.001 (maximum)* | For aquatic ecosystem protection, based on LOR for ICPMS | |
| Nickel (mg/L) | 0.002 (maximum)* | For aquatic ecosystem protection, based on SMD guidelines | |
| Selenium (mg/L) | 0.010 (maximum)* | For aquatic ecosystem protection, based on LOR for ICPMS | |

| | | | |
|---|---|---|---|
| Silver (mg/L) | 0.001 (maximum)* | For aquatic ecosystem protection, based on LOR for ICPMS | |
| Zinc (mg/L) | 1.015 (maximum)* | Based on zinc readings from field sampling and NCC historical data | |
| Vanadium (mg/L) | 0.01 (maximum)* | For aquatic ecosystem protection, based on LOR for ICPMS | |
| Uranium | 0.001 (maximum)* | For aquatic ecosystem protection, based on LOR for ICPMS | |

*Note: 1. All metal and metalloids must be measured as total (unfiltered) and dissolved (filtered). Trigger levels for metal/metalloids apply if dissolved results exceed trigger.*

*Note: 2. The list of quality characteristics required to be monitored as per Table V-27 will be subject to review once the results of monitoring data are assessed. If it is determined by consultation that there is no need to monitor for certain individual characteristics, these can be removed from Table V-27*

**W5** If water quality characteristics of the release exceed any of the trigger levels specified in Table V-29 during a release event, the environmental authority holder must compare the downstream results in the receiving waters to the trigger values specified in Table V-30 and Table V-34:

(a) where the trigger values are not exceeded then no action is to be taken; or

(b) where the downstream results exceed the trigger values specified in Table V-30 and Table V-34 for any quality characteristic, compare the results of the downstream site to the data from background monitoring sites and;

i. if the result is less than the background monitoring site data, then no action is to be taken; or

ii. if the result is greater than the background monitoring site data, complete an investigation in accordance with the ANZECC & ARMCANZ 2000 methodology into the potential for serious or material environmental harm and provide a written report to the administering authority in the next annual return, outlining the details of the investigations carried out and actions taken to prevent environmental harm not authorised under this environmental authority.

*Note: Where an investigation is being undertaken in accordance with W7(b)(ii) no further reporting is required for subsequent trigger events for that quality characteristic*

**W6** If an exceedance in accordance with condition W5(b)(ii) is identified, the holder of the authority must notify the administering authority.

### Contaminant Release Events

**W7** The environmental authority holder must install, operate and maintain a stream flow gauging station to determine and record stream flows at the locations upstream of each Release Point for any receiving water into which a release occurs.

**W8** The controlled release of contaminants to waters must only take place during periods of natural flow events specified as minimum flow in Table V-31 for the contaminant release point(s) specified in Table V-29. Table V-32 also specifies the required information that should be recorded continuously if possible, during controlled release events from any of the controlled release points identified in Table V-29

Table V-31 Interim Release Contaminant Trigger Investigation Levels and recording requirements

| Receiving water description | Gauging station description | Latitude or northing (GDA94) | Longitude or easting (GDA94) | Minimum Flow in Receiving Water Required for a Release Event | Flow recording Frequency |
|---|---|---|---|---|---|
| Lagoon Creek | | XXXX | XXXX | > or = 10 $m^3$/sec | Continuous (minimum daily) |

**W9** Contaminant release flow rate must not exceed **10%** of receiving water flow rate.

**W10** The daily quantity of contaminants released from each release point must be measured and recorded at the monitoring points in Table V-29.

**W11** Releases to waters must be undertaken so as not to cause erosion of the bed and banks of the receiving waters, or cause a material build up of sediment in such waters.

**W12** The release of contaminants directly or indirectly to waters:

a) must not produce any visible discolouration of receiving waters; and
b) must not produce any slick or other visible or odorous evidence of oil, grease or petrochemicals nor contain visible floating oil, grease, scum, litter or other objectionable matter.

### Notification of Release Event

**W13** The authority holder must notify the administering authority as soon as practicable (no later than **six (6) hours** of having commenced releasing water to the receiving environment) and for every 24 hours while releases occurring and at the cessation of releases. Notification must be in writing (which may be electronically) and include:

a) release commencement date/time;
b) expected release cessation date/time;
c) release point/s;
d) if the release limits defined in Table V-29 are exceeded;
e) release volume (estimated);
f) receiving water/s including the natural flow rate;
g) any details (including available data) regarding likely impacts on the receiving water(s);
h) any actions undertaken by the holder that may have contributed to the release;
i) measures that have been taken to prevent or mitigate any potential or actual environmental harm.

**W14** The authority holder must notify the administering authority as soon as practicable, (nominally within twenty-four (24) hours) of the cessation of a release notified under condition W13 and within 28 days provide the following information in writing:

a) release cessation date/time;
b) natural flow volume in receiving water;
c) volume of water released;
d) details regarding the compliance of the release with the conditions of this authority (i.e. contamination limits, natural flow, discharge volume);
e) all in-situ water quality monitoring results; and
f) any other matters pertinent to the water release event.

## Notification of Release Event Exceedance

**W15** The authority holder must, within 28 days of a release that exceeds the conditions of this authority, provide a report to the administering authority detailing:

a) the reason for the release;

b) the location of the release;

c) all water quality monitoring results;

d) any general observations;

e) all calculations; and

f) any other matters pertaining to the release event.

## Monitoring of Water Storage Quality

**W16** Water storages stated in the Table V-32, which are associated with the release points, must be monitored for the water quality characteristics specified in Table V-33 at the monitoring locations and at the monitoring frequency specified in Table V-32.

**W17** In the event that water storages defined in Table V-32 exceed the contaminant limits defined in Table V-33, the environmental authority holder must implement measures to prevent access to waters by all livestock.

Table V-32 Water Storage Monitoring

| Northing (GDA94) | Easting (GDA94) | Water Storage Description | Monitoring Location* | Frequency of monitoring |
|---|---|---|---|---|
| TBA | TBA | (All Regulated Dams) | | monthly |
| TBA | TBA | | | |

*TBA to be advised by holder upon completion of detailed design*

Table V-33 Onsite Water Storage Quality Parameters and Limits for Livestock Exclusion

| Quality Characteristic | Value | Contaminant Limit |
|---|---|---|
| pH (pH unit) | Range | Greater than 5, less than 9 |
| EC (µS/cm) | Maximum | 3,000 |
| Sulphate (mg/L) | Maximum | 1,000 |
| Calcium (mg/L) | Maximum | 1,000 |
| Fluoride (mg/L) | Maximum | 2 |
| Nitrate (mg/L) | Maximum | 400 |
| Aluminium (mg/L) (dissolved) | Maximum | 5 |
| Arsenic (mg/L) | Maximum | 0.5 |
| Cadmium (mg/L) | Maximum | 0.01 |
| Cobalt (mg/L) | Maximum | 1 |
| Copper (mg/L) | Maximum | 0.4 |
| Lead (mg/L) | Maximum | 0.1 |
| Nickel (mg/L) | Maximum | 1 |
| Zinc (mg/L) | Maximum | 20 |

## Receiving Environment Monitoring and Contaminant Trigger Levels

**W18** The quality of the receiving waters must be monitored daily during controlled releases from dam/s for each quality characteristic in Table V-34 at the locations specified in Table V-35.

Table V-34 Receiving Waters Contaminant Investigation Trigger Levels

| Quality Characteristic | Value | Contaminant Limit |
|---|---|---|
| pH | 6.5 (minimum)*<br>8 (maximum) | Daily during release with the first sample taken within two hours of the commencement of release. |
| Electrical conductivity (µS.cm–1) | 400 (maximum)* | |
| Total suspended solids (mg/L) | 1500 (maximum)* | |
| Sulphate (mg/L) | 20 (maximum)* | |

Table V-35 Receiving Water Upstream Background Sites and Downstream Monitoring Points

| Monitoring Points* | Receiving Waters Location Description | Site type | Northing (GDA94) | Easting (GDA94) |
|---|---|---|---|---|
| **Lagoon Creek** | | | | |
| LCU | Lagoon Creek upstream | Upstream background | 7418923 | 447249.7 |
| LCL | Lagoon Creek | Murdering Lagoon | 7426371 | 448159 |
| LCSCD | Lagoon Creek – exit of the MLA | Downstream monitoring | 7444277 | 449480.3 |
| FDP | Lagoon Creek 10 km downstream of the MLA | Downstream monitoring | 7453981 | 449557 |
| **Sandy Creek** | | | | |
| SCU | Sandy Creek upstream | Upstream background | 7438237 | 440745.8 |
| **Spring Creek** | | | | |
| SPU | Spring Creek upstream | Upstream background | 7424345 | 438988.9 |

** map showing location of monitoring points to be provided by holder*

**W19** If quality characteristics of the receiving water at the downstream monitoring points exceed any of the trigger levels specified in Table V-34 during a release event, the environmental authority holder must compare the downstream results to the upstream results in the receiving waters and:

1. where the downstream result is the same or a lower value than the upstream value for the quality characteristic then no action is to be taken; or
2. where the downstream results exceed the upstream results, complete an investigation in accordance with the ANZECC & ARMCANZ 2000 methodology, into the potential for environmental harm and provide a written report to the administering authority in the next annual return, outlining:
   a) details of the investigations carried out; and
   b) actions taken to prevent environmental harm.

*Note: Where an exceedance of a trigger level has occurred and is being investigated, in accordance with condition W19(2)(b), no further reporting is required for subsequent trigger events for that quality characteristic.*

## Receiving Environment Monitoring Program (REMP)

**W20** A REMP must be implemented by (3 months from the date of issue of the EA) to monitor and record the effects of the release of contaminants on the receiving environment periodically and whilst contaminants are being discharged from the site, with the aims of identifying and describing the extent of any adverse impacts to local environmental values, and monitoring any changes in the receiving water. A copy of the REMP must be provided to the administering authority prior to its implementation and due consideration given to any comments made on the REMP by the administering authority.

For the purposes of the REMP, the receiving environment is the waters of (Lagoon and Sandy Creeks) and connected waterways within ten (10) kilometres downstream of the release.

**W21** The REMP report must address (but not necessarily be limited to) the following:

a) Description of potentially affected receiving waters including key communities and background water quality characteristics based on accurate and reliable monitoring data that takes into consideration any temporal variation (e.g. seasonality);
b) Description of applicable environmental values and water quality objectives to be achieved (i.e. as scheduled pursuant to the *Environmental Protection (Water) Policy 2009)*;
c) Any relevant reports prepared by other governmental or professional research organisations that relate to the receiving environment within which the REMP is proposed;
d) Water quality targets within the receiving environment to be achieved, and clarification of contaminant concentrations or levels indicating adverse environmental impacts during the REMP;
e) Monitoring for any potential adverse environmental impacts caused by the release;
f) Monitoring of stream flow and hydrology;
g) Monitoring of toxicants should consider the indicators specified in Table V-30 to assess the extent of the compliance of concentrations with water quality objectives and/or the ANZECC & ARMCANZ (2000) guidelines for slightly to moderately disturbed ecosystems;
h) Monitoring of physical chemical parameters specified in Table V-29, as well as dissolved oxygen saturation, concentration of sulphide and temperature;
i) Monitoring biological indicators (for macroinvertebrates in accordance with the AusRivas methodology) and metals/metalloids in sediments (in accordance with ANZECC & ARMCANZ (2000)), BATLEY and/or the most recent version of AS/NZS 5667.12:1999 Water quality - Sampling - *Guidance on Sampling of Bottom Sediments*) for permanent, semi-permanent water holes and water storages;
j) The locations of monitoring points (including the locations specified in Table V-35 which are background and downstream impacted sites for each release point);
k) The frequency or scheduling of sampling and analysis sufficient to determine water quality objectives and to derive site specific reference values within two (2) years (depending on wet season flows) in accordance with the *Queensland Water Quality Guidelines* 2009. For ephemeral streams, this should include periods of flow irrespective of mine or other discharges;
l) Specify sampling and analysis methods and quality assurance and control;
m) Any historical datasets to be relied upon;
n) Description of the statistical basis on which conclusions are drawn; and
o) Any spatial and temporal controls to exclude potential confounding factors.

**W22** A report outlining the findings of the REMP, including all monitoring results and interpretations in accordance with condition W20 must be prepared and submitted in writing to the administering authority by **(date to be determined)**.This should include an assessment of background water quality, any assimilative capacity for those contaminants monitored and the suitability of current discharge limits to protect downstream environmental values.

### Water Reuse

**W23** Water contaminated by mining activity may be piped or trucked or transferred by some other means that does not contravene the conditions of this authority during periods of dry weather for the purpose of supplying stock water to properties directly adjoining properties owned by the environmental authority holder or a third party and subject to compliance with the quality release limits specified in Table V-36.

Table V-36 Stock water release limits

| Quality characteristic | Units | Minimum | Maximum |
|---|---|---|---|
| pH | pH units | 6.5 | 8.5 |
| Electrical Conductivity | µS/cm | N/A | 5,000 |

**W24** Water contaminated by mining activity may be piped or trucked off the mining lease for the purpose of supplying water to a third party for purpose of construction and/or road maintenance in accordance with the conditions of this environmental authority.

**W25** If the responsibility of water contaminated by mining activities (the water) is given or transferred to another person in accordance with conditions **W23**, and **W24**:

a) the responsibility of the water must only be given or transferred in accordance with a written agreement (the third party agreement), and
b) include in the third party agreement a commitment from the person utilising the water to use water in such a way as to prevent environmental harm or public health incidences and specifically make the persons aware of the General Environmental Duty (GED) under section 319 of the *Environmental Protection Act 1994,* environmental sustainability of the water disposal and protection of environmental values of waters.

### Water General

**W26** All determinations of water quality must be:

a) performed by a person or body possessing appropriate experience and qualifications to perform the required measurements;
b) made in accordance with methods prescribed in the latest edition of the administering authority's *Monitoring and Sampling Manual 2009*,
c) collected from the monitoring locations identified within this environmental authority, within ten (10) hours of each other where possible;
d) carried out on representative samples; and
e) laboratory testing must be undertaken using a laboratory accredited (e.g. NATA) for the method of analysis being used.

### Future Data

**W27** Contaminant release limits must be finalised based on a background monitoring program and submitted to the administering authority by **(date to be determined)**.

### Annual Water Monitoring Reporting

**W28** The following information must be recorded in relation to all water monitoring required under the conditions of this environmental authority and submitted to the administering authority in the specified format upon request:

- the date on which the sample was taken;
- the time at which the sample was taken;
- the monitoring point at which the sample was taken;

- the measured or estimated daily quantity of the contaminants released from all release points;
- the release flow rate at the time of sampling for each release point; and
- the results of all monitoring and details of any exceedances with the conditions of this environmental authority.

**Temporary Interference with Waterways**

**W29** Temporarily destroying native vegetation, excavating, or placing fill in a watercourse, lake or spring necessary for and associated with mining operations must be undertaken in accordance with Department of Environment and Resource Management *Guideline - Activities in a Watercourse, Lake or Spring associated with Mining Activities.*

**Water Management Plan**

**W30** A Water Management Plan must be developed and implemented within 3 months from the date of issue that provides for the proper and effective management of the actual and potential environmental impacts resulting from the mining activity and to ensure compliance with the conditions of this environmental authority.

**W31** The Water Management Plan must be developed in accordance with the administering authority's Guideline **-** *Preparation of Water Management Plans for Mining Activities* or any updates that become available from time to time and must include at least the following components**:**

a) Contaminant Source Study;
b) Site Water Balance and Model;
c) Water Management System;
d) Saline Drainage Prevention and Management Measures;
e) Acid Rock Drainage Prevention and Management Measures (if applicable);
f) Emergency and Contingency Planning; and
g) Monitoring and Review.

**W32** Each year the holder of the environmental authority must ensure that proper and effective measures, practices and procedures are in place as outlined in the Water Management Plan prior to the wet season (i.e. by 1 November) and a further review following the wet season (i.e. by 1 May the following year) so that the mine is operated in accordance with the conditions of this environmental authority and that environmental harm is prevented or minimised.

**W33** A copy of the Water Management Plan and/or revised Water Management Plan must be provided to the administering authority on request.

**Saline Drainage**

**W34** The holder of this environmental authority must ensure proper and effective measures are taken to avoid or otherwise minimise the generation and/or release of saline drainage.

**Acid and Metalliferous Drainage**

**W35** The holder of this environmental authority must ensure proper and effective measures are taken to avoid or otherwise minimise the generation and/or release of acid and metalliferous drainage (AMD).

**Stormwater and Water Sediment Controls**

**W36** An Erosion and Sediment Control Plan must be developed by a suitably qualified person and implemented for all stages of the mining activities on the site which will provide reasonable and practical measures to minimise erosion and the release of sediment to water and contamination of storm water.

**W37** The maintenance and cleaning of any vehicles, plant or equipment must not be carried out in areas from which contaminants can be released into any waters without appropriate treatment.

**W38** Any spillage of wastes, contaminants or other materials must be cleaned up as quickly as practicable to minimise the release of wastes, contaminants or materials to any stormwater drainage system or waters.

**Uncontrolled contaminant releases**

**W39** The holder of the Environmental Authority must ensure that the potential for uncontrolled discharge from any dam listed in Table V-32 is limited to the AEP probabilities specified in Table V-39.

**Water Management System**

**W40** On 1 November each year, the holder of the Environmental Authority shall review the mine catchments, storage capacity, current storage volumes, transfer capacity, and Standard Operating Procedures of all key infrastructure elements of the mine water management system and update the mine water balance model. An assessment of the mine water balance model must be undertaken to ensure that the mine water management system has sufficient storage capacity, transfer capacity, and transfer operations to ensure that the frequency of uncontrolled discharges of mine water is less than or equal to the specified AEP in Table V-39.

The assessment must be undertaken with an appropriate period of climate data that includes representation of wet season rainfall events up to the AEP specified in Table V-36. The assessment results must be documented and be available for auditing.

**W41** The holder of the Environmental Authority must notify the administering authority within fourteen (14) days, if any assessment of the mine water management system shows that the risk of uncontrolled discharge is greater than the specified AEP in Table V-39.

a) Notwithstanding the provisions for Mandatory Report Levels in: Table V-39 Dams, the holder of the Environmental Authority must not allow any uncontrolled discharge to be caused by either: failure to stop transferring water to a dam where the transfer into that dam contributes in part, or full, to the overflow (uncontrolled discharge) of that dam; or
b) failure to start and continue transferring water from a mine water dam, where the Standard Operation Procedures require the water transfer from the dam to prevent overflow (uncontrolled discharges).

**Monitoring and Reporting in the event of uncontrolled release**

**W42** In the event of an uncontrolled release from any component of the mine water system to the receiving environment, the holder of this environmental authority shall:

a) Sample and monitor the uncontrolled release waters during or as immediately practical after the event (recognising that uncontrolled discharges should only occur during extreme rainfall and site may not be accessible) to determine quality characteristics of the uncontrolled release for parameters specified in Table V-29, and Table V-30;
b) Sample and monitor the receiving environment monitoring sites listed in Table V-35 for sites relevant to the uncontrolled release location;
c) Estimate the quantity of uncontrolled release waters, by a suitably qualified and experienced person;
d) Provide a written report to the administering authority within fourteen (14) days of the uncontrolled release event, which shall include as a minimum:
   (i) the time and dates of the uncontrolled release event;
   (ii) the location of the uncontrolled release;
   (iii) the monitoring quality of the uncontrolled release waters; or if not available due to site access constraints in wet weather during the event, the quality of waters in the dam that contributed to the uncontrolled release before the event (from monitoring undertaken as part of condition W18) and quality in that dam after the release events;
   (iv) the estimated quantity of uncontrolled release;
   (v) downstream receiving water monitoring results;
   (vi) rainfall during, or that contributed to, the uncontrolled release event and dam levels prior to the rainfall event that caused uncontrolled release;
   (vii) a determination of whether uncontrolled release was solely caused by rainfall exceeding the design AEP events specified in Table V-39;
   (viii) a determination of whether the uncontrolled release was cause in part of full, by failure to operate the integrated mine water system in accordance with Standard Operating Procedures for the integrated mine water system, or physical failure of one or more components of the integrated mine water system;
   (ix) a determination of whether the uncontrolled release caused environmental harm; and
   (x) if determined that the uncontrolled release could have been reasonably prevented, actions that will be taken to ensure uncontrolled releases comply in all respects with this environmental authority.

### V.3.4.10.2 *Dams*

**All Dams**

**G1** The hazard category of each dam must be determined by a suitably qualified and experienced person, prior to its construction and at least once every two (2) years thereafter.

**G2** Construction of any dam determined to be in the significant or high hazard category (a regulated dam) must not be commenced unless the location, basic details, and hydraulic performance of that dam are specifically referenced in this environmental authority.

**G3** On cessation of operation of any dam, that dam must be maintained so as to avoid environmental harm until that dam is decommissioned.

**G4** Prior to the cessation of the mining activity, each dam must be decommissioned such that it either:

a) becomes a stable landform, that no longer contains flowable substances, or
b) is approved or authorised under relevant legislation for a beneficial use, or
c) is a void authorised by the administering authority to remain after decommissioning; and,
d) is compliant with the rehabilitation requirements of this environmental authority.

**Regulated dams – Location**

**G5** The following dams must be wholly located within the control points defined in Table V-37.

**G6** Regulated dams must be consistent with the details in Table V-38.

Table V-37 Location of regulated dams

| Name of regulated dam | Longitude GDA 94(*) | Latitude GDA 94(*) |
|---|---|---|
| TBA | TBA | TBA |

TBA- To be advised by proponent as part of detailed design

Table V-38 Details of Regulated Dams

| Regulated Dam | Maximum Surface Area (ha) | Maximum Volume of Dam (ML) | Maximum Depth of Dam (m) | Purpose of Dam |
|---|---|---|---|---|
| TBA | TBA | TBA | TBA | TBA |

TBA- To be advised by proponent as part of detailed design

**G7** All dams must meet the hydraulic performance criteria specified in Table V-39.

Table V-39 Hydraulic performance criteria of regulated dams and mine water management system dams.

| Regulated Dam | Hazard Category for Failure to Contain | Uncontrolled Discharge AEP | Hazard Category for Dam break | Spillway Critical Design Storm AEP | Mandatory Reporting Level |
|---|---|---|---|---|---|
| **Regulated Dams** | | | | | |
| TBA | TBA | TBA | TBA | TBA | 1: 100 AEP 72 hour storm volume below spillway level OR 1:100 AEP wind wave height below spillway level. |

TBA- To be advised by proponent as part of detailed design

**Certification and Operation**

**G8** Every regulated dam must be constructed in accordance with a certified design plan that has been submitted to the administering authority, and such that the resulting dam is capable to deliver the performance stated in that submitted design plan and that design plan is compliant with relevant conditions in this environmental authority.

**G9** Construction of a regulated dam must not be commenced unless:

1. the licensee has submitted to the administering authority two copies of a design plan, together with the certification of a suitably qualified and experienced person that the design of the regulated dam will deliver the performance stated in that submitted design plan and that dam is compliant in all respects with this environmental authority; and
2. at least twenty (20) business days has passed since the receipt of those documents, or the administering authority notifies the licensee that a design plan and certification has been received for that dam.

**G10** When construction of any regulated dam is complete and prior to commencing operation of that dam, the licensee must submit to the administering authority two (2) copies of a set of 'as constructed' drawings, together with the certification of a suitably qualified and experienced person that the dam 'as constructed' will deliver the performance stated in that submitted design plan and that dam is compliant in all respects with this environmental authority.

**G11** An operational plan must be kept current for each regulated dam.

**G12** Where an operational plan covers decommissioning and rehabilitation, those operations are to be consistent with the design plan for the dam and the rehabilitation requirements of this environmental authority.

**G13** The licensee must notify the administering authority as soon as possible, but within twenty-four (24) hours, of the level in any regulated dam reaching the mandatory reporting level (MRL) and must immediately act to prevent or minimize any actual or potential environmental harm.

**Regulated Dams - Annual Inspection and Report**

**G14** Each regulated dam must be inspected annually by a suitably qualified and experienced person.

**G15** At each annual inspection, the condition and adequacy of each regulated dam must be assessed for dam safety and against the necessary structural, geotechnical and hydraulic performance criteria.

**G16** At each annual inspection, if a mandatory reporting level is required, it must be determined and marked on each regulated dam.

**G17** A final assessment of adequacy of available storage in each regulated dam must be based on a dam level observed within the month of October and result in an estimate of the level in that dam as at 1 November.

**G18** For each annual inspection, two (2) copies of a report on the condition and adequacy of each regulated dam, certified by the suitably qualified and experienced person and including any recommended actions to be taken to ensure the integrity of each regulated dam; must be provided to the administering authority by 1 December.

**G19** The holder of this environmental authority must, within one week of receipt of the annual inspection report, consider the report and its recommendations; and as soon as possible, but within one month of receipt of the annual inspection report, formulate and implement actions to ensure that each regulated dam safely performs its intended functions.

### V.3.4.10.3 *Groundwater*

**W42** A groundwater monitoring program must be designed and submitted to the relevant authority for approval before the commencement of mining operations. The monitoring program must include the following criteria:

- Allow for the compilation of representative groundwater samples from the aquifers potentially affected by mining activities;
- Comprise at least twelve (12) sampling events, no more than two (2) months apart over a 2 year period, to determine background groundwater quality as far as practicable;
- Obtain background groundwater quality in hydraulically isolated background bore(s) that have not been affected by any mining activities (once mining activities begin), and

- Allow for the establishment of groundwater water level and contaminant trigger levels.

The bore locations, included in Table V-40, are indicated on Figure V-14. Table V-40, the proposed groundwater monitoring program, currently forms the basis for the "approved monitoring report". Additional monitoring bores, standpipe and vibrating wire piezometer bores, constructed post EIS are detailed and presented in SEIS Volume 2, Appendix N. The details of these bores are included in the monitoring network in Table V-40,

Table V-40 Groundwater monitoring program

| Monitoring Sites* | Parameter | Frequency | Purpose |
|---|---|---|---|
| AMB-01, AMB-02, AMB-03, AMB-04 | Water level | A maximum of 12 hour readings – electronic loggers | Determine baseline data, Detect drawdown in shallow coal seam aquifer and any variation in groundwater quality |
| | pH, EC, TDS (lab), cations, anions, selected metals (Al, As, B, Cd, Cr, Co, Cu, Fe, Pb, Hg, Mn, Mo, Ni, Se, Ag, U, Zn), nutrients | Currently monthly until sufficient data is compiled | |
| New TSF standpipe bores 1553R, 1554R, 1556R, 1558R, 1561R, 1563R, 1564R, 1565R, 1556R | Water level | A maximum of 12 hour readings – electronic loggers | Determine baseline data, any variation in groundwater quality. Evaluate groundwater flow both vertical and horizontal |
| | pH, EC, TDS (lab), cations, anions, selected metals (Al, As, B, Cd, Cr, Co, Cu, Fe, Pb, Hg, Mn, Mo, Ni, Se, Ag, U, Zn), nutrients | Currently monthly until sufficient data is compiled | |
| Proposed monitoring bores adjacent infrastructure AlphaWest1, AlphaWest2, AlphaWest3, Landfill1, Landfill2, Landfill3, MIA, CHPP1, CHPP2, EWT, TLO1, RWD1, ROMSouth, ROMNorth | Water level | A maximum of 12 hour readings – electronic loggers | Monitoring potential impacts of mining activities on groundwater resources |
| | pH, EC, TDS (lab), cations, anions, selected metals (Al, As, B, Cd, Cr, Co, Cu, Fe, Pb, Hg, Mn, Mo, Ni, Se, Ag, U, Zn), nutrients, TPH (selected bores only) | Every 2 months (for first two years) | |
| VWP bores 1234C, 1228C, AVP_11, AVP_01, AVP_14, AVP_03, AVP_05, AVP_04, AVP_06, AVP_07, AVP_08, AVP_13, AVP_09, AVP_10 | Water level only | A maximum of 12 hour readings – electronic | Detect dewatering impacts on regional aquifers |
| New TSF VWP bores 1553R, 1558R, 1561R, 1563R, 1564R, 1565R | Water level only | A maximum of 12 hour readings – electronic | Detect TSF seepage impacts and artificial recharge |
| All monitoring bores | Selected metals suits | Annually | If pH becomes acidic |
| Additional sites (Figure V-12) have been identified for installation of monitoring points based on site layout and mine plan. Please note the monitoring bores installed during the TSF study supersede the three proposed TSF monitoring bores discussed in the EIS. The groundwater monitoring bores are to be constructed according to Queensland standards (W45) and utilised to monitor groundwater levels and quality, as detailed above. | | | |

*Note: * As shown on attached map (Figure V-12). Position of individual bores will consider the mine plan to ensure life-of-mine and where required, post mine monitoring, can be continuous.*

**W43** Groundwater in aquifers potentially affected by mining activities must not exceed any of the contaminant limits and (trigger) levels in Table V-41 – Groundwater contaminant limits and levels.

It is envisaged that a mean value will be calculated for each of the hydrochemical monitoring parameters as well as the standard deviation. Depending on the spread of data the trigger values could be as follows:

- Compare the monitoring results to either 2 times standard deviation of the mean (95 of data captured);
- If groundwater quality data exceeds trigger value (2 times standard deviation) then resample and submit for full analysis suite;
- If elevated concentrations (above trigger) are recorded on two consecutive sampling runs then an investigation into cause, optimum response, and the potential for environmental harm is to be conducted; and
- If elevated concentrations are recorded on two consecutive sampling runs then the administering authority will be notified within 1 month of receiving the analysis results.

Suggested groundwater level triggers are compiled in Table V-41.

Table V-41 Groundwater contaminant limits and trigger levels

| Parameter | Units | Contaminant limits |
|---|---|---|
| Dissolved metals Aluminium (Al)<br>Antimony (Sb)<br>Arsenic (As)<br>Barium (ba)<br>Beryllium (Be)<br>Boron (B)<br>Cadmium (Cd)<br>Chromium (Cr)<br>Cobalt (Co)<br>Copper (Cu)<br>Iron (Fe)<br>Lead (Pb)<br>Manganese (Mn)<br>Mercury (Hg)<br>Nickel (Ni)<br>Selenium (Se)<br>Vanadium (V)<br>Zinc (Zn) | µg/L | Arithmetic mean + 2 standard deviations |
| TDS | mg/L | Arithmetic mean +10% |
| EC | µS/cm | Arithmetic mean +10% |
| Sulphate | mg/L | Arithmetic mean + 2 standard deviations |
| pH | unit | Average and maximum ± 1 pH unit |

*Note: Baseline value ±1.0 for pH, means the corresponding variation allowed is 1.0 pH unit above and below average and maximum pH values.*

**W44** Groundwater monitoring bores must be constructed and operated in accordance with methods prescribed in the latest edition of the Land and Water Biodiversity Committee, 2003 *Minimum Construction Requirements for Water Bores in Australia*.

Table V-42 Groundwater Level Triggers

| Aquifer | Trigger Level |
|---|---|
| Quaternary alluvium and Tertiary perched water tables | Limited storage in alluvium and limited seasonal nature of the perched water tables naturally range from saturated (wet season) to dry (dry season and droughts).<br>Therefore no trigger value is proposed. |
| Fracture Rock Aquifers – (within Mine Area) | No trigger value for areas overlying mine workings (dewatered due to mining).<br>Monitoring of groundwater to aid with model refinement and predictions. |
| Fractured Rock Aquifers Interburden Sandstone and Coal Seam - Off-site | Variation in water level of greater than 5 m compared to previous corresponding season (i.e. dry season to dry season, wet season to wet season) and comparison to cumulative rainfall departure curve. |

The trigger levels are to be revised and discussed with DERM once groundwater modelling provides sufficiently accurate predictions regarding dewatering impacts.

**W44** Groundwater monitoring bores must be constructed and operated in accordance with methods prescribed in the latest edition of the Land and Water Biodiversity Committee, 2003 *Minimum Construction Requirements for Water Bores in Australia*.

The monitored data will be reported to the relevant authority, and will contain the following criteria:

- Data collected under the monitoring program will be forwarded to the relevant authority within 30 business days of being collected and in a format approved by the relevant authority;
- The proponent shall undertake an assessment of the impacts of mining on groundwater after the first 12 months of dewatering commencing and thereafter every subsequent calendar year;
- The report will be forwarded to the relevant authority by the first of March each calendar year; and
- The report will include an assessment of impacts, any mitigation strategies as wells as any recommendations for changes to the approved monitoring program.

If there is a requirement to submit a similar groundwater report as part of any term issued under a water licence under the *Water Act 2000* then the proponent and the relevant authorities may agree for the reports to be combined.

#### V.3.4.10.4 *Sewage Effluent*

**W45** The daily operation of the wastewater treatment plant must be carried out by a person(s) with appropriate experience and/or qualifications to ensure its effective operation.

**W46** Effluent can only be released to the decant dam associated with the tailings storage facility.

**W47** Pipelines and fittings associated with the effluent irrigation system must be clearly identified.

**W48** All effluent released from the treatment plant must be monitored at the frequency and for the parameters specified in Table V-43.

Table V-43 Sewage treatment effluent quality targets

| Monitoring point | Quality characteristics | Release limits | Frequency |
|---|---|---|---|
| To be confirmed in detailed design. | 5 day Biological oxygen demand (mg/L) | 20 | Monthly |
| | Suspended solids (mg/L) | 30 | |
| | Thermotolerant coliforms (Cfu/100mL$^2$) | 10 | |
| | Total phosphorous (mg/L) | 15 | |
| | Total nitrogen (mg/L) | 30 | |
| | pH | 6.5 to 8.5 | |

## V.3.5 Noise and Vibration

### V.3.5.1 Background

The Project has the potential to generate noise and vibration impacts on nearby sensitive receptors. Operation and construction activities will vary and change in location throughout the various mine stages. The noise levels and potential noise and vibration impacts at the sensitive receptor locations will therefore vary accordingly.

Eight existing residences (Receptors A – H) are located within approximately 4.5 – 17 km of the mine lease application boundary to the north, east and south; these receptors are setback from the mining disturbance area by no less than 8 km.

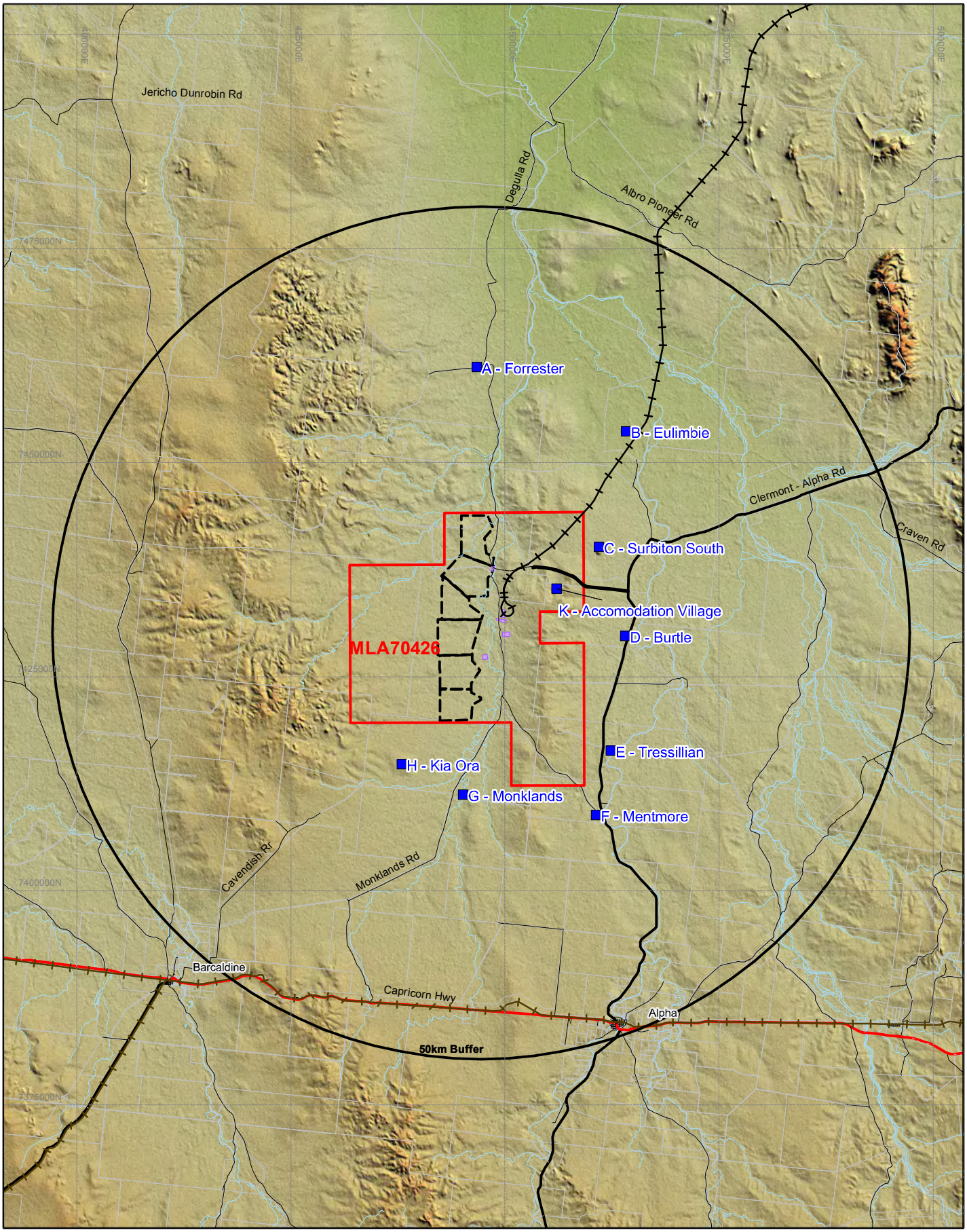
The on-site Project accommodation village (K) is located at approximately 8 km to the east of the disturbance area.

Locations of the noise sensitive receptors in relation to the Project site are shown in Figure V-15 whilst Table V-44 sets out the nearest potentially affected noise sensitive receptor locations and their respective distances from the nearest mining lease boundary and pit area boundary.

Two existing homesteads situated on the Project site (Hobartville and Wendouree Homesteads) will be purchased by the Proponent through appropriate compensation agreements prior to the commencement of the Project. These two homesteads are therefore not considered as sensitive receptors.

Table V-44 Noise Sensitive Receptors

| Receptor | Address | Approx. Distance from MLA70426 Mining Lease Boundary, (km) | Approx. Distance from Pit Area Boundary, (km) |
|---|---|---|---|
| A | Forrester Homestead | 16,7 | 17,2 |
| B | Eulimbie Homestead | 9,4 | 16,2 |
| C | Surbiton South Station | 3,7 | 13,6 |
| D | Burtle Station | 4,6 | 17,3 |
| E | Tressillian Homestead | 4,2 | 16,7 |
| F | Mentmore Homestead | 5,4 | 18,4 |
| G | Monklands Homestead | 7,9 | 8,8 |
| H | Kia Ora Homestead | 4,6 | 8,2 |
| I | Hobartville Homestead | Within MLA70426 | 3,7 |
| J | Wendouree Station | Within MLA70426 | 1,2 |
| K | Project Accommodation Village | Within MLA70426 | 7,3 |
| Notes: | * Locations I and J will be purchased by the Proponent prior to the commencement of the Project. These two homesteads are not considered as sensitive receptors. | | |




Mining Lease Application (MLA70426) Boundary

Sensitive Receptor

Mine Pit Extent

Source: See Copyright Details below and for full disclosure Please Refer to the SEIS ***Volume 2, Appendix B***

0 5 10 15Km

Scale 1:600 000 (A4)

Datum: GDA94, MGA Zone55

N W E S

**HANCOCK** PROSPECTING PTY LTD

Alpha Coal Project
Supplementary Environmental Impact Statement

# ALPHA COAL PROJECT (MINE) MINING LEASE BOUNDARY, PIT AREA BOUNDARY AND NOISE RECEPTOR LOCATIONS

| | |
|---|---|
| Job Number | 4262 6680 |
| Revision | B |
| Date | 07-06-2011 |

Figure: V-15

File No: 42626680-g-2056b.wor

#### V.3.5.1.1 *Background Noise Monitoring*

Long-term unattended noise monitoring was undertaken at the locations of Wendouree Station (J) between 23 and 30 June 2010 and Hobartville Homestead (I) between 26 June and 3 July 2010. It is understood that the monitoring was undertaken in accordance with the Ecoaccess Guideline: *Noise Measurement Manual* (2000) and *AS1055:1997 Acoustics – Description and Measurement of Environmental Noise*.

Given the very rural nature of the proposed mine site and far reaching surrounds, the measured noise levels obtained from the monitoring locations within the mining lease boundary would be expected be reasonably representative of the noise levels expected at the locations of Receptors A – H.

Rating Background Levels (RBL) for daytime, evening and night-time periods determined from the noise monitoring results for both measurement locations are summarised in Table V-45. The median maximum $L_{Aeq,1hour}$ noise levels measured at each location are also shown.

Table V-45 Noise Monitoring Results

| Location | Rating Background Noise Level (RBL) $L_{A90}$ dB(A) | | | Ambient Noise Level (AL) $L_{Aeq}$ dB(A) | | |
|---|---|---|---|---|---|---|
| | Day | Evening | Night | Day | Evening | Night |
| Wendouree Station (J) | 27 | 26 | 26 | 43 | 31 | 27 |
| Hobartville Homestead (I) | 26 | 26 | 25* | 42 | 31 | 27 |

* In accordance with the Ecoaccess guideline, the threshold background level is $L_{A90}$ 25 dB(A). The RBL of $L_{A90}$ 24 dB(A) was adjusted accordingly.

Operational noise criteria for the Project are based on the levels set out in Table V-45 in accordance with provisions of the Queensland DERM Ecoaccess Guideline: *Planning for Noise Control*. For the receptor locations where monitoring was not conducted, the assessment criteria has been based the lowest daytime, evening and night-time noise monitoring results, effectively from the Hobartville Homestead location.

Given the nearest receptors are located in a very rural area, vibration monitoring of existing environment was not undertaken. It is considered unnecessary to undertake vibration monitoring in a rural area where no industry operation is currently present.

### V.3.5.2 Environmental Value

The environmental values to be enhanced or protected, as set out in the Queensland *Environmental Protection (Noise) Policy 2008* [EPP (Noise)], are:

- The qualities of the acoustic environment that are conducive to protecting the health and biodiversity of ecosystems;
- The qualities of the acoustic environment that are conducive to human health and wellbeing, including by ensuring a suitable acoustic environment for individuals to do any of the following:
  - Sleep;
  - Study or learn;
  - Be involved in recreation, including relaxation and conversation; and
- The qualities of the acoustic environment that is conducive to protecting the amenity of the community.

### V.3.5.3 Potential Impacts on the Environmental Value

Open cut mining at the Project will involve overburden removal and strip mining of coal. Overburden removal will occur during the pre-strip process and will utilise two in-pit crushing and conveying (IPCC) systems, truck and shovel fleets, as well as draglines in pit. The exposed coal will be loaded by excavators and front end loaders into trucks for hauling either to the field coal stockpiles or to the ROM stockpiles for screening, crushing and processing.

The mine will operate on a 24 hour, seven days per week basis during the construction and operational phases, with blasting limited to the daytime period only each day.

#### V.3.5.3.1 *Construction Noise*

***Criteria***

Whilst the Queensland EPP (Noise) does not include construction noise limits, it does provide acoustic quality objectives for the protection of amenity, human health and wellbeing, including sleep protection. Construction noise effects have been assessed against these criteria, which are set out in Table V-46.

Table V-46 Environmental Protection (Noise) Policy 2008 - Acoustic Quality Objectives

| Sensitive Receptor | Time of Day | Acoustic Quality Objectives (measured at the receptor) dB(A) | | | Environmental Value |
|---|---|---|---|---|---|
| | | $L_{Aeq,1hour}$ | $L_{A10,1hour}$ | $L_{A1,1hour}$ | |
| Dwelling (external) | Daytime and Evening | 50 | 55 | 65 | Health & wellbeing |
| Dwelling (internal) | Daytime and Evening | 35 | 40 | 45 | Health & wellbeing |
| Dwelling (internal) | Night-time | 30 | 35 | 40 | Health & wellbeing in relation to the ability to sleep |

As set out in Table V-46, for the protection of sleep, the EPP (Noise) recommends that internal noise levels do not exceed 40 dB(A) $L_{A1,1hour}$. Assuming a 10 dB(A) reduction through a partially opened window, this is approximately equivalent to an external level of 50 dB(A) $L_{A1}$; a more stringent limit than the WHO guideline of 55 dB(A) $L_{Amax}$. For the purposes of this assessment, the EPP sleep protection criterion of 50 dB(A) $L_{A1}$ is adopted.

**Predicted Construction Noise Levels**

The noise levels at each receptor location generated by the construction activities have been predicted for four discrete construction stages by modelling of the anticipated construction noise sources located throughout the mine site. The noise modelling has been carried out considering neutral and adverse meteorological conditions.

Modelling results indicate that full compliance with the EPP (Noise) noise limits would be achieved for the construction of the proposed mine infrastructure during the day, evening or night time periods.

The predicted construction noise levels result from a conservative noise modelling approach where it has been assumed that all equipment would operate continuously and simultaneously during the assessment period.

### Low Frequency Noise

The Queensland DERM Ecoaccess Guideline: *Assessment of Low Frequency Noise* provides guidance for the assessment of low frequency noise impacts. Where a noise emission occurs exhibiting an unbalanced frequency spectra, the overall sound pressure level inside residences should not exceed 50 dB(Linear) to avoid complaints of low frequency annoyance. If the dB(Linear) measurement exceeds the dB(A) measurement by more than 15 dB, a one-third octave band analysis should be carried out.

Predictive noise modelling estimated the noise levels to be less than 50 dB(L) at receptor locations (A-H) outside the mining lease boundary and at Location K (Accommodation village). Additionally, no more than 15 dB difference between linear levels and A-weighted levels were predicted at these locations.

On this basis it is concluded that low frequency noise would not be at a level to cause annoyance to these residential receptors and compliance with the 20 dB $L_{pA,LF}$ criterion inside these dwellings is predicted. Accordingly, no adjustment to the A-weighted operational noise criteria is deemed necessary.

## V.3.5.3.2 *Operational Noise*

### Criteria

The potential operational noise impacts from the site have been assessed in accordance with the provisions of the *Environmental Protection Act* (1994) and the EPP (Noise) whilst the operational noise criteria for the Project have been set in accordance with the EPA Ecoaccess Guideline: *Planning for Noise Control*.

The Ecoaccess Guideline: Planning for Noise Control prescribes a process, which takes account of:

- Control and prevention of background creep in the case of steady noise;
- Containment of variable noise levels and short term noise events; and
- Prevention of sleep disturbance.

The resultant assessment criteria applied for each sensitive receptor based on the noise monitoring results are set out in Table V-47. The Hobartville location criteria have been applied for receptor locations where no background noise monitoring was undertaken.

In accordance with the Ecoaccess guideline, the most stringent of the Planning Noise Level and Specific Noise Level criteria are applied in setting the $L_{Aeq,1\ hour}$ limits for the purposes of this assessment.

Table V-47: Summary of Operational Noise Design Criteria

| Receptor | Daytime Criteria, dB(A) | | Evening Criteria, dB(A) | | Night Criteria, dB(A) | |
|---|---|---|---|---|---|---|
| | $L_{A90,1hour}$ | $L_{Aeq,1hour}$ | $L_{A90,1hour}$ | $L_{Aeq,1hour}$ | $L_{A90,1hour}$ | $L_{Aeq,1hour}$ |
| A-H (Off-site Receptors) and K (Project Accommodation Village) | 31 | 29 | 28 | 29 | 25 | 28 |

The guideline recommends that in order to achieve a good night's sleep, internal noise levels will not exceed 45 dB(A) $L_{Amax}$ more than 10 to 15 times per night. This corresponds to an external limit of 55 dB(A) $L_{Amax}$ assuming 10 dB(A) attenuation through open windows. Based on the EPP(Noise) acoustic quality objectives for sleep protection, however, the more stringent external limit of 50 dB(A) $L_{A1}$ as

assessed at 4 m from the dwelling façade is applied for sleep protection; applicable during the night-time period only.

The Ecoaccess guidelines: *Assessment of Low Frequency Noise*; and *Noise and Vibration from Blasting* have also been considered with respect to the proposed operation activities.

#### Predicted Operational Noise Levels

No impacts are expected at any receptor location outside the mining lease. Full compliance with the operational noise criteria is predicted at Receptors A – H.

The primary function of the Project Accommodation Village (Receptor K) is to provide sleeping facilities and an area for recreation and relaxation for mine workers between shifts. On this basis, only the internal noise criteria are considered appropriate for the assessment of the accommodation village. External noise levels of up to 33 dB(A) $L_{Aeq}$ are predicted at this location under adverse meteorological conditions and as such it would be expected that the internal noise criteria would be met with windows open. Irrespectively the accommodation will need to be air conditioned, allowing for windows to be kept closed.

#### Low Frequency Noise

A low frequency noise criterion of 50 dB(L) is applicable to the Project.

The mining equipment noise sources under assessment typically emit noise of a broadband nature and have not been known to generate the very low frequencies that the Ecoaccess guideline was intended to address. The assessment of low frequency noise, in accordance with the Ecoaccess guideline, has determined that low frequency noise would not be at a level to cause annoyance to these residential receptors. Accordingly, no adjustment to the A-weighted operational noise criteria is required.

#### Cumulative Noise

The cumulative noise impacts are controlled through the background creep ($L_{90}$) and specific/intrusive ($L_{eq}$) criteria contained in the *Planning for Noise Control* guideline. Both criteria take into account the existing ambient noise level in an area from all existing industry and other noise sources such as road and railway traffic.

The assessment methodology prescribed by the Ecoaccess guideline *Planning for Noise Control* is based on the existing ambient noise monitoring (undertaken at two locations within the mining lease boundary) and comparison to recommended ambient noise levels. The cumulative effect of the existing industry and other noise sources, together with the Project, is assessed not to exceed the recommended ambient noise levels. If the existing noise level is already above the recommended noise levels, the associated noise levels of the Project are set between 8 and 10 dB(A) below the existing ambient noise level so as the cumulative effects of existing and proposed industry will not increase above existing noise levels.

No exceedance of the recommended ambient noise levels are predicted at Receptors A – H and K due to the cumulative noise contribution from existing industry or any other noise sources, in combination with the Project.

### V.3.5.3.3 *Blasting Noise and Vibration*

#### Criteria

Table V-48 presents a summary of the overpressure and ground vibration criteria and the time of blasting applicable to the Project.

Table V-48 Blasting Overpressure and Ground Vibration Design Criteria

| Airblast Overpressure and Vibration Parameter | Daylight hours Monday to Saturday<br>Between 0900 – 1300 on Sundays and public holidays |
|---|---|
| Airblast Overpressure | 115 dB(L) for 9 out of any 10 consecutive blasts regardless of interval between blasts.<br>Any single blast must not exceed 120 dB(L). |
| Peak Particle Velocity | 5 mm/s for 9 out of any 10 consecutive blasts regardless of interval between blasts.<br>Any single blast must not exceed 10 mm/s. |

When a temperature inversion or a heavy low cloud cover is present, values of airblast overpressure will be higher than normal in surrounding areas. Accordingly, blasting will be avoided if predicted values of airblast overpressure in noise-sensitive places exceed acceptable levels. If this is not practicable, blasting will be scheduled to minimise noise annoyance. An appropriate period is generally between 11 am and 1 pm. Similarly, blasting will be avoided at times when strong winds are blowing from the blasting site towards noise sensitive places.

Blasting will be carried out in accordance with the relevant Australian Standards, *AS 2187 Explosives – Storage, Transport and Use* and the *Explosive Act, 1999*.

All blast holes will be confined and standard central Queensland strip mining blasting techniques will be used. Electronic initiation will be used to optimise blast performance and to limit the MIC values. For blasting of weathered overburden and Permian units (>30 m), dragline blast bench height MICs of between 780 -1,800 kg can potentially be used. The dragline blast bench height will range between 40 and 55 m and the MIC will vary accordingly. Generally, substantially lower MICs than stated will be used.

Blasting of weathered overburden and Permian units, >30 m, would occur on average at a frequency of once or twice per week. During peak production, typically only one blast per day would occur.

No overburden blasting will occur beyond the pit areas.

Predicted Overpressure

- Receptors A – H: Calculations indicate that blasts requiring up to the maximum 1,800 kg MIC would not exceed the most stringent 115 dB(L) overpressure at any sensitive receptor location beyond the mining lease boundary based on minimum setback distance to the pit area. Of the identified receptors beyond the mining lease boundary, Location H (Kia Ora Homestead) is the closest to the pit area boundary at a setback distance of approximately 8 km. At this location overpressure levels of no more than 113 dB(L) are predicted.
- Receptor K (Project Accommodation Village): Overpressure levels are not predicted to exceed 114 dB(L), and therefore the criteria would be expected to be readily achieved at this location.

### Predicted Ground Vibration

No ground vibration impacts are predicted and therefore, with respect to ground vibration, the proposed blasting schedule may be undertaken in compliance with the established criteria, without risk of damage to the receptor properties or community annoyance.

Standard DIN 4150.3-1999 recommends offset distances for buried pipelines constructed from various materials for the prevention of damage from vibration effects. Masonry or plastic pipes are most susceptible; for these pipeline types an offset distance of 510 m is recommended. There are no known

buried pipelines within 510 m of the proposed blasting areas and therefore no adverse effects on pipelines due to blasting are expected.

Optic fibre cables would supply communications to the site, and would likely enter the mine site along the Powerlink powerlines. It is understood that the cable network would not be sited within 500 m of the proposed blasting areas and therefore no adverse effects on communications networks due to blasting are expected.

#### V.3.5.3.4 *Noise and Vibration Impact on Wildlife*

Apart from the possibility of noise from blasting startling birds and therefore over time possibly changing where they nest, no adverse impacts on animals are predicted for the Project. Given that there is no conclusive information available to confirm that should birds be startled they will change where they nest, noise impacts on animal life surrounding the proposed mine is considered acceptable.

### V.3.5.4 Environmental Protection Objectives

The environmental protection objectives for noise and vibration are:

- To avoid causing nuisance noise levels at sensitive receptors; and
- To avoid causing nuisance airblast overpressure and ground vibration impacts at sensitive receptors.

### V.3.5.5 Performance Criteria (Indicators)

The performance criteria for noise and vibration are:

- Compliance with the requirements of the project's environmental authority.
- Noise and vibration monitoring in accordance with the control strategies outlined below.
- The number of substantiated noise or vibration complaints from the community.

### V.3.5.6 Control Strategies

#### V.3.5.6.1 *Construction*

No adverse construction noise levels are predicted for receptor locations. Therefore, specific construction noise mitigation measures for the Project are not warranted.

#### V.3.5.6.2 *Operations*

- Receptors A – H: No operational noise mitigation measures are required.
- Receptor K (Project Accommodation Village): The accommodation will need to be air conditioned allowing windows to be kept closed.

The following general noise and vibration management measures will be implemented:

- The Proponent will maintain all plant and equipment in good working order to ensure compliance with the noise criteria;
- The Proponent will site and design noise generating plant to comply with the applicable noise criteria at receptor locations outside of the mining lease boundary;
- The Proponent will develop a noise, vibration and overpressure monitoring program, making results of this monitoring available to the relevant authority upon request;

- In the event of any exceedance of the established noise, vibration or overpressure criteria, the Proponent will take immediate action to investigate and remedy the situation; and
- The Proponent will develop a complaints handling protocol to respond to any complaints in relation to noise, vibration or overpressure and investigate these, where necessary.

The following control strategies for blasting will be implemented:

- Carry out blasting only during daylight hours.
- Where there exists the possibility that instantaneous, short-duration, high-level noise events may occur during night-time hours (22:00 – 07:00), consideration will be given to the potential for the disturbance of sleep within residences and the accommodation village.
- Where monitoring or complaints indicate airblast overpressure or ground vibration levels of impact consistently above the environmental protection objectives, the following mitigations measures will be considered:
  - Reducing the maximum instantaneous charge (MIC) by using delays, reduced hole diameter and/or deck loading;
- Changing the burden and spacing by altering the drilling pattern and/or delay layout, or altering the hole inclination;
- Ensuring stemming depth and type is adequate; and
- Restricting blasts to favourable weather conditions.

### V.3.5.7 Monitoring

#### V.3.5.7.1 *Ongoing Monitoring Program*

A combination of permanent and short term attended noise and vibration monitoring will be undertaken at the Project Accommodation Village (Receptor K).

Additionally, the following locations will be considered for non-permanent noise monitoring:

- Receptor C: Surbiton South Station;
- Receptor G: Monklands Homestead; and
- Receptor H: Kia Ora Homestead.

A permanent noise monitoring system to be installed at Receptor K would require additional housing or security measures to protect the monitoring equipment due to public accessibility.

The permanent noise logger will be set to statistically process and store the measured $L_{Aeq}$, $L_{A10}$, $L_{A50}$, $L_{A90}$, $L_{A1}$ and $L_{Amax}$ noise levels and ground vibration (peak particle velocity, mm) every 15 minutes with the measuring microphones set at 1.2 – 1.5 m above ground level. Calibration of the systems will be regularly verified.

Attended noise measurements will be conducted quarterly during day, evening and night-time periods over a 48 hour period at the same locations using the same measurement time interval. The combination of permanent and short-term annual noise monitoring will ensure that a comprehensive monitoring program for continuous noise and vibration is achieved. Additionally, attended noise monitoring will be carried out promptly at other sensitive receptor location(s) in response to any substantiated complaint(s).

All noise monitoring will be carried out in accordance with the Ecoaccess Guideline: *Noise Measurement Manual* and AS1055:1997 "*Acoustics – Description and Measurement of Environmental*

*Noise*". All noise monitoring instruments will comply with AS IEC 61672.1 – 2004 "*Electroacoustics – Sound level meters – Specifications*". All instruments will have valid and current calibration certificates traceable to a NATA certified laboratory.

#### V.3.5.7.2 *Complaints Based Monitoring*

In the event of a community member registering a complaint regarding excessive noise or vibration levels, a two-phase response regime will be implemented:

- First complaint: Remote Response - Data from the permanent monitoring site, mine site activities and weather data will be interrogated to determine justification of the complaint.
- Second complaint: Site Response - An acoustic professional will visit the area where the complaint was registered for a 48-hour period to undertake continuous logging as well as short-term noise and/or vibration monitoring to determine impacts.

### V.3.5.8 Commitments

- Noise and vibration monitoring will be carried out in accordance with the environmental authority.
- The Project will investigate all substantiated noise and vibration related complaints.
- The Project will implement corrective action resulting from complaints investigations as required.

### V.3.5.9 Proposed Environmental Authority Conditions

Schedule D – Noise and Vibration

#### V.3.5.9.1 *Departmental Interest: Noise and Vibration*

**(D1)** **Noise nuisance**

Noise from the mining activity must not cause a noise nuisance at any sensitive place.

**(D2)** All noise from the mining activity must not exceed the levels specified in Table V-46 at any sensitive place.

**(D3)** Noise is not considered to be a nuisance under condition D1 if monitoring shows that noise from the mining activity does not exceed the following levels in the time periods specified in Table V-49.

**Table V-49 Noise Limits (Sensitive Place)**

| Location | Daytime (0700-1800) | Evening (1800-2200) | Night-Time (2200-0700) | |
|---|---|---|---|---|
| | $L_{Aeq, adj\ 15\ mins}$ dB(A) | $L_{Aeq, adj\ 15\ mins}$ dB(A) | $L_{Aeq, adj\ 15\ mins}$ dB(A) | $L_{Amax,15\ mins}$ dB(A) |
| Any Noise Sensitive Receptor | RBL + 5 | RBL + 5 | RBL + 5 | 55 |

**(D4) Noise monitoring**

When requested by the administering authority, noise monitoring must be undertaken within a reasonable and practicable timeframe nominated by the administering authority to investigate any complaint (which is neither frivolous nor vexatious nor based on mistaken belief in the opinion of the authorised officer) of noise nuisance at any sensitive place, and the results must be notified within fourteen (14) days to the administering authority following completion of monitoring. Monitoring must include:

- $L_{Aeq,adj,15\ mins}$ (external)
- $L_{A1,15\ mins}$ (internal – or a measured external noise level and calculation of corresponding internal noise level)
- the level and frequency of occurrence of impulsive or tonal noise
- atmospheric conditions including wind speed and direction
- effects due to extraneous factors such as traffic noise, and
- location date and time of recording.

**(D5)** The method of measurement and reporting of noise levels must comply with the current edition of the Department of Environment and Resource Management's *Noise Measurement Manual* and any subsequent versions.

**(D6)** If monitoring indicates exceedance of the relevant limits in Table V-49, then the environmental authority holder must:

a) address the complaint including the use of appropriate dispute resolution if required, and
b) immediately implement noise abatement measures so that emissions of noise from the activity do not result in further environmental nuisance.

**(D7) Vibration nuisance**

Subject to conditions D8 and D9, vibration from the mining activity must not cause an environmental nuisance at any sensitive or commercial place.

**(D8)** If the environmental authority holder can provide evidence through monitoring that the limits defined in Table V-50 are not being exceeded then the holder is not in breach of condition D7.

**(D9)** If monitoring indicates exceedance of the relevant limits in Table V-49, then the environmental authority holder must:

a) address the complaint including the use of appropriate dispute resolution if required, and
b) immediately implement vibration abatement measures so that vibration from the activity does not result in further environmental nuisance.

**Table V-50 Airblast Overpressure and Peak Particle Velocity Levels**

| Blast Noise and Vibration Parameter | Daylight hours – Monday to Saturday<br>Between 0900 – 1300 on Sundays and public holidays |
|---|---|
| Airblast Overpressure Level [dB(L)] | 115dB (linear) peak for nine out of any 10 consecutive blasts initiated, regardless of the interval between blasts; and<br>No more than 120dB (linear) peak for any blast. |
| Peak Particle Velocity (mm/s) | the ground-borne vibration must not exceed a peak particle velocity of 5mm per second for nine out of any 10 consecutive blasts initiated, regardless of the interval between blasts; and<br>must not exceed a peak particle velocity of 10mm per second for any blast. |

**(D10)** When requested by the administering authority, vibration monitoring must be undertaken within a reasonable and practicable timeframe nominated by the administering authority to investigate any complaint (which is neither frivolous nor vexatious nor based on mistaken belief in the opinion of the authorised officer) of environmental nuisance at any sensitive or commercial place, and the results must be notified within fourteen (14) days to the administering authority following completion of monitoring.

**(D11)** The method of measurement and reporting of vibration levels must comply with Appendix J of AS 2187.2-2006.

**(D12) Airblast overpressure nuisance**

Subject to Conditions D13 and D14, airblast overpressure level from blasting operations must not cause an environmental nuisance, at any sensitive or commercial place.

**(D13)** If the environmental authority holder can provide evidence through monitoring that the limits defined in Table V-50 are not being exceeded then the holder is not in breach of condition D12.

**(D14)** If monitoring indicates exceedance of the relevant limits in Table V-50, then the environmental authority holder must:

a) address the complaint including the use of appropriate dispute resolution if required, and

b) immediately implement airblast overpressure abatement measures so that airblast overpressure from the activity do not result in further environmental nuisance.

**(D15)** When requested by the administering authority, airblast overpressure monitoring must be undertaken within a reasonable and practicable timeframe nominated by the administering authority to investigate any complaint (which is neither frivolous nor vexatious nor based on mistaken belief in the opinion of the authorised officer) of environmental nuisance at any sensitive or commercial place, and the results must be notified within fourteen (14) days to the administering authority following completion of monitoring.

**(D16)** Airblast overpressure monitoring must include the following descriptors, characteristics and conditions:

a) location of the blast(s) within the mining area (including which bench level)
b) atmospheric conditions including temperature, relative humidity and wind speed and direction
c) location, date and time of recording.

**(D17)** The method of measurement and reporting of airblast overpressure levels must comply with Appendix J of AS 2187.2-2006.

## V.3.6 Waste Management

### V.3.6.1 Background

### V.3.6.2 Regulatory Framework

In Queensland, the management of waste (non-mineral) is governed by a number of pieces of legislation. As a generator of waste, the Proponent will ensure that it meets its obligations under the *Environmental Protection Act 1994* (EP Act), *Environmental Protection (Waste Management) Policy 2000* (EPP Waste), *Environmental Protection (Waste Management) Regulation 2000* and the *National Environmental Protection (Movement of controlled Wastes between States and Territories*) Measure during construction and operation of the open cut mine.

#### V.3.6.2.1 *Waste Definition*

The EP Act (Section 13) defines 'waste' as anything that is:

- Left over, or an unwanted by-product, from an industrial, commercial, domestic or other activity; and
- Surplus to the industrial, commercial, domestic or other activity generating wastes.

The EPR defines 'general waste' as waste other than "regulated" waste. Section 65 of the *Environmental Protection Regulation 2008* (EPR) defines 'Regulated waste' as waste that:

i. uses less energy, water or another input is commercial or industrial waste, whether or not it has been immobilised or treated; and

ii. is of a type, or contains a constituent of a type, mentioned in schedule 7 (of EPR).

### V.3.6.3 Waste Management Principles and Hierarchies

The *Environmental Protection (Waste Management) Policy 2000* (EPP (Waste) provides a strategic framework for managing wastes by establishing a waste management hierarchy that identifies the following waste management practices in the preferred order of adoption.

- Waste avoidance
- Waste re-use
- Waste recycling
- Energy recovery from waste
- Waste disposal

The EPP (Waste) also requires that *'cleaner production'* be considered in determining how waste is managed. A cleaner production program is defined in the EPP (Waste) to identify and implement ways of improving a production process so that the process:

- Uses less energy, water or another input; or
- Generates less waste; or
- Generates waste that is less environmentally harmful.

Certain waste management activities including disposal and transport of waste are considered to be environmentally relevant activities (ERA) and require approval of DERM and local government. The Waste Regulation also contains requirements for handling specific waste streams.

Certain "regulated wastes" are considered 'trackable wastes'. The Waste Regulation provides a process to allow such wastes to be tracked from the point of generation to the point of final processing, recycling or disposal. Examples of such waste include:

- Organic solvents, other than halogenated solvents;
- Oil and water mixtures or emulsions, or hydrocarbons and water mixtures or emulsions;
- Tyres; and
- Waste of an explosive nature, other than an explosive within the meaning of the Explosives Act 1999.

### V.3.6.4 Project Waste Streams

#### V.3.6.4.1 *Early works and Construction*

The wastes generated by mine and infrastructure construction activities are shown in Table V-51.

## Table V-51 Construction waste inventory for total construction period

| Waste material | Waste sources | Units | Estimated Quantity* | Management Strategy |
|---|---|---|---|---|
| Green waste | Clearing of vegetation during early works and construction phase of mine | tonnes | 810,000 | Suitable material to be used on site to provide fauna habitat. Remaining material to be chipped and mulched for reuse during progressive rehabilitation and revegetation.<br>Burning of green wastes will only occur as a last resort, subject to obtaining necessary permits and approvals. |
| Cardboard and paper | Construction activities, contractor crib rooms, offices, accommodation facilities | tonnes | 2,200 | Segregation of paper and cardboard for removal off-site for recycling where possible by a licensed recycling or waste contractor. |
| Plastics | Contractor crib rooms, offices, accommodation facilities, construction activities | tonnes | 720 | Segregation of plastics for removal off-site for recycling where possible by a licensed recycling or waste contractor. |
| Glass | Contractor crib rooms, offices, accommodation facilities, construction activities | tonnes | 235 | Segregation of glass for removal off-site for recycling where possible by a licensed recycling or waste contractor. |
| Metals | Construction of structures for the mine industrial area and accommodation facilities | tonnes | 800 | Segregation for reuse on-site, otherwise removal off-site to a recycling facility or disposal at a licensed waste disposal facility by a licensed recycling or waste contractor. |
| Processed timber and wood | Left-over from new construction and deconstruction of existing structures and temporary construction phase structures | tonnes | 2,600 | Reused if possible, either on or off-site. Where reuse is not possible, processed timber and wood to be disposed to the on-site landfill. If hazardous materials are present, such as lead-based paints, asbestos or timber treatment chemicals, specialist handling and off-site disposal will be undertaken. |
| Concrete materials, bricks and pavers | Left-over from new construction and deconstruction of temporary construction phase structures | tonnes | 2,950 | Concrete and other masonry material to be used as clean fill or removed from site for clean fill or crushed aggregate recycling if possible, otherwise disposed to the on-site landfill. |
| Electrical wastes | Contractor crib rooms, offices, accommodation facilities, and mine, CHPP and infrastructure facilities | tonnes | 725 | Segregation of electrical wastes for removal off site for recycling or reprocessing where possible by the waste contractor. |

| Waste material | Waste sources | Units | Estimated Quantity* | Management Strategy |
|---|---|---|---|---|
| General putrescible wastes | Contractor crib rooms, offices, accommodation facilities | tonnes | 10,400 | General refuse to be collected in covered bins and removed at least once a week to the on-site landfill during construction phase. |
| Batteries | Mobile phones, radios, vehicles, equipment, etc | tonnes | 330 | Mobile phone, radio and other batteries to be segregated and then collected by a licensed waste contractor for reuse, reprocessing, recycling or disposal. |
| Oils (synthetic and mineral) | Routine servicing of vehicles and equipment at designated hardstand areas near the construction office facilities. Construction and assembly of draglines and other mining equipment, and first fuel for CHPP equipment | tonnes | 9,000 | Waste oil to be removed from machinery in workshops using pneumatic pumps and oil transferred to bunded waste oil holding tank for collection by a licensed contractor for reuse, reprocessing, recycling or disposal. |
| Other hydrocarbon and hydrocarbon contaminated materials | Routine servicing of vehicles and equipment at designated hardstand areas near the construction office facilities. Construction and assembly of the draglines and other mining equipment | tonnes | 9,200 | Stored in bunded areas then removed by licensed contractor for reuse, reprocessing, recycling or disposal. |
| Empty waste oil containers | Small and bulk drums and containers that typically contained oils and greases | | | Empty drums to be stored in a covered, sealed and bunded area with enclosures in place for periodic collection by a licensed waste contractor for reuse, reprocessing, recycling or disposal. |
| Sealants, resins, solvents and paint materials | Construction of the MIA, accommodation facilities and conveyors, assembly and maintenance of vehicles and equipment. Construction and assembly of draglines, other mining and CHPP equipment | | | Stored in bunded areas then removed by licensed contractor for reuse, reprocessing, recycling or disposal. |

| Waste material | Waste sources | Units | Estimated Quantity* | Management Strategy |
|---|---|---|---|---|
| Other regulated waste | Deconstruction, maintenance and construction activities | | | All regulated wastes shall be collected and removed by a specialised licensed waste contractor/s or specialist maintenance personnel. Tracking of all regulated wastes will be undertaken. |
| Asbestos | Deconstruction of existing structures | tonnes | TBD | Asbestos will be removed and disposed by a specialist contractor. |
| Tyres | Maintenance of vehicles | Number | 770 | Tyres will be removed by the tyre supplier for reprocessing, otherwise tyres will be stored and appropriately disposed of once mining operations commence by burying in the mine overburden in a designated location which will be identified on the EMR managed by DERM. |
| | | Number | 980 | |
| Sewage effluent | Contractor offices, crib room, accommodation facilities | kilolitres | 283,900 | Provision of dedicated WWTP facilities during construction (pump out system) until pipeline connection to permanent WWTP is made available. |
| WWTP sludge | WWTP | tonnes | 85 | Sludge to be collected by a licensed waste contractor and taken to a licensed waste disposal facility. |

#### V.3.6.4.2 *Operations Phase*

The wastes expected to be generated annually during operation of the mine are shown in Table V-52.

**Table V-52 Operational phase waste inventory (annualised)**

| Waste material | Waste sources | Units | Quantity/ annum | Management Strategy |
|---|---|---|---|---|
| Green waste | Clearing of vegetation for ongoing development of the mine | tonnes per year | 108,000 | Suitable material to be reused on site to provide fauna habitat. Remaining material to be chipped and mulched for reuse during progressive rehabilitation and revegetation.<br>Burning of green waste will only occur as a last resort, subject to obtaining permits and approvals. |
| General and putrescible wastes | Contractor crib rooms, accommodation facilities, administration building, warehouse, workshops, CHPP | tonnes per year | 6,200 | General refuse to be collected in covered bins and removed to the on-site landfill at least once a week. |
| Non-hazardous waste | Contractor crib rooms, accommodation facilities, administration building, warehouse, workshops, CHPP | tonnes per year | 1,300 | Segregation of paper and cardboard, glass and recyclable plastics for removal off site for recycling by waste contractor where possible. |

| Waste material | Waste sources | Units | Quantity/ annum | Management Strategy |
|---|---|---|---|---|
| Scrap metal recycled | Contractor crib rooms, accommodation facilities, administration building, warehouse, workshops, CHPP, maintenance and fabrication of machines and equipment and the replacement of machinery parts. | tonnes per year | 2,000 | Metal will be segregated using marked bins for metal and aluminium; bin sizing would depend on location. Bins will be regularly monitored and serviced by the recycling contractor. |
| Batteries | Mobile phones, radios, vehicles, equipment, etc | tonnes per year | 105 | Mobile phone, radio and other batteries to be segregated and then collected by a licensed waste contractor for reuse, reprocessing, recycling or disposal. |
| Oils (synthetic and mineral) | Routine servicing and shutdown overhaul of vehicles and equipment in workshops, including synthetic and mineral oils | tonnes per year | 2,850 | Waste oil will be evacuated from machinery in the workshop using pneumatic pumps and the oil will be transferred to waste oil holding tanks. These tanks will be in a bunded area. The waste oil will be reprocessed by a licensed contractor. |
| Grease | Waste grease from the accommodation facility kitchens, workshop, shutdowns and dragline maintenance | | | Waste grease will be placed in a bunded storage container. Waste grease will be collected periodically by a licensed waste contractor for reuse, reprocessing, recycling or disposal. |
| Hydrocarbons and hydrocarbon contaminated materials | Routine servicing and shutdown overhaul of vehicles and equipment in workshops and maintenance facilities, refuelling and fuel storage facilities. Construction and assembly of draglines and other mining equipment. | tonnes per year | 2,900 | Stored in bunded areas then removed by licensed contractor for reuse, reprocessing, recycling or disposal. |
| Empty waste oil containers | Small and bulk drums and containers that typically contain oils and greases. | | | Empty drums to be stored in a covered, sealed and bunded area with enclosures in place for periodic collection by a licensed waste contractor for reuse, reprocessing, recycling or disposal. |
| Sealants, resins, solvents and paint materials | Routine servicing and shutdown overhaul of vehicles and equipment in workshops, operation and maintenance of conveyors, draglines and other mining equipment. | | | Stored in containers in bunded areas then removed by licensed contractor for reuse, reprocessing, recycling or disposal. |

| Waste material | Waste sources | Units | Quantity/ annum | Management Strategy |
|---|---|---|---|---|
| Oil and air filters | Routine servicing and shutdown overhaul of equipment in the workshop. | | | Stored in containers in bunded areas then removed by licensed contractor for reuse, reprocessing, recycling or disposal. |
| Blasting residue (from use of ANFO explosive, boosters and detonator) | Blasting of overburden | tonnes per year | 27,500 average | Fragments to be buried in overburden stockpiles. |
| Tailings (including process water) | Coal handling, preparation and processing | tonnes per year | 2.5 million | Fine particulates from the coal processing will be disposed to a TSF in slurry form. Tailings will be capped following suitable drying of materials. The area of the tailings dam will then be rehabilitated and revegetated.<br>After a period of operation, in-pit disposal options will be investigated in discussion with regulator. |
| Coarse rejects | Coal handling, preparation and processing | tonnes per year | 6.6 million | During the first year of operation, coarse rejects will be encapsulated in the out-of-pit spoil pile. When sufficient space is available, all coarse rejects will be stored within the in-pit spoil piles above groundwater level. If possible, some coarse rejects may be used for civil works, such as haul road construction depending on the characteristics of the coarse rejects. |
| Discharge from vehicle washdown | Vehicle washdown facilities at MIA | kilolitres per year | 346,750 | Vehicle washdown water and associated contaminants will be collected and put through a hydrocarbon separator. Hydrocarbon emulsion will be disposed by a licensed contractor as a regulated waste, clarified waters will be discharged to a holding dam, and sediments will be disposed to the tailings storage facilty. |
| Tyres | Maintenance of vehicles | number per year<br><br>number per year | 1450<br><br>230 | If possible, tyres will be removed by the tyre supplier for reprocessing, otherwise tyres will be stored and appropriately disposed of by burying in the mine overburden in a designated location which will be identified on the EMR managed by DERM. |
| Sewage and wastewater | Contractor crib rooms, accommodation facilities, administration building, warehouse, workshops, CHPP | kilolitres per year | 130,700 | Continued disposal as per existing licensing requirements with potential beneficial reuse options investigated during detailed design. |

| Waste material | Waste sources | Units | Quantity/ annum | Management Strategy |
|---|---|---|---|---|
| WWTP sludge | WWTP | tonnes per year | 40 | Continued disposal as per existing licensing requirements with potential beneficial reuse options investigated during detailed design. |

### V.3.6.5 Sewage Treatment

Various potable water demand nodes will be located on the mine site, including the accommodation village, LIA, MIA, CHPP, dragline erection pad and hot-seat change facilities. These demands will give rise to the generation of waste water that will need to be collected, stored and transported to a sewage treatment plant (STP) for treatment and disposal.

The sewage management strategy is based on a number of assumptions including the following:

- all sewage will be treated at a single package sewage treatment plant (STP) on site, with waste products such as sludge and fine screenings to be transported off-site by licensed commercial hazardous waste handling contractors;
- the STP will be located close to accommodation village and LIA as these are the largest producers of waste water on the site;
- the STP will treat all sewage to a class A effluent, which will be disposed of by irrigation in the vicinity of the access into the LIA. Treating effluent to this quality provides a high degree of flexibility in how this can be disposed of and/or reused in the future;
- waste water generated at remote locations such as the dragline erection pad and hot-seat change facilities will be collected in buried concrete tanks, emptied by tanker service on a regular basis, and transported to the STP for treatment; and
- all components of the sewerage reticulation network will accommodate worst case scenarios driven by staffing levels during the construction and operation phases. Downward fluctuations in these numbers will result in spare capacity in the system.

Design has been based on relevant codes and guidelines including the following:

- Department of Natural Resources and Mines – Planning Guidelines for Water Supply & Sewerage
- Queensland Water Recycling Guidelines – EPA, 2005
- Code AS.2200:2006 – Design Charts for Water Supply and Sewerage

Specific design criteria include the following:

- the STP will be a packaged treatment plant with inlet works incorporating inlet screening, screenings compactor and 2 buffer tanks sized for 24hrs storage;
- sewage will be pumped from the buffer tanks to the treatment works;
- pump stations will be submersible below ground installations, comprising precast concrete packaged Flygt ITT stations (or similar) fitted with duty and standby pumps with an elevated motor control centre in a weather-proof kiosk,
- all pumps will be controlled by a simple level transducer that will switch pumps off and on,
- 4 hours of emergency storage have been provided at each pump station in the event of power failures,

- all infrastructure will be located above the 3,000 year flood inundation level and close to access roads and power supply; and
- where specific EP or demand is unknown the Queensland Department for Planning and Resource Management (DERM) - Planning Guideline - Water Supply and Sewerage (April 2010), Chapter 5, Table A (Demands Flow and projection) was applied.

Estimated waste water generation is summarised in Table V-53.

**Table V-53 Estimated waste water generation**

| Generator | Construction (kL/day) | Operations (kL/day) | Peak hourly flow (L/s) |
|---|---|---|---|
| Accommodation village | 520 | 432 | 70 |
| Light industrial area | 0 | 255 | 18 |
| MIA/CHPP | 0 | 50 | 25 |
| Dragline erection | 0 | 10 | Tanker |
| Hot-seat change area (2) | 0 | 10 | Tanker |
| TOTALS | 520 | 757 | |

A site Effluent Irrigation Management Plan will be prepared and updated from time to time, as necessary. This Plan will include, but not be limited to, identification of the area(s) on which treated sewage effluent can be disposed, sewage effluent irrigation procedures and monitoring requirements.

### V.3.6.6 Mining Waste

Project waste generated through mining (overburden) and coal processing (coarse rejects and tailings) has been defined for the EM Plan as mining waste. The coarse rejects, as the name implies, are the larger pieces of overburden and coal that are not suitable for product sale. The tailings material is the fine component of this waste material. Both coarse rejects and tailings are segregated from the coal product in the Project CHPP. The Project coal rejects (coarse and fine) are expected to comprise in the order of 1.7% of all mining waste produced by the Project. The proportion of coal rejects to overburden for the Project is less than similar coal mines in the nearby Bowen Basin, which typically average about 5% of overburden.

The Project is expected to generate 42 million tonnes per annum (Mtpa) Run of Mine (ROM) coal generating 30 Mtpa of product coal from an open cut pit with a projected 30 year life of mine. The open pit will cover an area of approximately 24 km by 7 km and the total mined overburden volume is expected to approximate over 14 billion tonnes over a 30 year LOM. That is, approximately 466 Mtpa.

#### V.3.6.6.1 *Mine waste storage*

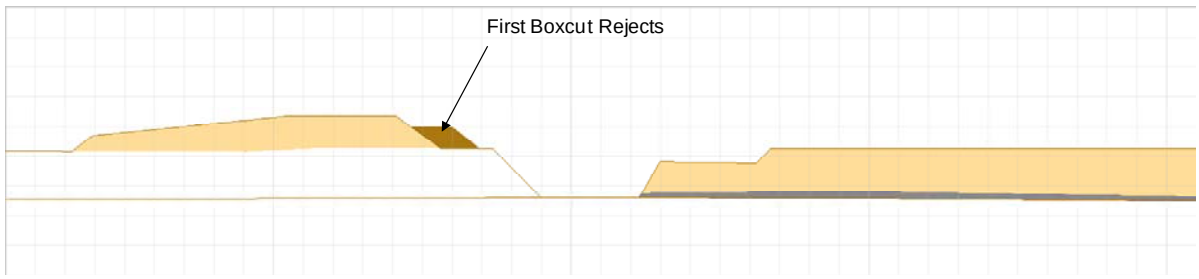
**Overburden**

At the Project, spoil will be predominantly be stored within the open pit, although an out-of-pit spoil emplacement area will be constructed parallel to the eastern edge of the open pit using a truck-shovel operation to accommodate material from the initial box-cut developed during the first year of mining. The out-of-pit spoil emplacement area will comprise approximately 320 million tonnes (approximately 2.3%) of the total overburden mined over the 30 year mine life. Mining will evolve into a dragline stripping operation with truck-shovel pre-strip.

## Coarse Rejects

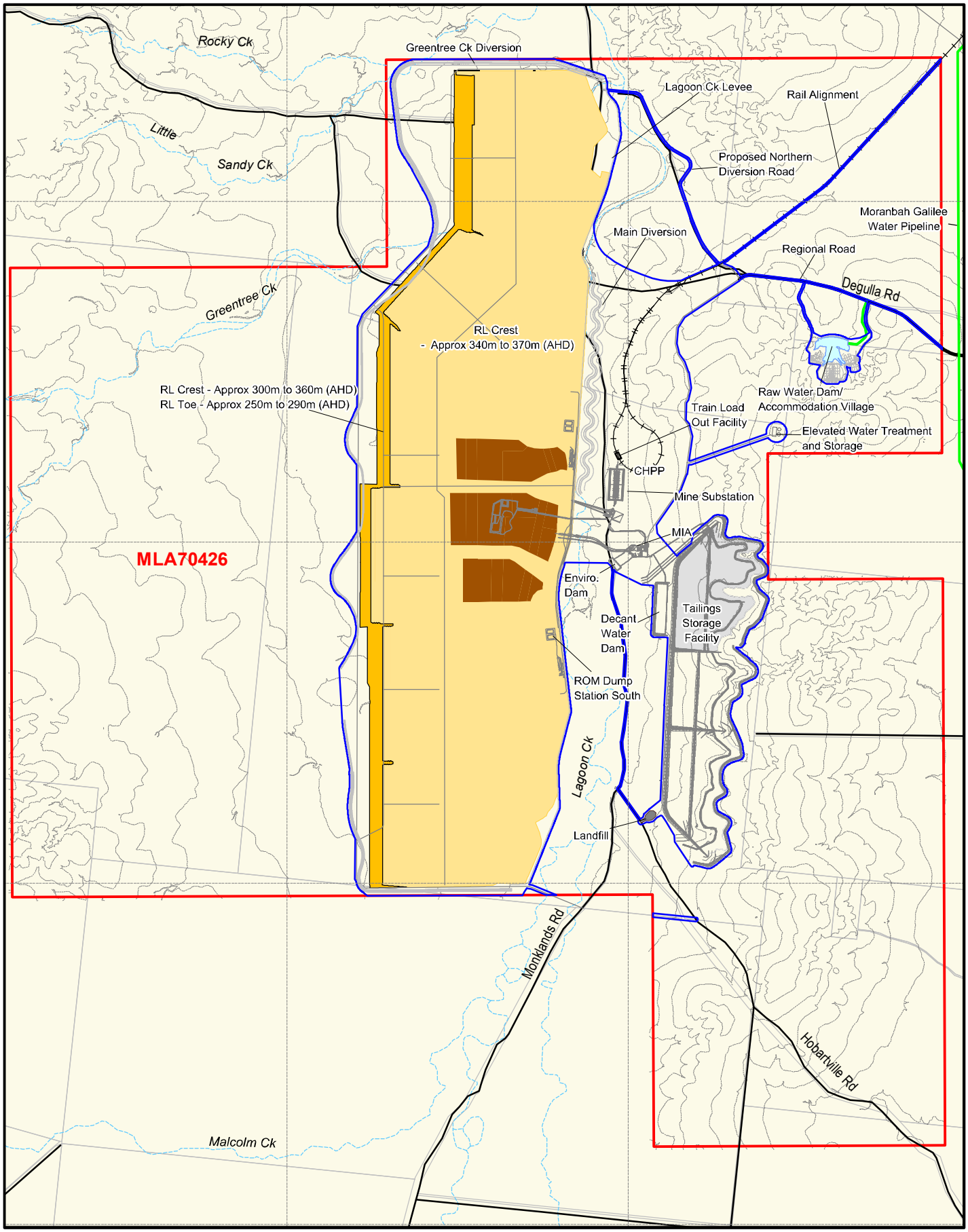
The coarse rejects generated from the CHPP will be dewatered and discharged onto the CHPP rejects conveyor, which reports to the rejects bin. During the first year of mining, the coarse rejects will be truck-hauled and placed adjacent to the low-wall edge of the boxcut area as shown in Figure V-16 (cross-section) and Figure V-17 (Plan view). Development of the Project mine plan identified the most appropriate initial coarse rejects placement area to be in the overburden dumps opposite the proposed location of the CHPP. The reject emplacement area will have a 4 km strike length parallel to the low wall and will be in close proximity to the proposed reject bin location.

**Figure V-16 Placement of coarse reject materials**




All coarse reject materials will be paddock dumped and compacted in approximate 1-2 m layers using dozing and vibrating or square roller equipment. Lime dosing of compacted coarse reject layers will also be used to extend the lag period preceding acid generation. During the first year of mining, coarse rejects placed at the low wall edge of the boxcut area will be isolated with clay within 4 weeks before being encapsulated with NAF spoil within 3 months.

From around Year 2 to end of mine life, the coarse reject material is planned to be placed in the in-pit voids between the dragline spoil. Again compaction, lime dosing, clay isolation and encapsulation with NAF spoil will be utilised to manage the potential for AMD. These placement areas are below the natural ground surface and extend to a depth of 10-20 m below ground level, which is above the predicted depth of the recovered groundwater table. Truck-shovel pre-strip spoil materials will be used to cap the reject areas. Coarse reject placement will be sequenced such that capping of the rejects will be completed progressively as the working face progresses down dip.




Mining Lease Application (MLA70426) Boundary
Disturbance Area
Working Face and Void (year 30)
Spoil Dump Area
Rejects

Source: See Copyright Details below and for full disclosure Please Refer to the SEIS ***Volume 2, Appendix B***

0 2 4Km
Scale 1:150,000 (A4)
Datum: GDA94, MGA Zone55

N W E S

**HANCOCK** PROSPECTING PTY LTD
Alpha Coal Project
Supplementary Environmental Impact Statement

# ALPHA COAL PROJECT (MINE)
# PLACEMENT OF
# COARSE REJECT MATERIALS

Job Number | 4262 6680
Revision | B
Date | 07-06-2011

Figure: V-17

File No: 42626680-g-2057b.wor

## Tailings Management

Tailings will report to a purpose built tailings storage facility (TSF) located to the east of the open pit. The location of the TSF is based on factors such as existing site features, mine pit and dump locations, proximity to the Coal Handling and Preparation Plant (CHPP), mine tenement boundaries and other infrastructure locations. The Proponent is currently investigating the feasibility of accommodating tailings materials in the open pit after Year 5, when the mine plan allows and sufficient storage capacity becomes available. The placement of tailings material in-pit, if proven viable, would significantly reduce the size of the required out-of-pit TSF footprint. In this event, the Proponent would consult with DERM regarding the alternative and pending agreement, an amendment to the EA would be required.

Tailings will report to the TSF in a slurry form containing approximately 30% solids and excess water will be recycled from the TSF using a decant system for reuse at the CHPP. Recovery of surface water from the tailings will be predominantly via a decant system. The decant system will include decant structures located at low points immediately upstream of the main embankment. The decant structure will consist of concrete rings supported on a reinforced concrete footing. The crest height of the decant structure will be adjusted by adding rings as the level of the tailings in the TSF rises. The decant structure is accessed for general maintenance and raising via the main embankment with an access ramp that would be raised with general fill at each raising stage. The concrete rings would be supported by rock fill to resist any lateral loading from the incremental construction of the access ramp.

Water collected by the decant system is proposed to be removed by an outfall system comprising flexible pipes that discharge into the decant water dam located downstream of the main embankment. The decant discharge pipe work will include flow measurement to monitor flow between the TSF and the decant dam.

Given the arid climate of the region, the tailings surface is expected to dry out relatively quickly and form a dense compact solid material, which will facilitate a cover placement and rehabilitation at the end of mine life. A cover system will be required utilised for TSF closure and topsoil will be placed onto the re-profiled final landform slopes.

### TSF storage capacity

The Alpha Coal Mine TSF is proposed to receive and store the expected amount of tailings produced by the CPP for the nominal 30 year mine life. Table V-54 shows the estimated storage requirements per year.

## Table V-54 Tailings storage capacity requirements

| Year | Life of mine | Solid Tailings ML/yr | Water ML/yr | Return water 20% ML/yr | Water loss 10% ML/yr | Stored tailings (ML/yr) | Cumulative stored Tailings ML |
|---|---|---|---|---|---|---|---|
| 2011 | -3 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2012 | -2 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2013 | -1 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2014 | 1 | 353 | 1330 | 266 | 133 | 1284 | 1284 |
| 2015 | 2 | 934 | 3515 | 703 | 351 | 3394 | 4678 |
| 2016 | 3 | 1204 | 4531 | 906 | 453 | 4375 | 9054 |
| 2017 | 4 | 1408 | 5299 | 1060 | 530 | 5117 | 14171 |
| 2018 | 5 | 1408 | 5299 | 1060 | 530 | 5117 | 19288 |
| 2019 | 6 | 1408 | 5299 | 1060 | 530 | 5117 | 24405 |
| 2020 | 7 | 1408 | 5299 | 1060 | 530 | 5117 | 29523 |
| 2021 | 8 | 1408 | 5299 | 1060 | 530 | 5117 | 34640 |
| 2022 | 9 | 1408 | 5299 | 1060 | 530 | 5117 | 39757 |
| 2023 | 10 | 1408 | 5299 | 1060 | 530 | 5117 | 44874 |
| 2024 | 11 | 1408 | 5299 | 1060 | 530 | 5117 | 49992 |
| 2025 | 12 | 1408 | 5299 | 1060 | 530 | 5117 | 55109 |
| 2026 | 13 | 1408 | 5299 | 1060 | 530 | 5117 | 60226 |
| 2027 | 14 | 1408 | 5299 | 1060 | 530 | 5117 | 65343 |
| 2028 | 15 | 1408 | 5299 | 1060 | 530 | 5117 | 70461 |
| 2029 | 16 | 1408 | 5299 | 1060 | 530 | 5117 | 75578 |
| 2030 | 17 | 1408 | 5299 | 1060 | 530 | 5117 | 80695 |
| 2031 | 18 | 1408 | 5299 | 1060 | 530 | 5117 | 85812 |
| 2032 | 19 | 1408 | 5299 | 1060 | 530 | 5117 | 90930 |
| 2033 | 20 | 1408 | 5299 | 1060 | 530 | 5117 | 96047 |
| 2034 | 21 | 1408 | 5299 | 1060 | 530 | 5117 | 101164 |
| 2035 | 22 | 1408 | 5299 | 1060 | 530 | 5117 | 106281 |
| 2036 | 23 | 1408 | 5299 | 1060 | 530 | 5117 | 111399 |
| 2037 | 24 | 1408 | 5299 | 1060 | 530 | 5117 | 116516 |
| 2038 | 25 | 1408 | 5299 | 1060 | 530 | 5117 | 121633 |
| 2039 | 26 | 1408 | 5299 | 1060 | 530 | 5117 | 126750 |
| 2040 | 27 | 1408 | 5299 | 1060 | 530 | 5117 | 131867 |
| 2041 | 28 | 1408 | 5299 | 1060 | 530 | 5117 | 136985 |
| 2042 | 29 | 1408 | 5299 | 1060 | 530 | 5117 | 142102 |
| 2043 | 30 | 1408 | 5299 | 1060 | 530 | 5117 | 147219 |

### Tailings Emplacement Strategy

The tailings will be pumped to the TSF by a pipeline constructed along the TSF access road. Tailings will be discharged into the storage area via discharge points regularly spaced along the embankments or hillside. Discharge strategy of tailings would be developed to allow flexibility in operation and to force surface water to flow to the decant system.

The tailings will be discharged from the hillside of the facility with surface water to be collected through the decant structure located immediately upstream of the starter embankment.

The tailings will be disposed within six TSF cells in 5 stages.

The anticipated progression and staging of the TSF is outlined in Table V-55.

**Table V-55 TSF cell / stage estimated volumes**

| Cells | Cell No. | Stage No. | Crest RL (m) | Estimated Storage Capacity ($m^3$) | Cumulative Storage Capacity ($m^3$) | Life of Mine (yrs) |
|---|---|---|---|---|---|---|
| 1 & 2 | 1 | 1 | 338.3 | 12,922,715 | 12,922,715 | 1 - 3 |
| | 2 | 2 | 343.3 | 7,519,485 | 20,442,200 | to 5 |
| | 1 | 3 | 343.3 | 14,160,216 | 34,602,416 | to 8 |
| | 2 | 4 | 348.3 | 17,532,953 | 52,135,369 | to 11 |
| | 1 | 5 | 348.3 | 14,279,302 | 66,414,671 | to 14 |
| 3 & 4 | 3 | 1 | 338.3 | 10,378,788 | 76,793,459 | to 16 |
| | 4 | 2 | 343.3 | 4,806,081 | 81,599,540 | to 17 |
| | 3 | 3 | 343.3 | 8,814,532 | 90,414,072 | to 19 |
| | 4 | 4 | 348.3 | 10,688,279 | 101,102,351 | to 21 |
| | 3 | 5 | 348.3 | 8,873,750 | 109,976,101 | to 23 |
| 5 & 6 | 5 | 1 | 338.3 | 12,862,162 | 122,838,263 | to 25 |
| | 6 | 2 | 343.3 | 6,577,128 | 129,415,391 | to 27 |
| | 5 | 3 | 343.3 | 10,698,311 | 140,113,702 | to 28 |
| | 6 | 4 | 348.3 | 14,569,898 | 154,683,600 | to 30 |

### Design Criteria - Embankments

Generally, embankments containing tailings require appropriate design and operation techniques in order to perform satisfactorily as part of the TSF. While the tailings disposal system would be decommissioned at completion of tailings discharge in each cell, the embankments will need to be designed to perform indefinitely as they would ultimately contain the tailings indefinitely.

Embankments will be designed and constructed in accordance with ICOLD and ANCOLD guidelines and requirements for tailings dams. The TSF would be designed for a 30 year operating life and would include 6 cells that are constructed progressively. Embankments would be constructed using locally available materials where possible.

Operational management would ensure that embankment maintenance and capital development activities comply with ANCOLD and other relevant design and regulatory requirements. Monitoring of tailings characteristics, water balance, groundwater etc would be routinely reviewed.

The design of the TSF includes:

- external starter embankments and their subsequent raising which require soil materials for construction; and
- internal embankments and their subsequent raising which separate the various cells upslope, which could be constructed out of the tailings and reject material (depending on acceptable geochemical properties).

Engineering design parameters that have been used for the TSF concept design and which will be applicable to the detailed design include:

- a minimum acceptable factor of safety of 1.5 for long term embankment slope stability;
- a minimum factor of safety of 1.2 for short term stability during construction;
- a minimum factor of safety of 1.1 under seismic loading conditions;
- a freeboard of 0.5 m plus 0.8 m for DSA requirement; and
- a seismic coefficient of 0.04 g for horizontal force.

The above criteria are in accordance with internationally accepted guidelines including those of ANCOLD.

### Design Criteria – Seepage Control

The TSF will be designed to minimise any potentially adverse effects arising from seepage from the impoundments. Seepage from the TSF will be minimised by implementing some, or all, of the following measures as appropriately required after further detailed engineering evaluation:

- design and construction of main embankments using fill materials paced to engineering specifications;
- providing a liner system to reduce seepage from the TSF to groundwater;
- providing an underdrainage system to collect seepage from the TSF;
- recovery of surface water from within the TSF using an engineered recovery system;
- management of tailings deposition via discharge points to ensure that tailings are deposited in a controlled manner maximising evaporation and decant;
- providing appropriate embankment drainage design to manage seepage through embankments; and
- compacting of existing soils within the storage area.

The available geotechnical data indicates that seepage may occur through the foundation soils and underlying sandstones. Therefore a liner system may be required in areas where sandy soils are encountered to limit seepage of tailings water into the foundation soils/rock and reduce the impact to groundwater and the Lagoon Creek alluvial area. It is considered that the sandy clay layer encountered in places in the northern half of the TSF site could act as a liner system in these areas which would limit seepage into the foundation. The liner system could be established in a number of ways, including using either the clayey soils won from site or from tailings fines. Further investigation and studies are planned at the detailed design stage to finalise the design of the liner system to accord with accepted standards and a permeability target of around $10^{-9}$ m/s.

Given the low density of the slurry, the tailings will settle in the TSF with significant associated water content, generating a hydraulic head. Should an acceptable permeability target not be achieved, an

underdrainage system will be employed. An underdrainage system or subsurface drainage is widely used to increase the rate of dewatering and consolidation of placed tailings. The underdrainage system will also provide the following:

- improve stability by lowering the phreatic surface;
- improve water return to the plant;
- promote early consolidation of the solids;
- subsurface drainage placed above a liner would reduce the hydraulic head on the liner thereby reducing the quantity of seepage through the liner;
- reducing the moisture content of the tailings during operation will also reduce long-term seepage from the TSF; and
- stabilisation of the TSF during operation through dewatering/drainage will reduce consolidation and differential settlement of the surface which is important for successful rehabilitation.

The underdrainage system would involve the installation above the liner system of slotted pipe and geotextile drains running across the floor of the TSF covered with granular free-draining sand material. This will discharge via a pipe in the same trench as the decant outlet and flow to the tailings decant dam.

**Environmental Value**

Environmental values at the Project site that may potentially be impacted upon by waste include:

- The life, health and wellbeing of people;
- The biological integrity and diversity of ecosystems and processes surrounding the Project site;
- The integrity of receiving environments such as land, air, surface water and groundwater (including the suitability of water for agricultural use);
- The stability of disturbed land and ensuring it is non-polluting;
- The suitability of land for beneficial post mining land use; and
- Visual amenity.

### V.3.6.7 Potential Impacts on the Environmental Value

Environmental harm could potentially occur in and around the Project site if wastes are not managed properly. Sensitive receptors including residences and ecosystems sounding the Project site could be impacted if AMD from PAF mining wastes and other waste streams entered waterways and groundwater systems and migrated off-site. Similar, air emissions , such as dust have the potential to impact off-site sensitive receptors. The following waste streams from the Project have the potential to impact on the above mentioned environmental values:

- Solid waste (other than mining waste) including regulated waste, general waste and sewage;
- Coal and mining wastes;
- Waste water from the mining operations and CHPP; and
- Air emissions including particulates, fumes and odour from the Project during construction and operation.

### V.3.6.7.1 *Potentially acid generating material*

#### Overburden

The sedimentary genesis of the Project coal deposit and information contained in the geological and geostatistical models indicates that the overwhelming majority of overburden materials are likely to have negligible sulphide content and be Non-Acid Forming (NAF). The only exceptions could be visually distinguishable small amounts of any uneconomic coal seams or specific carbonaceous rock types such as some mudstone and claystone located in, or immediately adjacent to, coal seams. Such materials would be managed in the out-of-pit spoil emplacement area or, after Year 1, be retained in the open pit and managed in a similar manner to PAF coarse reject materials, described below.

The overburden units have an excess of ANC and will produce a neutral pH leachate. Hence, from a potential acid generation viewpoint, overburden materials have a high factor of safety and spoil piles pose a low risk to the immediate and downstream environment. The main environmental management activities for spoil materials generated from overburden removal will be placement of any saline and/or sodic materials within the core of the spoil pile away from the final cover and batters, before covering with less saline/sodic overburden materials, reshaping and adding topsoil and vegetation as part of rehabilitation. A schematic of the typical final rehabilitated profile of the overburden/spoil material emplacement areas is provided at Figure V-18. More details of the overall rehabilitation and decommissioning strategy at the mine including a conceptual final landform and rehabilitation plan is provided at Section 3.7.7.

#### Coarse Rejects

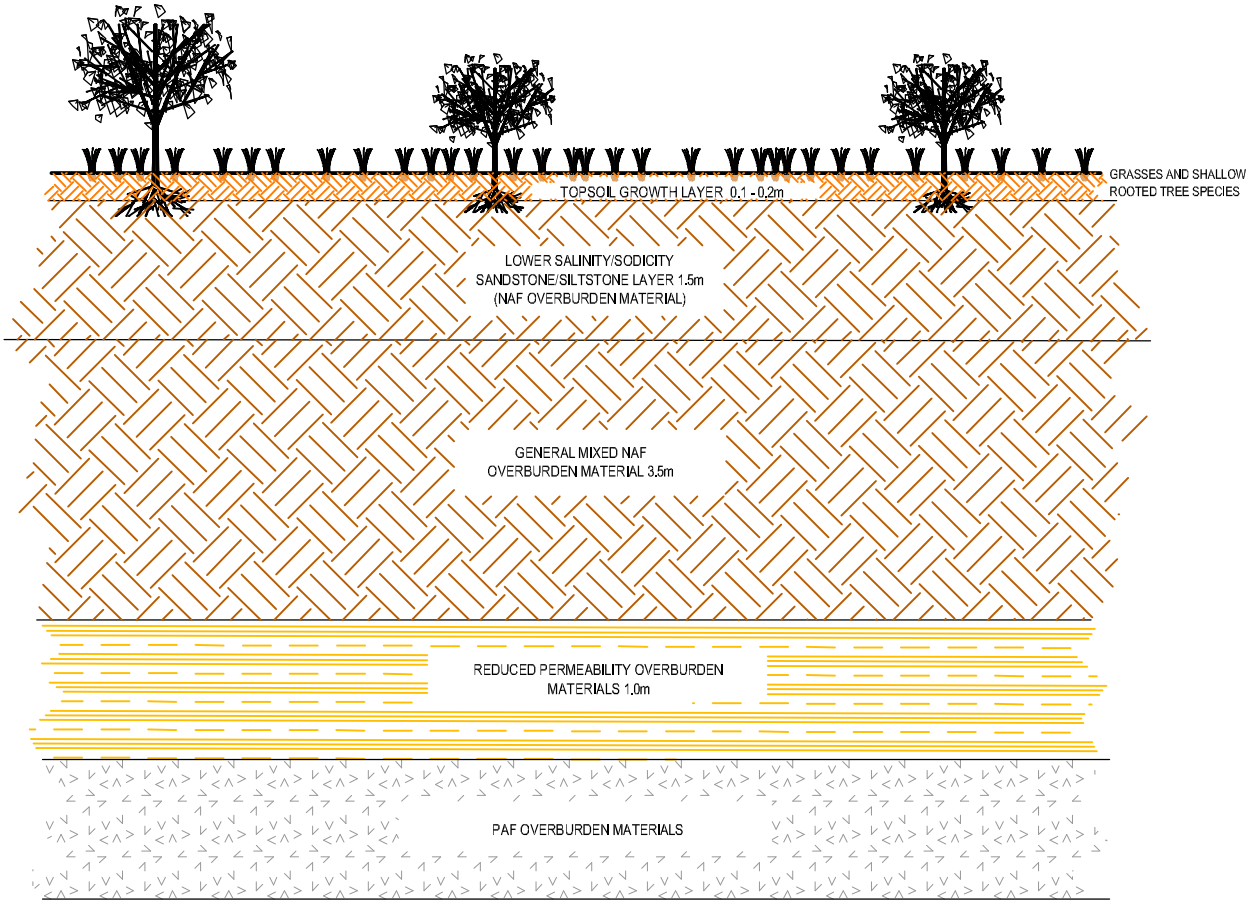
Coarse reject materials generated on the Project may have elevated total sulphur content and little ANC and therefore may be PAF and will need to be carefully managed. All coarse rejects will report back to the open pit from the CHPP around the start of Year 2, be stored within the in-pit spoil piles, and managed with compaction, lime dosing, clay isolation and encapsulation with spoil. In Year 1 the coarse rejects will report to an above ground storage emplacement area at the low wall of the boxcut area and be managed as per the in-pit coarse rejects.

#### Tailings

Some of the fine reject materials (tailings) generated at the Project may also be PAF and in the first five years will report to the TSF. Lime dosing of tailings will be considered if the tailings pH is less than pH 5.

Kinetic leach column test results for tailings indicate this material typically has less risk of generating acid leachate than coarse reject; however, leachate may be moderately saline and contain elevated sulphate concentrations, and therefore any seepage water at the TSF will need to be managed. The current TSF design includes lining of the base and installation of under drainage in order to mitigate the risk from seepage.

The intention is to return all tailings materials back to the open pit from the CHPP after approximately Year 5 and store these within the in-pit spoil piles (along with coarse rejects) with encapsulation using spoil.




Source: See Copyright Details below and for full disclosure Please Refer to the SEIS

NOT TO SCALE

N W E S

HANCOCK PROSPECTING PTY LTD

Alpha Coal Project
Supplementary Environmental Impact Statement

ALPHA COAL PROJECT (MINE)
SCHEMATIC OF TYPICAL COVER PROFILE FOR OVERBURDEN REHABILITATION PROGRAM

| | |
|---|---|
| Job Number | 4262 6680 |
| Revision | A |
| Date | 27-05-2011 |

Figure: V-18

File No: 42626 680-g-2066.dwg

### V.3.6.8 Environmental Protection Objective

The environmental protection objectives for waste are:

- To avoid contaminating land, surface water or groundwater through poor waste and mining waste management practices;
- To manage waste through the use of licensed contractors, transporters and disposal facilities;
- To manage and monitor potential impacts from mining wastes using the measures described in a MWMP; and
- To minimise the generation of waste in accordance with the waste management hierarchy listed in the Environmental Protection (Waste Management) Policy 2000.

### V.3.6.9 Performance Criteria

The performance criteria for waste management are:

- Prevent adverse environmental impacts from and mining waste management during the construction phase;
- Adherence to waste minimisation principles;
- Management of mining waste in accordance with the MWMP and
- Adhere to waste management hierarchy.

### V.3.6.10 Control Strategies

#### V.3.6.10.1 *General Waste Management Strategies*

Specific control strategies for the identified waste streams are presented in Tables V-48 and V-49 above for both construction and operational waste.

**Waste Minimisation**

Waste minimisation has been considered throughout the initial planning and conceptual design stages of the Project and will continue during detailed design, construction and operation. The waste management hierarchy has been considered when selecting the waste management strategies for each waste stream.

**Cleaner Production**

Cleaner production is designed to provide environmental, economic and other, less tangible benefits. It forms an important component of the continual improvement approach to management adopted by the Proponent. Cleaner production focuses on implementing ways to improve a production process (or processes). The principals of cleaner production will be adopted where possible throughout the Project life cycle.

In general, cleaner production can be achieved through a selection of one or more of the following techniques:

- Input substitution - this is not readily applicable to this Project;
- Product reformulation - this is not readily applicable to this Project;
- Production process modification - selection of the best available practicable technologies;
- Improved operation and maintenance - this refers to the selection and use of the most appropriate processes and equipment;
- Reuse of resources that are otherwise wastes; and

- Closed-loop recycling – where a product is recycled and used again in the same form.

### Waste Management Plan (Construction)

A detailed Waste Management Plan (Construction) will be prepared as part of the Project-specific Environmental Management Plan (EM Plan) prior to the commencement of construction. The Waste Management Plan (Construction) will address the following:

- Identification of waste streams;
- Consideration of the waste management hierarchy when selecting waste management strategies, with emphasis on minimising any hazardous waste;
- Identification of solid, liquid or hazardous waste collection, storage and or disposal strategies;
- Training of all personnel on procedures concerning waste minimisation, handling, storage, reuse, segregation, collection and disposal;
- Concept design of proposed on-site landfill for non-regulated and non-recyclable waste;
- Waste not suitable for on-site disposal to be removed and transported from site by appropriately licensed contractor/s with disposal only to licensed re-processors, recyclers, or waste disposal facilities;
- Transport of any hazardous or regulated waste to comply with all relevant legislation including waste tracking requirements; and
- Monitoring of waste streams and auditing against the Waste Management Plan (Construction) to ensure overall objectives are being met.

### Waste Management Plan (Operations)

A detailed Waste Management Plan (Operations) will be prepared as part of the Project-specific Environmental Management Plan (EM Plan) and Plan of Operations prior to the commencement of operations, and updated annually to reflect the current activities of the Project. The Waste Management Plan (Operations) will address the following:

- Identification of waste streams and establishment of a baseline measurement for each stream;
- Consideration of the waste management hierarchy when selecting waste management strategies, with emphasis on minimising waste;
- Identification of solid, liquid or hazardous waste collection, storage and or disposal strategies;
- Training of all personnel on procedures concerning waste minimisation, handling, storage, reuse, segregation, collection and disposal;
- Waste removal and transport from site to be by appropriately licensed contractors with disposal only to licensed reprocessing, recycling or waste disposal facilities;
- Transport of any hazardous or regulated waste to comply with all relevant legislation including waste tracking requirements;
- Monitoring waste streams and identifying opportunities for reduction and reuse of wastes;
- Auditing against the Waste Management Plan (Operations) to ensure waste management strategy objectives are being met; and
- All operational wastes will be managed in accordance with the Waste Management Plan (Operations).

### V.3.6.10.2 *Mining Waste*

All mining wastes will be managed in accordance with the MWMP which will be prepared as part of the Project-specific Environmental Management Plan (EM Plan) prior to the commencement of construction and updated annually to reflect the current activities of the Project. The MWMP will address the following:

- Identification of mining waste materials that could potentially generate AMD and/or could have the potential to be saline, sodic, or dispersive.
- Implementation of appropriate mining waste management strategies;
- Training of all relevant personnel on procedures concerning mining waste management;
- Monitoring mining waste materials and identifying storage locations;
- Auditing against the MWMP to ensure mining waste management strategy objectives are being met; and
- Specific conditions of the Environmental Authority document (see proposed conditions at Schedule E – E13 and E14)

The management strategies used for the mining waste materials (overburden, coarse reject and tailings are those already described in some detail in Section 3.6.6.1.

### V.3.6.11 Monitoring

- Monitoring of waste streams and mining waste materials and their management will be undertaken as part of the waste management plans, MWMP, Erosion and Sediment Control Plan and Surface and Groundwater Management System already described in this EM Plan. As part of the mine waste management plans, a system of waste tracking in accordance with legislative requirements will be undertaken.

#### Mining Waste

Groundwater monitoring is addressed in Section 3.4.8.6.

With respect to the TSF, groundwater level and quality will be monitored over the duration of the tailings discharge operations as well as after cessation, as part of an on-going closure plan. Groundwater monitoring bores will be installed not only on the main embankments but it may be necessary to install them to monitor specific areas of interest..

Ongoing monitoring and investigations will include:

- Undertaking a repeat (electromagnetic) EM survey within 12 months of commencement of tailings emplacement, to test whether leakage of leachate from the TSF is occurring;
- Monthly water level and quarterly water quality monitoring;
- Sample tailings water (and determine indicators compared to ambient groundwater);
- Annual reporting of water level and water quality results; and
- Notification to the regulating authority within one month of receiving water quality analysis results, should any parameters tested exceed agreed trigger levels.

Should trigger levels be exceeded, investigations will be undertaken to establish:

- Whether actual environmental harm has occurred; and
- Immediate measures that should be taken to reduce the potential for environmental harm.

- long-term mitigation measures required to address any existing contamination, and to prevent recurrence of contamination. This may include for example:
  - Undertaking further EM surveys to establish the location of contaminant plumes;
  - Installation of a low-permeability cut-off wall; and
  - Installation of interception trenches to collect leachate and drain to a central sump for transfer of leachate to the process water stream.

Groundwater investigations that would be undertaken prior to final design of the TSF include:

- Drilling and construction of nested groundwater monitoring bores up-gradient of the TSF, as well as down-gradient in the area of the downstream toe of the TSF, to establish the depth at which water is struck, and the depth to which water will rise in the bore. The nested sites would comprise a deep bore screened in saturated sediments, and a shallow bore that would be drilled dry initially, but would be monitored for appearance of water that could be indicative of leakage from the TSF;
- Hydraulic testing on monitoring bores to test the saturated hydraulic conductivity of the material underlying the TSF;
- Seepage modelling to make predictions of the potential for the TSF, as designed, to leak leachate to the shallow groundwater system and ultimately toward Lagoon Creek. Seepage modelling would be used to predict a hydraulic conductivity of material that would limit leakage from the TSF to levels deemed acceptable;
- Daily water level monitoring (automatic dataloggers) reviewed monthly and monthly groundwater quality monitoring from bores to establish baseline levels prior to development of the facility. Based on available information from the waste management strategy the major potential contaminants are expected to include sulphate, elevated EC/TDS, decreased alkalinity and pH. If the seepage is acidic this may result in mobilisation of metals, most likely aluminium, iron and manganese, though other metals/metalloids to be monitored should include cadmium, copper, lead, nickel, selenium, and zinc;
- The suite of parameters to be tested will include:
  - Field parameters – pH and EC;
  - Major/minor ions, including TDS, calcium, magnesium, potassium, sodium, chloride, sulphate, alkalinity (hydroxide, carbonate, bicarbonate, total), fluoride;
  - Metals/metalloids, including aluminium, arsenic, antimony, boron, cadmium, chromium, cobalt, copper, iron, lead, mercury, manganese, molybdenum, nickel, selenium, silver, uranium, vanadium, zinc; and
  - It is anticipated that the parameter list would be modified once the TSF is operational, and the nature of liquid generated by the TSF becomes apparent.
- An electromagnetic (EM) survey on the down-gradient side of the TSF to establish baseline conditions, prior to operation of the TSF.

### V.3.6.12 Commitments

#### General Mine Waste

- A register of all chemicals stored on the Project site will be maintained.
- The storage and handling of flammable and combustible liquids will be in accordance with AS 1940 – Storage and Handling of Flammable and Combustible Liquids.

- All regulated waste will be appropriately disposed of to a facility licensed to receive such wastes and, where required, be tracked.
- As part of the staff awareness and induction program, re-use and recycling will be encouraged.

### Mining Waste

- During the first year of operation, coarse rejects will be encapsulated in the out-of-pit spoil pile. Following development of the initial open pit boxcut area in Year 1, all coarse rejects will be stored within the in-pit spoil piles.
- Tailings will be stored in an out of pit tailings storage facility. The Proponent will investigate the potential to store tailings in-pit within the first five years of operation.
- Initially, the overburden produced by mining the boxcut area will be stored at an out-of-pit spoil emplacement area adjacent to the eastern side of the open pit. When sufficient space is created within the mined areas, subsequent overburden will remain in the open pit.
- Any out-of-pit overburden will be managed to ensure that saline and/or sodic materials do not report to final top and bench surfaces and batters.
- Any saline and/or sodic overburden materials will be placed within the core of the spoil piles before covering with more benign materials, reshaping and adding topsoil and vegetation as part of rehabilitation as described at Sections 3.6.7.1 and 3.7.7 .
- Any requirement for rock mulching final batters to limit potential erosion from surface runoff will be assessed during rehabilitation field trials.
- During the first years of mining, the coarse rejects (approximately 23% moisture) will be truck-hauled and placed adjacent to the low-wall edge of the boxcut area. The reject emplacement area will have an approximate 4,000 m strike length parallel to the low wall and will be in close proximity to the proposed reject bin location. The coarse reject cells will be clay sealed before being further encapsulated with spoil
- All coarse reject materials will be paddock dumped and compacted in approximate 1-2 m layers using dozing and vibrating or square roller equipment.
- From around Year 2 to end of mine life, the coarse reject material is planned to be placed in the in-pit voids between the dragline spoil. Truck-shovel pre-strip spoil materials will be used to cap the reject areas. Coarse reject placement will be sequenced such that capping of the rejects will be completed progressively as the working face progresses down dip.
- Coarse reject material placed in the in-pit voids between the dragline spoil will be compacted in 1-2 m layers and capped with a clay cover prior to covering with at least 10 m of spoil material. Topsoil will be placed onto the re-profiled slopes.
- As a precautionary measure, the Proponent will ensure that any roof and floor materials within one metre of the coal seams not extracted as coal dilution will stay in the open pit and be managed in a similar fashion to PAF coarse rejects.
- Should any uneconomic coal seam material be extracted from the open pit and found to be PAF, this will preferentially be managed within the open pit voids in a similar fashion to coarse rejects.
- The ongoing management of mining waste (overburden and potential reject materials) will consider the geochemistry of materials with respect to their potential risk to cause harm to the environment and their suitability for use in revegetation.

- The design of a mining waste management strategy for the project will focus on placement of mining waste materials to minimise run-off, erosion and potential seepage.
- For future work, in addition to standard acid-base and metals testing (static tests) and kinetic leach column tests, geochemical characterisation will include assessing the general soil properties (sodicity, exchangeable cations) of selected mined waste materials to evaluate their suitability for use in revegetation/rehabilitation activities.
- Coal and mining waste materials will be monitored for geochemical characteristics (pH, EC, acidity, alkalinity, sulphur species (total sulfur and chromium reducible sulphur) and ANC) on a monthly basis until such time as the variability of the geochemical characteristics of these materials is well defined (approximately 12 months).
- Surface and seepage water at coal and mining waste storage areas will be monitored on a monthly basis and tested for pH, EC, Total Dissolved Solids (TDS), acidity and alkalinity. Major anions (sulphate, chloride, fluoride), major cations (calcium, magnesium, sodium and potassium) and trace metals (aluminium, arsenic, antimony, boron, cadmium, chromium, cobalt, copper, iron, lead, manganese, molybdenum, nickel, selenium, silver, uranium, vanadium and zinc) will be included in the range of parameters tested in these water samples, initially on a quarterly basis (for 12 months) and then on an annual basis throughout the life of mine. Should the pH of the TSF seepage water decrease below pH 5.0 or the EC increase by more than 100% from typical background values, the full range of parameters described in this Section will be included in the test suite.
- The Proponent will expedite a shift to in-pit disposal of tailings after the first five years of operation, if this alternative proves viable through further hands-on experience, ongoing testing and engineering investigation. Work is currently underway to progress this proposal, with the main input being the experience soon to be gained from the bulk sample test pit operation – underway at the time of writing. Further mine planning, testing on tailings rheology and tailings geochemistry is also in progress to further access the viability of in-pit disposal.
- A cover system will be utilised for TSF closure and topsoil will be placed onto the re-profiled final landform slopes.
- Additional drill-hole sampling and geochemical testing of coal and mining waste in advance of mining will be completed according to the program described in the SEIS.
- Open-pit mining geological control coupled with pre-mining and ongoing geochemical sampling and testing of mining materials will be used to delineate the extent of any PAF materials and ensure that these are selectively handled and managed in a similar manner to PAF coarse coal reject materials.
- The Proponent will compact and encapsulate PAF coarse coal reject material with NAF overburden within a limited period of time to mitigate potential impacts from any AMD.
- The Proponent will conduct larger-scale field trial kinetic tests to provide further validation of the effectiveness of the proposed mine material management strategies in the proposed operational phase of the Alpha Coal Project.
- Future sampling and geochemical testing of mining materials at the Alpha Coal Project will be completed to align with the infill drilling and future drilling programs.
- PAF coarse reject materials placed in the out-of-pit overburden emplacement facility during the first year of operation will be clay isolated within a period of four weeks and material scheduling

optimised to ensure encapsulation with a thick layer of NAF overburden material within three months.

- During steady state operations, if there is an increase in AMD potential due to issues such as greater than predicted PAF quantities or lower than predicted tailings PH levels, HCPL will consider additional risk management methods such as selective placement, early encapsulation or lime amendment.
- HCPL will continue kinetic leach column (KLC) tests on selected mining materials (potentially to 40 weeks) depending on the outcomes of a planned review of available KLC test data after 20 weeks of operation.

### V.3.6.13 Proposed Environmental Authority Conditions

Schedule E – Waste and Mining Waste Management

**Department interest: Waste and Mining Waste**

**(E1) Storage of tyres**

Scrap tyres stored awaiting disposal or transport for take-back and recycling, or waste-to-energy options must be stored in stable stacks less than 3 m high, and at least 10 m from any other scrap tyre storage area, or combustible or flammable material, including vegetation.

(**E2)** All reasonable and practicable fire prevention measures must be implemented, including removal of grass and other materials within a 10 m radius of the scrap tyre storage area.

**(E3) Disposal of tyres**

Disposing of scrap tyres resulting from the authorised activities in spoil emplacements is acceptable, provided tyres are placed as deep in the spoil as reasonably practicable. A record must be kept of the number and location for tyres disposed.

**(E4) Waste Management**

A Waste Management Plan, in accordance with the Environmental Protection (Waste Management) Policy 2000, must be implemented and must cover:

a) how the environmental authority holder will recognise and apply the waste management hierarchy

b) identify characterisations of wastes generated from the Project and general volume trends over the past five (5) years

d) waste commitments with auditable targets to reduce, reuse and recycle

e) waste management control strategies including:

i. the type of wastes
ii. segregation of the wastes
iii. storage of the wastes
iv. transport of the wastes
v. monitoring and reporting matters concerning the waste
vi. emergency response planning, and

vii. disposal, reused and recycling options

f) identify the potential adverse and beneficial impacts of the wastes generated

g) hazardous characteristics of the wastes generated including:

i. disposal procedures for hazardous wastes
ii. processes to be implemented to allow for continuous improvement of the waste management systems
iii. identification of responsible staff (positions) for implementing, managing and reporting the Waste Management Plan, and
iv. staff awareness and induction programs that encourage re-use and recycling.

**(E5)** Records of trade and regulated wastes or material leaving the mining lease for recycling or disposal, including the final destination and method of treatment, must be in accordance with the *Environmental Protection (Waste Management) Policy 2000.*

**(E6) Coal Handling and Preparation Plant Waste**

Waste from the Coal Handling and Preparation Plant must be disposed of in:

a) regulated dams in accordance with conditions in Department Interest: Dams of this environmental authority if the residual shear strength of the waste is less than 1000 Pascals prior to disposal, or
b) the Authorised Spoil Disposal Areas in accordance with conditions in Department Interest: Waste Table V-56 (Location of Spoil Disposal Facility) if the residual shear strength of the waste is equal or more than 1000 Pascals prior to disposal.

**(E7) Spoil disposal facility - certification and operation**

Authorised spoil disposal facilities, used for the disposal of waste are located within the control points defined in Table V-56.

**Table V-56 Location of spoil disposal facility**

| Name of spoil disposal facility | Control points | |
|---|---|---|
| | Longitude (GDA 94) | Latitude (GDA 94) |
| Alpha Coal Project Spoil Dumps | (A list of control points to be provided by the proponent) | (A list of control points to be provided by the proponent) |

**(E8)** Spoil disposal facility(s) shall be designed to prevent environmental harm arising from contaminants being generated in the facility, leachate and runoff from the facility or other sources.

**(E9)** Authorised spoil disposal facility(s) must be constructed and maintained in accordance with certified design plans, submitted to the administering authority.

**(E10)** Design plans for the authorised spoil disposal facility(s) must include performance indicators, such that:

a) during operations the spoil disposal facility(s) will be operated with minimal or no potential for adverse environmental harm resulting from collapse of any component of facility, and
b) the potential for leachate generation will be minimal or non-existent, and
c) adequate drainage structures, erosion protection and storage are provided to manage seasonal and rare rainfall events with minimal or no environmental harm.

**(E11)** Construction of any spoil disposal facility detailed in Table V-56 must not commence unless:

a) the environmental authority holder has submitted to the administering authority two copies of a design plan, and
b) certification from a suitably qualified and experienced person that the design of the spoil disposal facility(s) will deliver the performance stated in that design plan and that it will be compliant in all other respects with this environmental authority, and
c) at least twenty (20) business days has passed since the receipt of those documents by the administering authority, or
d) the administering authority notifies the environmental authority holder that a design plan and certification, has been submitted for that disposal facility.

**(E12) Operational plan – Spoil disposal facility**

An operational plan must be developed and maintained for the spoil disposal facility. The operational plan must include but not be limited to:

a) description of landform development stages of the spoil disposal facility,
b) placement technique for spoil and waste material from the coal handling and processing plant on the Alpha mine site,
c) management of any containment structures within the spoil disposal facility designed to contain materials from the coal handling and processing plant on the Alpha mine site,
d) demonstration of how operations of the spoil disposal facility are consistent with the accepted design plan for the facility, and
e) decommissioning and rehabilitation strategies for the spoil disposal facility that demonstrate consistency with conditions of this environmental authority.

**(E13) Mining waste management**

A Mining Waste Management Plan together with the certification by an appropriately qualified person must be developed and implemented during the continuation of the environmental

The Mining Waste Management Plan must at a minimum include:

a) characterisation programs to ensure that all mining waste is progressively characterised during disposal for the following parameters: pH, Electrical Conductivity (EC), Acid Neutralising Capacity (ANC), Net Acid Producing Potential (NAPP), Total Sulfur (S), Chromium Reducible Sulfur (Scr), Boron (B) Cadmium (Cd), Iron (Fe), Aluminium (Al), Copper (Cu), Magnesium (Mg), Manganese (Mn), Calcium (Ca), Sodium (Na), Zinc (Zn) and Sulfate ($SO_4$);
b) characterisation programs to ensure that the physical properties of the mining waste is progressively characterised during disposal;
c) the availability or leachability of metals from the mining waste;
d) quantity of potentially acid forming (PAF) mining waste;
e) review potential impacts of PAF mining waste on the success of proposed rehabilitation methods;
f) management actions for any mining waste that has been identified as having a high availability or leachability of metals;
g) management actions for mining waste that has been defined as PAF;
h) identification of environmental impacts and potential environmental impacts;
i) control measures for routine operations to minimise likelihood of environmental harm;
j) contingency plans and emergency procedures for non-routine situations; and
k) periodic review of environmental performance and continual improvement.

**(E14) AMD and leachate management**

Subject to the release limits defined in Department Interest: Water, all reasonable and practicable measures must be implemented to prevent hazardous leachate being directly or indirectly released or likely to be released as a result of the activity to the environment.

**(E15) Storage and handling of flammable and combustible liquids**

All flammable and combustible liquids must be contained within an on-site containment system and controlled in a manner that prevents environmental harm and maintained in accordance with the current version *of AS 1940 – Storage and Handling of Flammable and Combustible Liquids*.

**(E16)** Spillage of all flammable and combustible liquids must be controlled in a manner that prevents environmental harm.

## V.3.7 Land Management

### V.3.7.1 Background

#### V.3.7.1.1 *Land Use*

The existing land uses across the MLA 70426 includes the following:

- Bushland;
- Cattle grazing;
- Coal exploration;
- 132 kV power line (between Clermont and Barcaldine);
- Roads;
- Two dwellings; and
- Farming infrastructure (various access tracks, fences, stockyards and sheds).

The dominant land use within the boundaries of MLA 70426 is cattle grazing. The landscape has been cleared and maintained for grazing together with remnant mid height woodland dominated by Boxwood and Ironbark. Some areas of remnant revegetation are evident where grazing has been limited or restricted. Land cover within the Project area is principally a combination of open forest and woodland with areas of open improved grazing pasture. Several isolated areas have been previously cropped for fodder species to supplement grazing on native and introduced pastures.

Two homesteads (Hobartville and Wendouree) are located within MLA 70426 as are several ephemeral creeks and surface water dams. The homesteads will most likely be purchased subject to the Project proceeding. They are likely to be removed. The creeks and dams provide habitat, movement corridors and water for terrestrial fauna species. The dams provide a water source for livestock and other terrestrial fauna and migratory birds, especially when the creeks are dry.

There are limited non-rural properties or commercial operations in the local area. An area designated as a service area, 'recreational and cultural' is located to the west of MLA 70426 within a 50 km radius.

#### V.3.7.1.2 *Soils*

Based on field and laboratory assessments, ten soil management units (SMUs) were identified within the Project site. These SMUs were classified as Britt, Waylon, Surbiton, Nelson, Malika, Rhi, Titus, Garret, Linda and Dunrobin.

The Surbiton, Rhi, Linda and Dunrobin SMUs all posses a non-sodic surface layer before levels of exchangeable sodium increase to sodic or strongly sodic within the upper 50 centimetres of the profile. Salinity also increases with depth within these profiles, but only two levels were considered slightly saline by 90-100 cm depth. An exception to this is the Linda SMU which becomes sodic within the first 0.2 m and moderately saline by 0.4 m, increasing further with depth.

With the exception of the Linda, Malika and Rhi SMUs, the soils of the Project site are all considered suitable for stripping to a depth of 0.1 – 0.3 m and stockpiling of the topsoil layer for post mine rehabilitation efforts. All soils are considered largely deficient of major soil nutrients. Refer to Table V-57 for soil specifics.

**Table V-57 Soil Budget with Available Topsoil Volumes for Each SMU**

| Soil Management Unit | Surface Area (Total Project Site) (ha) | Approximate Surface Area to be Disturbed (ha) | Percentage of Total Disturbance Area (%) | Stripping Depth (m) | Approximate Volume of Topsoil Available for Rehabilitation ($m^3$) |
|---|---|---|---|---|---|
| Britt | 670 | 36.4 | 0.2 | 0.4 | 145,600 |
| Titus | 11,040 | 1220.9 | 5.4 | 0.5 | 6,104,500 |
| Garret | 23,720 | 9,628.5 | 42.8 | 0.2 | 19,257,000 |
| Waylon | 1,620 | 750.4 | 3.3 | 0.2 | 1,500,800 |
| Nelson | 8,690 | 4,632.0 | 20.6 | 0.3 | 13,896,000 |
| Dunrobin | 3,400 | 0 | 0.0 | 0.2 | 0 |
| Surbiton | 270 | 0 | 0.0 | 0.2 | 0 |
| Linda | 4,930 | 3,708.0 | 16.5 | 0.1 | 3,708,000 |
| Malika | 2,300 | 858.6 | 3.8 | 0 | 0 |
| Rhi | 8,190 | 1,664.7 | 7.4 | 0 | 0 |
| **Total** | **64,830** | **22,500** | **100** | **-** | **44,611,900** |

### V.3.7.1.3 *Land Classification*

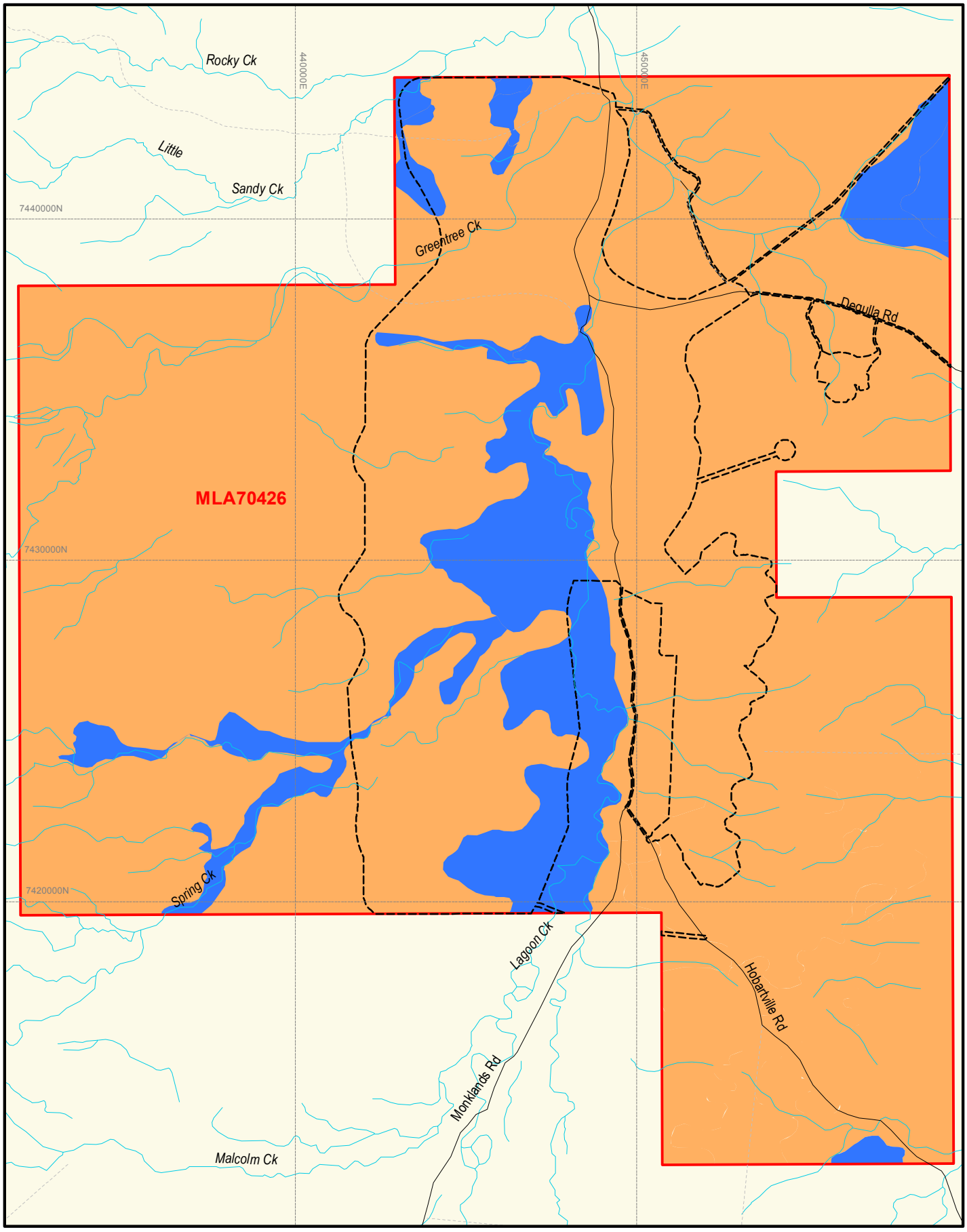
#### Suitability

The suitability of rainfed broadacre cropping as a land use on the Project site is mostly limited by nutrient deficiencies in the soil profile. Several of the soil units are shallow and/or have sodic subsoil. The soils are also limited by their plant available water capacity. Soils in the steeper areas of the Project site have additional limitations in respect to rockiness and erosion. The vast majority of the proposed disturbance area is classified as Rainfed Broadacre Cropping Land Suitability Class 4 with some Class 5 occurring on the disturbance area's eastern margin. In general the Project site land is considered marginal and unsuitable to cropping and has severe to extreme limitations.

The suitability of beef cattle grazing on the Project site is also mostly limited by nutrient deficiencies within the soil. Water erosion and poor water availability, primarily due to the shallow nature of the soil, are also considered limiting factors within some soils. The Project site is classified as Beef Grazing Land Suitability Classes 3 and 4. The land is suitable to marginally suitable to beef grazing and has moderate to severe limitations. The distribution of these land suitability classes is provided in Figure V-19.

#### Good Quality Agricultural Land

The majority of the proposed Project disturbance area (approximately 82%) has been assigned as Class C2. That is suitable for native pastures due to limitations which preclude cultivation for improved pastures or crop production. This aligns with findings of the land suitability assessment which found a majority of the site was either suitable or marginally suitable for beef cattle grazing with severe limitations. Small tracts of land (approximately 18% of disturbance area) have been assigned an agricultural land suitability class of C1. That is suitable for native pastures due to limitations that preclude cultivation for crop production. Figure V-20 indicates areas of good quality agricultural land.




Mining Lease Application (MLA70426) Boundary

Mine Disturbance Area

Beef Cattle Grazing Landuse Suitability Class 3

Beef Cattle Grazing Landuse Suitability Class 4

Source: See Copyright Details below and for full disclosure Please Refer to the SEIS ***Volume 2, Appendix B***

0 2 4Km

Scale 1:150 000 (A4)

Datum: GDA94, MGA Zone55

N W E S

**HANCOCK** PROSPECTING PTY LTD

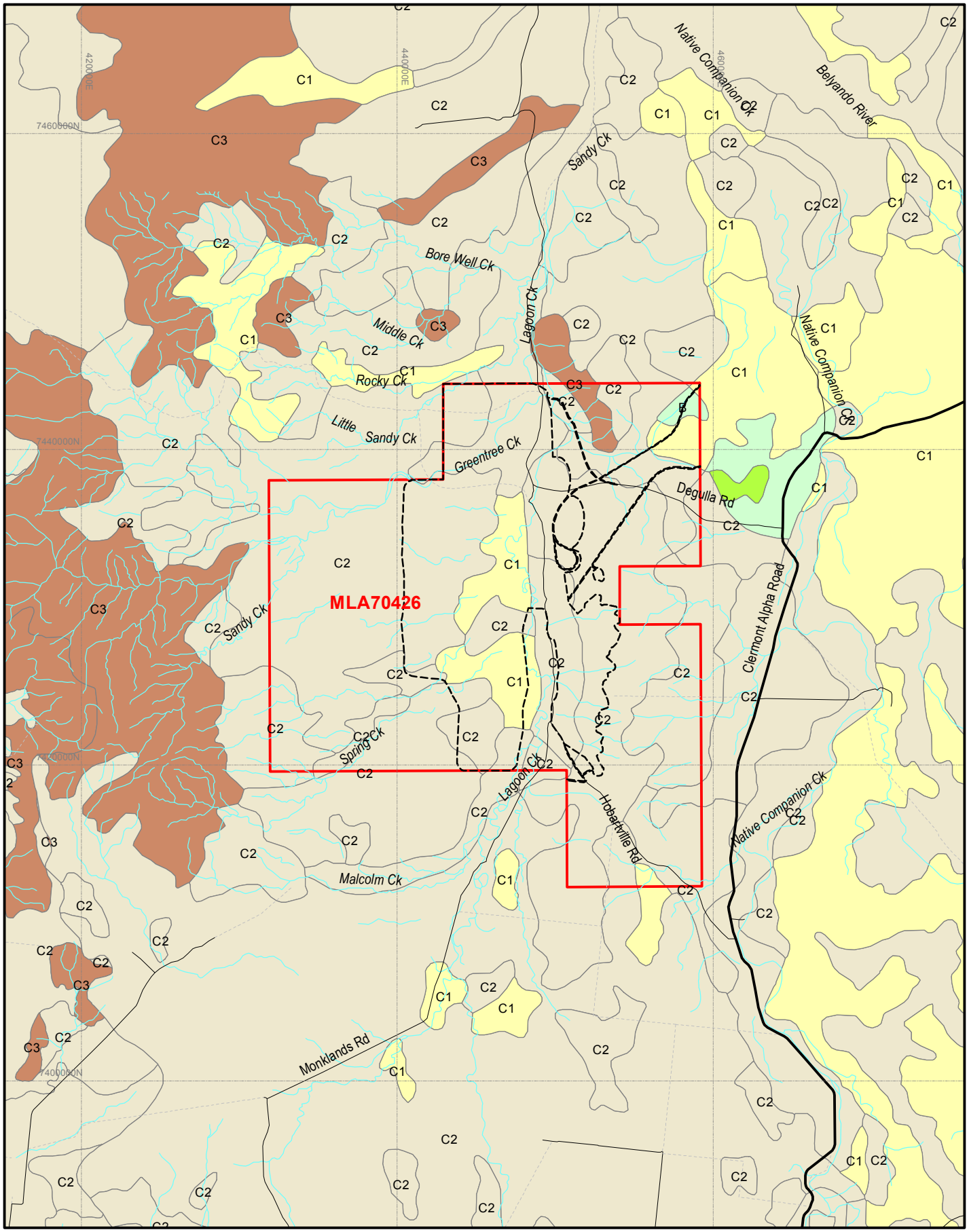
Alpha Coal Project
Supplementary Environmental Impact Statement

# ALPHA COAL PROJECT (MINE)
# LAND SUITABILITY CLASSIFICATION

Job Number | 4262 6680
Revision | C
Date | 07-06-2011

Figure: V-19

File No: 42626680-g-2058c.wor




Source: AARC supplied data.

Agricultural Land Classes

A
B
C1
C2
C3

Mining Lease Application (MLA70426) Boundary
Mine Disturbance Area
Good Quality Agricultural Land Boundaries

Source: See Copyright Details below and for full disclosure Please Refer to the EIS ***Volume 2, Appendix B***

0 5 10Km

Scale 1:325 000 (A4)

Datum: GDA94, MGA Zone55

N W E S

**HANCOCK PROSPECTING PTY LTD**

Alpha Coal Project
Supplementary Environmental Impact Statement

# ALPHA COAL PROJECT (MINE)
# GOOD QUALITY AGRICULTURAL LAND SURROUNDING THE PROJECT SITE

Figure: V-20

| | |
|---|---|
| Job Number | 4262 6680 |
| Revision | C |
| Date | 07-06-2011 |

File No: 42626680-g-2059c.wor

The post mining landform will be constructed and rehabilitated to attain an agricultural land suitability class of C2.

#### V.3.7.1.4 *Sensitive Environmental Areas*

A review of the Queensland Department of Environment and Resource Management (DERM) Environmentally Sensitive Areas (ESA) mapping for the Project site revealed no conservation parks, declared fish habitat areas, wilderness areas, aquatic reserves, heritage or historic areas, national estates, world heritage listings, sites listed by international treaties or agreements or areas of cultural significance relating to biodiversity and scientific reserves.

The EPBC Act Protected Matter Search Report identified two Ramsar wetlands of international significance, whose catchment extremities fall within 100 km of the Project site. These wetlands are Coongie Lakes and the Shoalwater and Corio Bays Area. The Shoalwater and Corio Bays Area Ramsar wetland is approximately 50 km north of Rockhampton and 410 km north-east of the Project. The Coongie Lakes wetland is located approximately 750 km south-west in the far north-east corner of South Australia in the Cooper Creek sub-catchment of the Lake Eyre Basin.

No essential habitat has been mapped within or adjacent to the Project site. Also, no areas have been identified as important habitat for species listed under the *Nature Conservation Act 1992* (NC Act) or *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act) as presumed extinct, critically endangered, endangered, vulnerable or near threatened.

Fauna species identified in the Environmental Protection and Biodiversity Conservation (EPBC) database as potentially inhabiting the Project site include the Brigalow Scaly Foot (*Paradelma orientalis*), Dunmall's Snake (*Furina dunmalli*), Squatter Pigeon (Southern) (*Geophaps scripta scripta*), Star Finch (eastern and southern) (*Neochmia ruficauda ruficauda*), Black-throated Finch (*Poephila cincta cincta*) and Australian Painted Snipe (*Rostratula australis*). Note that only the Squatter Pigeon (southern) was identified on the Project site during the surveys.

Two ecosystems, which are listed as Endangered under the EPBC Act, have been identified in database searches as potentially inhabiting the Project site. These include Bluegrass (*Dichanthium spp.*) dominant grasslands of the North and South Brigalow Belt Bioregions and Brigalow (*Acacia harpophylla* dominant and co-dominant) woodlands. The Brigalow Woodlands (which are endangered) consist of 16 regional ecosystems (REs), however, none of these REs occur on the Project site. No EPBC-listed habitats are located on the Project site and no REs recognised by DERM (where permits are no longer granted due to the community thriving at threshold levels) inhabit or surround the Project site.

No flora species listed under the EPBC Act or NC Act were identified in the Queensland Herbarium's (2008) HERBREC database search for the Project site and adjacent area.

#### V.3.7.1.5 *Contaminated Land*

The Project site comprises 6 land parcels of which the majority are currently utilised for cattle grazing. A review of current and historical titles as well as historical aerial photographs indicated that the majority of the Project area has been vacant grasslands used for cattle grazing. The remaining area is remnant bushland.

A search of DERM's EMR and CLR was carried out for the site. The results of the register search indicated no lots were listed on either register.

A site inspection conducted during July 2010, indicated that there are a few minor land contaminated areas resulting from fuel storage and contaminated liquid and rubbish burning activities. There were no other recognised environmental conditions observed during the site visit or review of historical site

data. The site appeared generally well maintained and few potential sources of contamination were identified over relatively small portions of the site. Notably, there was no visible or historical evidence of any plunge or spray dip at any of the cattle yards. Areas of interest identified during the site inspection are provided in Figure V-21 and include:

- A number of pieces of old defunct farm equipment at homesteads;
- Waste dumps adjacent to homesteads containing household debris, and used drums of petroleum products;
- Cattle yards used for loading and unloading cattle on each of the leases;
- Water and fuel storage tanks; and
- Groundwater and exploration bores in various locations throughout the site.

### V.3.7.2 Environmental Values

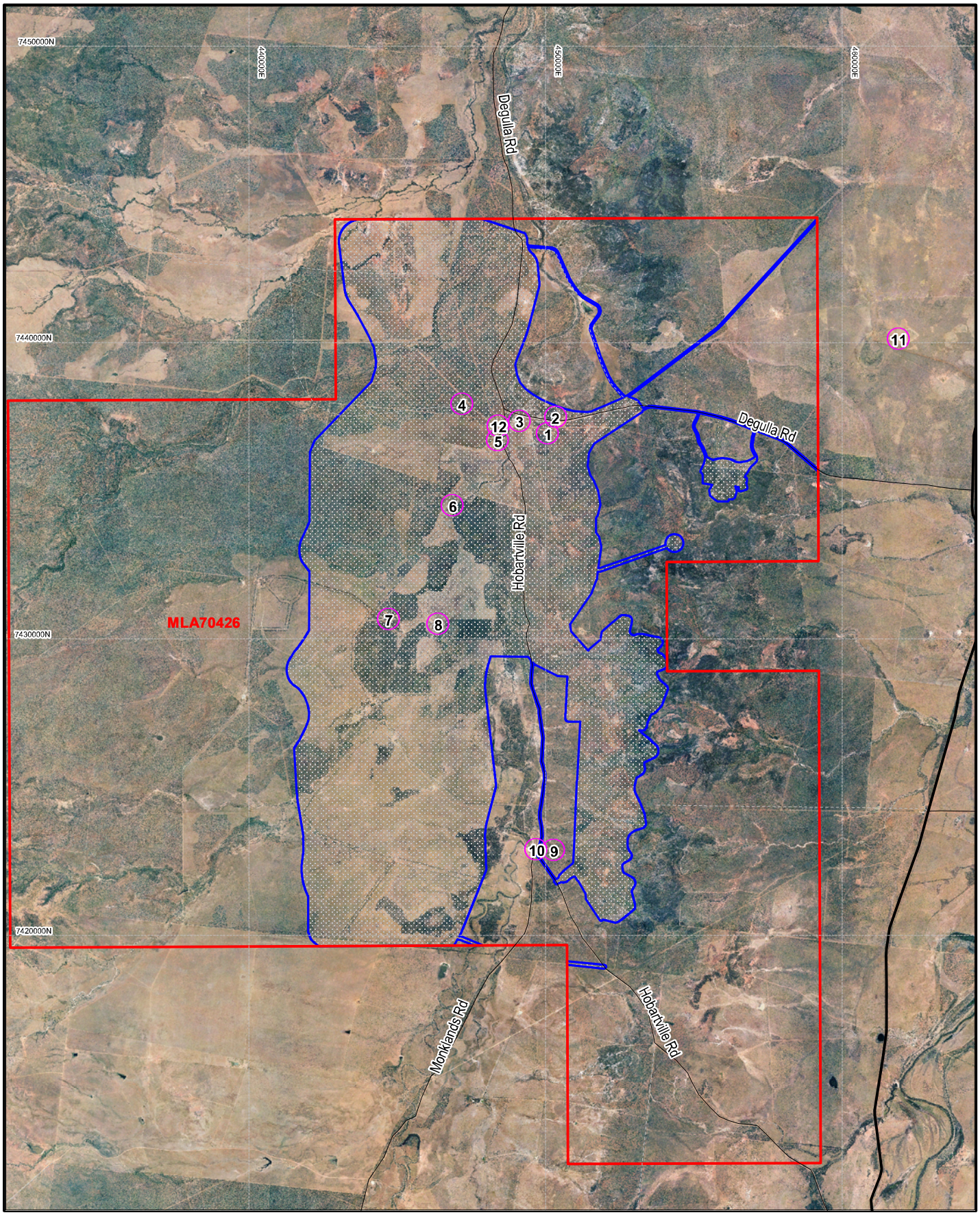
The environmental values of the land at the Project site that are to be protected or enhanced are:

- The integrity of undisturbed land and ecosystems on the Project site;
- The integrity of topsoil as a resource to be used in rehabilitation;
- The stability of disturbed land and ensuring it is non-polluting; and
- The suitability of land to support beneficial post mining land uses such as agriculture and native ecosystems.

### V.3.7.3 Potential Impacts on Environmental Values

Site activities with potential to impact on the land environmental values are:

- Land disturbance (vegetation clearance, topsoil stripping, stockpile management) causing erosion and degradation of topsoil resources;
- Land disturbance resulting in a reduction in agricultural land suitability, and capacity to support native ecosystems;
- Construction of spoil dumps, tailing storage facilities and potential AMD generation;
- Construction of access tracks, haul roads and pits;
- Disposal of coarse rejects and tailings;
- Creation of final voids; and
- Potential land contamination from the inadequate management of hazardous materials including fuels, oils and chemicals.




1. Exploration Camp
2. Wendouree Waste Dump
3. Old Wendouree Waste Dump
4. Defunct Excavator
5. Wendouree Water Well
6. Old Bore Hole
7. Cattle Yard
8. Old Bore Hole
9. Hobartville Waste Dump
10. Hobartville Homestead
11. Surbiton Homestead
12. Wendouree Homestead

Mining Lease Application (MLA70426) Boundary

Disturbance Area

Potential Contaminant Source

Source: See Copyright Details below and for full disclosure Please Refer to the SEIS ***Volume 2, Appendix B***

0 2.5 5km

Scale 1:175,000 (A4)
MGA94 Zone55

Datum: GDA94, MGA Zone55

N W E S

**HANCOCK** PROSPECTING PTY LTD

Alpha Coal Project
Supplementary Environmental Impact Statement

# ALPHA COAL PROJECT (MINE)
# CONTAMINATED LAND

| | |
|---|---|
| Job Number | 4262 6680 |
| Revision | C |
| Date | 07-06-2011 |

Figure: V-21

File No: 42626680-g-2060c.wor

### V.3.7.3.1 *Land Use*

The Alpha MLA 70426 is used for broad scale cattle grazing. Much of the area is either uncleared or partially cleared. Several isolated areas have been cropped for fodder species to supplement grazing on native and introduced pastures.

Post-mining, rehabilitation of the Project site will return a stable landform capable of uses similar to those prior to disturbance. These uses, as described in Section 3.7.3.3, are predominately beef cattle grazing on land that has been assessed as Good Quality Agricultural Land Class C2. This class of land is considered to be moderate quality grazing land for beef cattle. The remainder of the Project site is Good Quality Agricultural Land Class C1 land which is good quality grazing land for beef cattle.

The disturbance footprint of the Project includes mostly C2 land (82%) and some C1 land. As such, the post mining landform will be constructed and rehabilitated to ensure that a similar proportion of land suitability classification as per the pre-mining landscape is attained.

To achieve this, the nominated post-mining land use for the site is a mosaic of bushland and grazing land. The mosaic will link remnant native vegetation where possible and will aim to return some conservation value.

The bushland components will be established to return plant species similar to those prior to disturbance. These species, as described in the Flora & Fauna Report (EIS, Volume 2, Appendix E1), are mainly comprised of the Silver-leaved Ironbark Open Woodland Community and the Thozet's Box Open Woodland Community. Table V-61 shows that key species from each of these communities will be included in the site's revegetation programme. For example, the Thozet's Box Open Woodland's dominant species of Thozet's Box, Crimson Turkey Bush and Current Bush are key species listed in Table V-61. Similarly the, Silver-leaved Ironbark Open Woodland's dominate species of Silver-leaved Iron-bark, Quinine Bush and Black Supergrass are also key revegetation species for the proposed rehabilitation programme.

The bushland component is anticipated to be rehabilitated land that adds conservation value to the Project site and as such it is expected will have stock excluded from these areas.

The grazing land component of the post-mining landform will include a range of native species with key species selected based on the Non-remnant Grassland community as described by the aforementioned Flora & Fauna Report. Key revegetation grassland species include Fairy Grass, Buffel Grass as well as the shrub species Brigalow and Poplar Box (refer Table V-61). The grazing component is expected to be land moderately suitable for beef cattle grazing and will be typically land classified as Good Quality Agricultural Land Class C2. As discussed, Class C2 land is the Project Site's dominant pre-mining classification.

### V.3.7.3.2 *Soils*

#### Topsoil Suitability

The major land disturbance at the Project site will result from excavation of the open cut pit, placement of out-of-pit overburden dumps and haul road construction. Topsoil will be recovered in these areas of disturbance. Structural and textural properties of subsoils are the most significant limiting factors in determining depth of soil suitability for re-use, however, salinity levels, pH and dispersion potential are also limiting factors in some soils in the Project site. Recommended topsoil stripping depths for each soil unit are provided in Table V-59.

#### Erosion Potential

Field surveys have found that localised areas, primarily within the Rhi and Dunrobin SMUs, exhibit moderately to severe sheet and gully erosion. These areas are mostly restricted to the minor drainage lines which originate from the upper slopes of the minor ridge, formed along the Colinlea Sandstone and Joe Joe Group of geological developments.

Soils within the Rhi and Dunrobin SMUs have instances of hard setting surficial horizons and sodic soil layers within close proximity to the surface. Accordingly, in cleared areas these soils are likely to be prone to locally severe occurrences of sheet, rill and gully erosion due to uncontrolled surface water runoff from the hard setting surface soils. Over time this will inevitably lead to exposure of the more strongly dispersive subsoil layers which will exacerbate the effects and severity of the gully erosion.

Whilst also displaying high levels of exchangeable sodium, soils of the Linda SMU are at less of a risk of dispersion due to the relief of the mostly flat plains on which they occur.

Soil loss estimates have been computed to enable effective erosion and sediment control measures to be put in place during project development and to aid mitigation measure to reduce the erosion potential of post-mining landforms.

The computed soil loss results for the Project site for each soil management unit range from 48 - 97 tonnes/ha/yr and 201 - 435 tonnes/ha/yr for the flat and sloping rehabilitated landforms, respectively, with a bare soil surface. The Titus management unit has the highest erodibility ranking and is expected to generate the largest soil loss and erosion mitigation considerations are of particular importance for this soil unit. The computed soil loss rates will be significantly reduced during vegetation establishment. The theoretical soil loss rates will reduce by 65 to 85% with vegetative covers of 25 to 50%, respectively.

Soil loss (A) has been computed using the Revised Universal Soil Loss Equation (RUSLE) in accordance with Managing Urban stormwater: Soils and Construction Volume 1 – Appendix A (2004). The RUSLE is designed to predict the long term annual soil loss from the Project site due to erosion and this equation models five factors: rainfall erosivity (R), soil erodibility (K), slope length/gradient (LS), erosion control practice (P) and ground cover/management factor (C).

The estimated soil loss for each SMU for both flat and sloping post-mining landforms with a bare soil surface is quantified below in Table V-58.

**Table V-58: RUSLE Results (bare soil)**

| Factor | Soil Management Unit | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Britt | Waylon | Surbiton | Nelson | Malika | Rhi | Titus | Garret | Linda | Dunrobin |
| R | 2210 | 2210 | 2210 | 2210 | 2210 | 2210 | 2210 | 2210 | 2210 | 2210 |
| K | 0.015 | 0.017 | 0.025 | 0.025 | 0.025 | 0.015 | 0.030 | 0.025 | 0.025 | 0.025 |
| LS - flat | 1.82 | 1.82 | 1.82 | 1.82 | 1.82 | 1.82 | 1.82 | 1.82 | 1.82 | 1.82 |
| LS - slope | 7.59 | 7.59 | 7.59 | 7.59 | 7.59 | 7.59 | 7.59 | 7.59 | 7.59 | 7.59 |
| P | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 |
| C | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 |
| **A (flats) = (ton/h/yr)** | **48** | **55** | **80** | **80** | **80** | **48** | **97** | **80** | **80** | **80** |
| **A (slopes) = (ton/h/yr)** | **201** | **228** | **335** | **335** | **335** | **201** | **403** | **335** | **335** | **335** |

### Potential Acid Generating Material

The potential for acid generation from regolith material (topsoil and subsoil) within the Project site is low. Acid Sulphate Soils (ASS), which are the main cause of acid generation within the soil mantle, are commonly found less than 5 m above sea level, particularly in low-lying coastal areas such as mangroves, salt marshes, floodplains, swamps, wetlands, estuaries, and brackish or tidal lakes. The Project site is located within the Central Highlands region (which is located approximately 400 km from the coast at > 300 m AHD). There has been little history of acid generation from regolith material with this region.

The soils within the proposed disturbance areas are mildly acidic to alkaline. Given that the Project falls outside “low-lying coastal areas” in accordance with State Planning Policy 2/02 - Planning and Managing Development Involving Acid Sulphate Soils (DIP, 2002), an assessment of the risk of acid sulphate soils was not undertaken during the site’s soil survey.

### V.3.7.3.3 *Land Suitability and Good Quality Agricultural Land*

The post mining landform will be constructed and rehabilitated to ensure that a similar proportion of land suitability classification as the pre-mining landscape is attained. The Project site is classified as Rainfed Broadacre Cropping Land Suitability Class 4 with some Class 5 occurring on the disturbance area’s eastern margin and Beef Grazing Land Suitability Classes 3 and 4. The land is suitable to marginally suitable to beef grazing and has moderate to severe limitations.

The majority of the proposed Project disturbance area (approximately 82%) has been assigned as Class C2. That is suitable for native pastures due to limitations which preclude cultivation for improved pastures or crop production. The post mining landform will be constructed and rehabilitated to attain an agricultural land suitability class of C2.

### V.3.7.3.4 *Sensitive Environmental Areas*

Neither wetlands (Shoalwater and Corio Bays Area and the Coongie Lakes) are expected to be affected by Project activities because they are located in hydrological catchments that are different to the Project site. Note that the Project site and nearest Ramsar wetland are separated by approximately 400 km.

The two EPBC listed endangered communities identified as potentially occurring on the Project site were not actually identified on the site. No essential habitat for species of conservation significance is located on or adjacent to the Project site. The only EPBC fauna species identified on site was the Squatter Pigeon.

#### V.3.7.3.5 *Contaminated Land*

The principal risks for land contamination from the construction and operation of the Project result from hydrocarbon storage and use, chemical storage and use, waste storage and reject handling, and the potential for acid rock drainage. Due to the size of the Project and the resultant large fleets of mobile machinery, the site will have a large inventory and usage of hydrocarbons (fuel and lubricants) and chemicals. Spills from the use or storage of these materials have the potential to impact on the surrounding environment.

Additionally the handling and storage and mining waste is an area of long term potential impact to the environment. The incorrect handling and storage of the mine waste (rejects and tailings) and some of the overburden could result in acid mine drainage and salinity impacts to the surrounding groundwater and surface water environments in particular.

### V.3.7.4 Environmental Protection Objective

The objectives to protect the environmental values of the Project site are:

- To provide a stable, non-polluting landform;
  - Land disturbed by mining activities will be made stable (geotechnical and erosional) to ensure that the post mine landform are not compromised by instability.
- To provide a beneficial post mining land use;
  - The post-mine land uses for areas disturbed by mining will be a mosaic of self sustaining vegetation communities and grazing land, using appropriate native tree, shrub and grass species, and improved pasture species as appropriate.
- To minimise the extent and degree of disturbance on land and remnant vegetation as mining continues and will continue to rehabilitate land disturbed by mining;
- To maximise the recovery and reuse of topsoil;
- To minimise land contamination and to continue to remediate areas of contamination, as appropriate within the constraints of the continuing operations; and
- To minimise pre-mining disturbance and to continue to rehabilitate exploration areas.

### V.3.7.5 Performance Criteria

The performance criteria for land management are:

- Compliance with the requirements of the Project's environmental authority.
- No off site impacts from AMD.
- Stable landforms once rehabilitated with no visible rill or gully erosion.

### V.3.7.6 Control Strategies

#### V.3.7.6.1 *Soils*

The strategies discussed below will be implemented to minimise and manage potential impacts on soils at the Project site, along with other control strategies to be implemented as part of rehabilitation and decommissioning of the site. A topsoil management plan (TMP) will be maintained and regularly updated. This will include:

- All relevant aspects for topsoil retrieval such as stripping, stockpiling and re-spreading procedures, stockpile locations and inventory;
- Topsoil stripping quantities formulated from pre-mining soil survey information; and
- Stripping and stockpile methodology.

**Topsoil Stripping, Handling and Respreading**

Where topsoil stripping and transportation is required, the following topsoil handling techniques will be implemented to prevent excessive soil deterioration:

- Strip material to the depths stated in Table V-59, subject to further investigation as required.
- Topsoil will be maintained in a slightly moist condition during stripping. Material will not be stripped in either an excessively dry or wet condition.
- Stripped topsoil will be placed directly onto regraded overburden or other disturbed areas and spread immediately (if mining sequences, equipment scheduling and weather conditions permit) to avoid the requirement for stockpiling.
- Soil will be graded or pushed into windrows with excavators, graders or dozers for loading into rear dump trucks by front-end loaders. This is the preferred method as it minimises compression effects of the heavy equipment that is often necessary for economical transport of soil material.
- The surface of soil stockpiles will be left in as coarsely textured a condition as possible in order to promote infiltration and minimise erosion until vegetation is established, and to prevent anaerobic zones forming.
- Where possible, a maximum stockpile height that prevents biological and structural degradation will be maintained. Clayey soils will be stored in lower stockpiles for shorter periods of time compared to soils that have a coarser texture.
- Free-draining stockpiles will be created to minimise the formation of anaerobic zones. Stockpiles will be formed in a “chevron” profile with batters graded to achieve slopes approaching 18°, where practicable.
- If long-term stockpiling is planned (i.e. greater than 12 months), stockpiles will be seeded and fertilised. An annual cover crop species that produce sterile florets or seeds will be sown. A rapid growing and healthy annual pasture sward provides sufficient competition to minimise the emergence of undesirable weed species. The annual pasture species will not persist in the rehabilitation areas but will provide sufficient competition for emerging weed species and enhance the desirable micro-organism activity in the soil.
- Prior to re-spreading stockpiled topsoil onto regraded overburden or other disturbed areas (particularly onto designated tree seeding areas), an assessment of weed infestation on stockpiles

will be undertaken to determine if individual stockpiles require herbicide application and / or "scalping" of weed species prior to topsoil spreading.

- Topsoil will be spread to a minimum depth range of 0.1 m (steep slopes) to 0.2 m (flatter areas). Soil respreading on steep slopes at depths exceeding 0.1 m can be deleterious because of the "sponge" effect which can cause slippage of the topsoil from the slope. Flat areas will be topsoiled at a minimum depth of 0.2 m.

**Table V-59 Soil stripping depths and available volumes**

| Soil Management Unit | Surface Area (Total Project Site) (ha) | Approximate Surface Area to be Disturbed (ha) | Percentage of Total Disturbance Area (%) | Stripping Depth (m) | Approximate Volume of Topsoil Available for Rehabilitation ($m^3$) |
|---|---|---|---|---|---|
| Britt | 670 | 36.4 | 0.2 | 0.4 | **145,600** |
| Titus | 11,040 | 1220.9 | 5.4 | 0.5 | **6,104,500** |
| Garret | 23,720 | 9,628.5 | 42.8 | 0.2 | **19,257,000** |
| Waylon | 1,620 | 750.4 | 3.3 | 0.2 | **1,500,800** |
| Nelson | 8,690 | 4,632.0 | 20.6 | 0.3 | **13,896,000** |
| Dunrobin | 3,400 | 0 | 0.0 | 0.2 | **0** |
| Surbiton | 270 | 0 | 0.0 | 0.2 | **0** |
| Linda | 4,930 | 3,708.0 | 16.5 | 0.1 | **3,708,000** |
| Malika | 2,300 | 858.6 | 3.8 | 0 | **0** |
| Rhi | 8,190 | 1,664.7 | 7.4 | 0 | **0** |
| **Total** | **64,830** | **22,500** | **100** | **-** | **44,611,900** |

Sampling and analysis of topsoil resources for pH, conductivity, exchangeable Na% and nutrient requirements, whether stockpiled or *in situ*, will be undertaken prior to respreading to assess suitability (Table V-60). This will assist in identifying potential soil deficiencies and estimating required rates of fertiliser or ameliorant application.

**Table V-60 Soil Suitability Criteria**

| **Structure** | **30% peds present**<br>**coherent when wet or dry**<br>**no mottle present** |
|---|---|
| Texture | finer than sandy loam<br>sand and gravel content < 60% |
| Dispersion | EAT > 2 (2)<br>exchangeable Na% < 12% |
| pH | > 4.5 & < 8.4 |
| Conductivity | < 1.5 dS/m |

Not all reshaped overburden areas will require topdressing using conserved topsoil reserves when direct tree seeding techniques are implemented in the revegetation program. Suitable topsoil will be re-spread directly onto reshaped areas. Where topsoil resources allow, topsoil will be spread to a minimum depth of 0.1 m on all regraded spoil. Topsoil will be spread, treated with fertilizer or ameliorants (if required) and seeded in one consecutive operation, to reduce the potential for topsoil

loss to wind and water erosion. Prior to re-spreading stockpiled topsoil onto reshaped overburden (particularly onto designated tree seeding areas), an assessment of weed infestation on stockpiles will be undertaken to determine if individual stockpiles require herbicide application and/or scalping of weed species prior to topsoil spreading.

### Topsoil Respreading and Seedbed Preparation

Regrading will be undertaken to produce slope angles, lengths and shapes that are compatible with the proposed post-mine land use and not prone to an unacceptable rate of erosion. Suitable topsoil will be re-spread directly onto reshaped disturbance areas. Where topsoil resources allow, topsoil will be spread to a nominal minimum depth range of 0.1 to 0.2 m on all rehabilitation areas. Specific topsoil respreading depths for different post mining landform elements will be specified in the Project's TMP and Erosion and Sediment Control Plan (ESCP).

The spreading of topsoil, addition of soil ameliorants and application of seed will be carried out in consecutive operations to reduce the potential for topsoil loss to wind and water erosion.

Thorough seedbed preparation will be undertaken to ensure optimum establishment and growth of vegetation. All topsoiled areas will be lightly contour ripped (after topsoil spreading) to create a "key" between the soil and the subsoil/capping materials. Ripping will be undertaken on the contour and the tynes lifted for approximately 2 m every 200 m to reduce the potential for channelized erosion. Ripping will be undertaken when soil is moist and immediately prior to sowing for best results. The respread topsoil surface will be scarified prior to, or during seeding, to reduce run-off and increase infiltration.

Some of the soils in the Project site exhibit sodic properties. Sodic soils are not optimal for rehabilitation works as the clay particles tend to disperse and swell producing poor physical soil conditions. These conditions include water-logging and hard-setting crusts which in turn negatively affect infiltration rates, plant-available water capacity, seedling emergence and root development. Topsoil resources for rehabilitation works have been selected to minimise potential soil sodicity effects. For some soils, the application of soil ameliorants that decrease soil dispersibility and increase soil aggregate stability will be an important soil rehabilitation management tool.

Soil organic matter increases soil aggregate stability and adding carbon as a soil ameliorant will improve soil structure. Carbon ameliorants such as mulch will be beneficial for rehabilitated landforms within the Project site. Organic amendments will supplement elevated organic carbon levels in the Project site's soils to improve structural stability. Fertiliser additions will be undertaken upon routine receipt of soil test results during a proposed progressive soil testing programme.

### Erosion and Sediment Control

A detailed ESCP will be developed prior to the commencement of construction works. The ESCP will be prepared in accordance with *Best Practice Erosion & Sediment Control* (IECA, 2008). The principle objectives of the ESCP will be as follows:

- To minimise erosion and sedimentation from all active and rehabilitated areas, thereby minimising sediment ingress into surrounding surface waters;
- To ensure the segregation of dirty water (surface runoff from disturbed catchments (e.g. active areas of disturbance, stockpiles and rehabilitated areas (until stabilised)) from clean water (surface runoff from catchments that are undisturbed or relatively undisturbed by project-related activities and rehabilitated catchments), and maximise the retention time of dirty water such that any discharge from the Project site meets the relevant water-quality limits;

- To minimise the volume of water discharged from the Project site but, should the discharge of water prove necessary, ensure sufficient settlement time is provided prior to discharge such that suspended sediment within the water meets the objectives identified in the point above;

- To manage surface flows upstream of the Project site so that rehabilitation and coal recovery activities are not affected by flooding. Clean water diversion channels and creek diversions will be constructed prior to commencement of mining;

- To prevent erosion of the ephemeral watercourses that traverse the site;

- To develop sustainable long-term surface water features following rehabilitation of the site, including implementation of an effective revegetation and maintenance program; and

- To monitor the effectiveness of surface water and sediment controls and to ensure all relevant surface-water quality criteria are met.

The ESCP will be reviewed by a Certified Professional in Erosion and Sediment Control (CPESC) accredited by the International Erosion Control Association (IECA).

One of the primary design aspects of the Project is the prevention of clean water in ephemeral drainage channels entering the active disturbance area. This will be achieved through the use of levees, cut-off drains, dams and diversions, as well as the containment of dirty water in sediment dams within the active areas of the Project to limit any uncontrolled runoff.

Effective erosion and sediment control for the Project site will require appropriate activities to be carried out over the life of the Project including:

- Construction;
- Operations; and
- Rehabilitation and Closure.

The effectiveness of erosion and sediment controls during the operational and closure stages will be optimised through effective mine planning and design. Suitable strategies will include:

- Designing and operating drainage systems for the life of the mine so that they do not cause erosion. This will involve scour protection of open drains and energy dissipaters located at drain outlets;
- Designing the final mine geometry to create a landform that allows free drainage of surface runoff while minimising erosion. This includes designing an appropriate drainage system that avoids erosion;
- Staging open cut mining to minimise the operational area exposed at any one time. This helps to reduce the potential for erosion and the extent and capacity of erosion and sediment control measures required, especially where the operational area has the potential to drain to a waterway; and
- Stormwater reuse as part of the overall water-management strategy for the site to avoid or reduce discharge of polluted water. A range of non-potable water uses will be available on the mine site such as dust suppression, process water and irrigation of tree plantings.

A surface water management system will be installed that is capable of conveying runoff from the newly created catchments whilst minimising the risk of erosion and sedimentation. Contour banks will

be constructed at intervals down the slope to divide long slopes into a series of short slopes with the catchment area commencing at each bank. This will prevent runoff from reaching a depth of flow or velocity that would cause erosion. As the slope angle increases, the banks will be spaced closer together until a point is reached where they are no longer effective.

Contour ripping across the grade (to minimise erosion and cultivate the surface in readiness for sowing) will be constructed away from the true contour, at a designed gradient (0.5% to 1%) to drain water towards the sediment control structures. The use of engineered waterways using erosion blankets, ground-cover vegetation and/or rip rap will be used to safely dispose of runoff down slope. Sediment control basins will be constructed to capture sediment laden runoff prior to off-site release. The following points will be considered when selecting sites for sediment control basins:

- Each basin will be located so that runoff may easily be directed to it, without the need for extensive channel excavation or for excessive channel gradient. Channels must be able to discharge into the basin without risk of erosion. Spillways must be designed and located so as to safely convey the maximum anticipated discharge;
- The material from which the basin is constructed must be stable. Dispersive clays, such as the subsoils of the dark clays, will require treatment with lime, gypsum and/or bentonite to prevent failure of the wall by tunnel erosion. Basins will be well sealed, as leakage may lead to instability, as well as allowing less control over the storage and release of water; and
- The number and capacity of basins will be related to the total area of catchment and the anticipated volume of runoff.

Where practical, it is proposed to segregate water within the mine site according to its quality to minimise the stored volumes of water with high concentrations of contaminants. This would allow containment of water requiring treatment (e.g. settling suspended sediment) and water suitable for direct discharge (e.g. undisturbed catchments) to be diverted.
The clean water system comprises:

- Diversion of Lagoon Creek and Sandy Creek around the mine site;
- Clean water catch drains to divert minor catchments around the mine site, where practical; and
- Highwall dams and levees upslope of the pit to reduce inflows and velocities from undisturbed catchments.

Dirty water runoff from disturbed areas will be captured in sediment dams to allow suspended solids to settle. The Proponent proposes to have the ability to release this captured water to Lagoon Creek when water quality discharge criteria have been met.

Sediment dams will allow time for coarse sediments to settle and, if necessary, allow a flocculent to be added to remove fine or dispersive sediment to meet allowable turbidity discharge limits. The dams will be provided to intercept as much runoff from the overburden dump as practical. The eastern portion of the overburden dump drains east, and sediment dams will to intercept dirty runoff before it reaches Lagoon Creek. The eastern sediment dams overflow to a drain running along the western side of the main haul road. The overflow drain discharges to a final sediment dam, which discharges to Lagoon Creek. The western portion of the overburden dump drains to the pits, and sediment dams have been provided to intercept dirty runoff before it reaches the pit. Water captured in the western sediment dams (SD11 to SD20) will be pumped back to the eastern sediment dams. However, the western sediment dams will overflow to the pit during large storm events.

A total of 21 sediment dams are proposed to manage runoff from the site over the life of the Project. The proposed sediment dam locations have been selected so that runoff from disturbed areas will be intercepted and appropriately managed before release into the creek system.

A CPESC will be engaged to regularly audit the construction and maintenance of all erosion and sediment control measures throughout the construction and rehabilitation phases of the mine.

### V.3.7.7 Rehabilitation and Decommissioning

#### V.3.7.7.1 *Objectives*

The objectives of rehabilitating disturbed land that will result from the Project comprise:

- Achievement of acceptable post-disturbance land use suitability – Mining and rehabilitation will aim to create a stable landform with land use capability and/or suitability similar to that prior to disturbance, unless other beneficial land uses are pre-determined and agreed. This will be achieved by setting clear rehabilitation success criteria and outlining the monitoring requirements that assess whether or not these criteria are being accomplished;
- Creation of stable post-disturbance landform - Mine wastes and disturbed land will be rehabilitated to a condition that is self-sustaining, or to a condition where maintenance requirements are consistent with an agreed post-mining land use; and
- Preservation of downstream water quality – Surface and ground waters that leave the mining leases should not be degraded to a significant extent. Current and future water quality will be maintained at levels that are acceptable for users downstream of the site.

#### Rehabilitation Strategy

All areas significantly disturbed by mining activities will be rehabilitated to a stable landform with a self-sustaining vegetation cover. Rehabilitation of disturbed land will generally proceed within two years of the areas becoming available for rehabilitation. In some situations, progressive rehabilitation may not be possible because the area may be effectively integrated with areas nearby that are unavailable for rehabilitation. To achieve the objectives above, rehabilitation will be conducted so that:

- Suitable species of vegetation are planted and established to achieve the relevant grazing and bushland post-mine land uses;
- Wherever practicable landscaping and rehabilitation works will include endemic native species of local provenance, and if suitable will also make use of conservation significant flora species or species that can provide habitat opportunities for conservation significant fauna;
- Potential for erosion is minimised, including likelihood of environmental impacts being caused by the release of dust;
- The quality of surface water and seepage released from the site is such that releases of contaminants are not likely to cause environmental harm;
- The water quality of any residual water bodies meets criteria for subsequent uses and does not have the potential to cause environmental harm; and
- The final landform is stable and not subject to slumping or erosion which will result in the agreed post-mining landform being maintained.

A Rehabilitation Management Plan will be developed to incorporate the control strategies and monitoring programs identified within this EM Plan.

### Landform Design and Planning

Rehabilitation planning at the Project site will aid in minimising the total area of disturbance at any one time, so reducing the potential for wind-blown dust, visual impacts and increased sediment-laden run-off. Rehabilitation will be designed to achieve a stable final landform compatible with the surrounding environment. This will involve the reshaping, using large dozers, of the majority of overburden emplacement slopes to a stable landform. These control measures will enhance erosion / sediment control and aid in groundcover establishment.

Treed vegetation along the toe of rehabilitation areas will not be cleared unless an unacceptable safety or erosion risk remains.

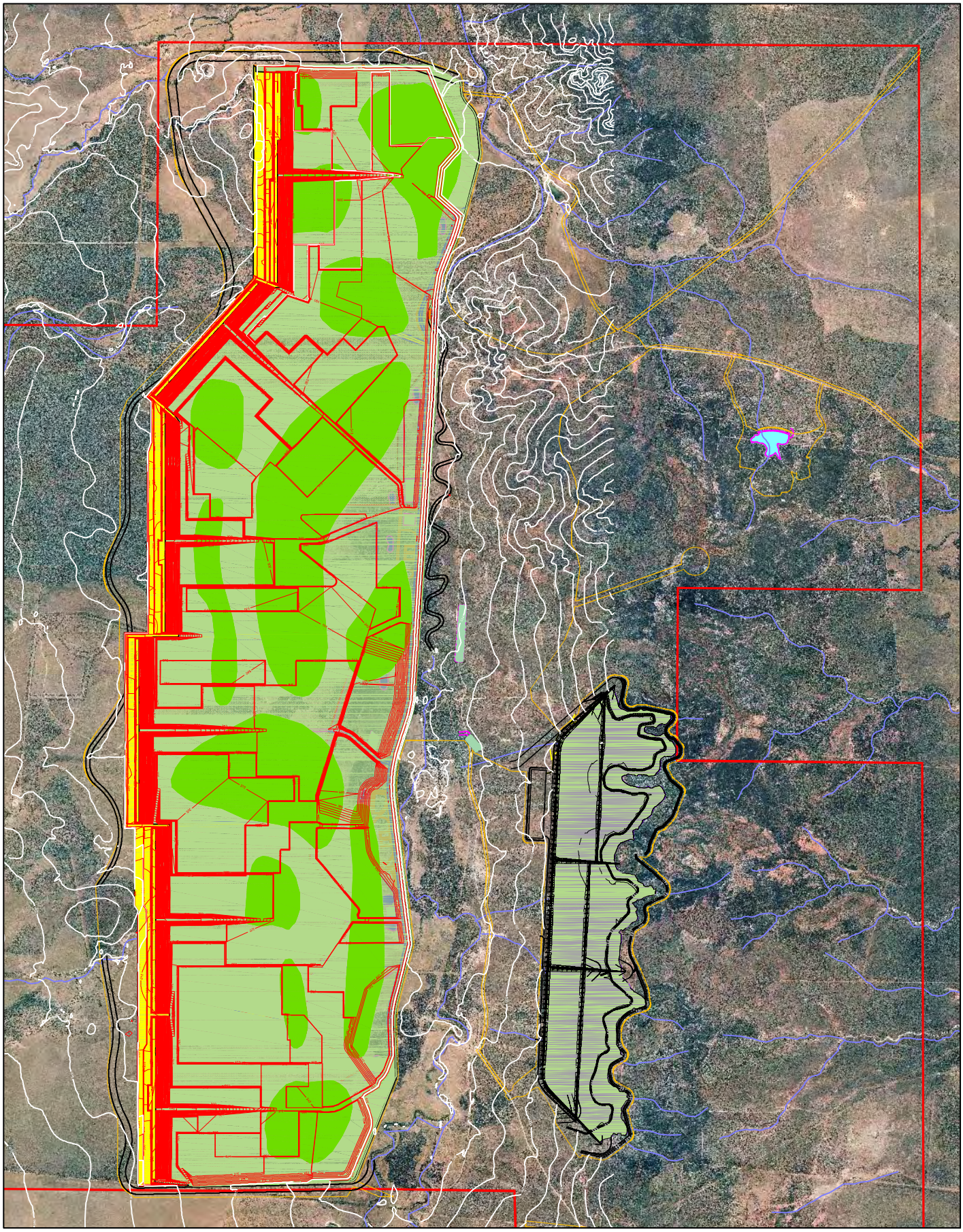
Where possible, rehabilitation planning will attempt to maximise opportunities for a diverse post-mining landscape and land-use. It is presently proposed that the final land-uses of the rehabilitated site will include a mixture of grazing and bushland. Creek diversions running around the site will have riparian areas rehabilitated to a post-mining standard to include a diverse vegetative community of native trees, shrubs and grasses. Monitoring will be undertaken to ensure that objectives are being met. Conceptual final landform and rehabilitation plans are shown as Figures V-22 and V-23.

### Selective Overburden Handling

Saline and/or sodic spoil will be removed separately with the dragline. Instead of dumping this material on top of the spoil pile, the material will be placed at the low wall side of the cut, at the toe of the spoil pile. The method will require the base of the cut to be broadened in proportion to the volume of material to be selectively handled.

Benign spoil will be dumped behind the back of the first spoil pile and will be subsequently reclaimed by front-end loaders and dozers. This method will demand that reshaping be kept up to within one spoil pile of the cut so that the selectively placed material is accessible.

A schematic of the typical final rehabilitated profile of the overburden/spoil material emplacement areas is provided at Figure V-18.




Source: See Copyright Details below and for full disclosure Please Refer to the SEIS *Volume 2, Appendix B*

NOT TO SCALE

Datum: GDA94, MGA Zone55

N W E S

HANCOCK PROSPECTING PTY LTD

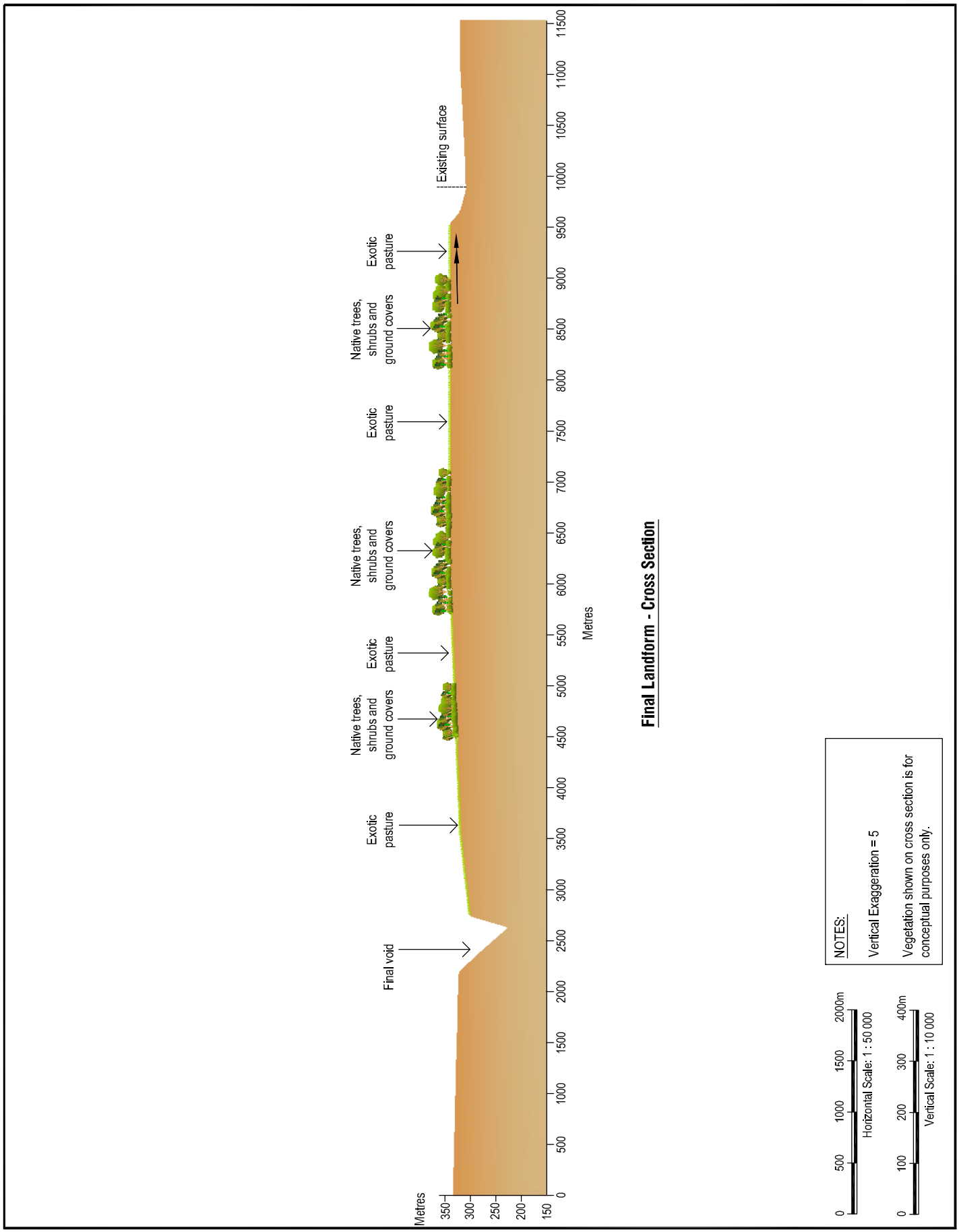
Alpha Coal Project
Supplementary Environmental Impact Statement

# FINAL REHABILITATION LANDFORM

Job Number 4262 6680
Revision C
Date 07-06-2011

Figure: V-22

File No: 42626 680-g-2061c.dwg




Source: See Copyright Details below and for full disclosure Please Refer to the SEIS

AS SHOWN

N
W E
S

HANCOCK PROSPECTING PTY LTD

Alpha Coal Project
Supplementary Environmental Impact Statement

ALPHA COAL PROJECT (MINE)
FINAL LANDFORM
INDICATIVE CROSS SECTION

Job Number | 4262 6580
Revision | A
Date | 06-06-2011

Figure: V-23

File No: 42626 680-g-2067.dwg

## Rehabilitation Methods

### Progressive Rehabilitation

Rehabilitation will be progressively undertaken on areas that cease to be used for mining or mine-related activities within two years of becoming available, to reduce the amount of disturbed land at any one time. Results of progressive rehabilitation will be used to refine rehabilitation methods for future application such as the selection of appropriate drainage measures and plant species for re-establishment. Areas available for progressive rehabilitation and the types of disturbance at those sites will be detailed in the mine's Plan of Operations.

### Revegetation

A revegetation strategy is proposed for the Project disturbance area that seeks to compliment desirable post-mining land-use objectives whilst maintaining effective erosion and weed controls.

Revegetation activities will be scheduled to occur after the completion of reshaping, re-topsoiling and drainage works. Where possible, the timing of these works will enable a preferred seasonal sowing of pasture and tree seed in autumn or spring.

On prepared surfaces, selected tree, shrub and pasture species will be sown using seed stock and/or planted depending on the species, slope gradients and area to be revegetated. Tree and shrub species will be established at a density and richness consistent with the nominated post-mine ecosystem.

Plants selection for areas to be returned to bushland will focus on those species that will successfully establish on the available growth medium, species that that will bind the soil and species that will result in a variety of structure and food/habitat resources, with an aim to establishing woodland to open forest. Native species will be established through direct seeding or planting of tube stock/nursery-raised stock from local propagules. Seed will be collected from site where possible to ensure it is adapted to environmental conditions in the area.

Prior to application, some of the tree seed (eg Acacia spp) will be appropriately pre-treated in order to break dormancy restrictions to promote earlier germination, develop more robust seedlings, wider and more uniform germination and increased germination rates.

Tree and shrub establishment on site will be dominated by the direct seeding method, currently being used at the majority of coal mines in the Bowen Basin, located to the east of the Galilee Basin. A recommended tree, shrub and groundcover mix, based on the species list from the EIS flora assessment is provided in Table V-61. The species dominate the Project area's vegetation communities and represent a combination of canopy, sub-canopy, shrub, lower shrub and groundcover strata.

**Table V-61 Recommended native species mix**

| Scientific Name | Common Name |
|---|---|
| *Acacia harpophylla* | Brigalow |
| *Eremophila latrobei* | False Sandalwood |
| *Carissa ovata* | Currant Bush |
| *Eucalyptus melanophloia* | Silver-leaved ironbark |
| *Petalostigma pubescens* | Quinine Bush |
| *Eucalyptus populnea* | Poplar Box |
| *Carissa ovata* | Currant Bush |
| *Triodia mitchelli* | Soft Spinifex |
| *Aristida calycina* | Dark Wiregrass |
| *Callitris glaucophylla* | White Cypress Pine |
| *Panicum decompositum* | Native Millet |
| *Artistida latfolia* | Feathertop Wiregrass |
| *Eucalyptus melanophloia* | Silver-leaved Ironbark |
| *Eucalyptus populnea* | Poplar Box |
| *Acacia cambagei* | Gidgee |
| *Carrisa ovata* | Current Bush |
| *Eucalyptus camaldulensis* | Red River Gum |
| *Sporobolus caroli* | Fairy Grass |
| *Pennisetum cillare* | Buffel Grass |
| *Melaleuca tamariscina* | Weeping Bottlebrush |
| *Calytrix microcoma* | Desert Star Flower |
| *Triodia pungens* | Soft Spinifex |
| *Eucalyptus thozetiana* | Thozet's Box |
| *Eremophila mitchelli* | False Sandalwood |
| *Eremophila latrobei* | Crimson Turkey Bush |
| *Carissa ovata* | Current Bush |
| *Acacia shirleyi* | Lancewood |
| *Eucalyptus similis* | Queensland Yellowjacket |
| *Triodia pungens* | Soft Spinifex |
| *Heteropogon contortus* | Black speargrass |

A combination of native and introduced pasture species will be used on the bushland sites to ensure the quick establishment of a continuous groundcover, thereby reducing the risk of erosion. Legumes may also be selected to assist in the supply of bio-available nitrogen to the soil. If the use of introduced grasses and/or legumes is deemed necessary for erosion control in the bushland areas, pasture seed and fertiliser will be applied at a lower rate than for pasture outcomes to reduce competition with tree seed and/or seedlings. Native and exotic pasture species (warm season perennial, cool season perennial, yearlong green perennial and annual) will be sown where the risk of erosion is less and on the more protected aspects of landforms. Introduced, stoloniferous grass species (e.g. Rhodes Grass, Indian Couch) will be sown on the steeper slopes as their growth habit provides more extensive coverage in a shorter time.

Aerial sowing and ground broadcasting will be conducted for both tree and pasture seed as the preferred sowing methods and grazing will be restricted whilst the vegetation is establishing. All

revegetated areas will be monitored to ensure long-term groundcover establishment and success. Revegetation techniques will be continually developed and refined over the life of mine through an ongoing process of monitoring at the site and recognition of other industry experiences.

Additional erosion control measures such as the application of 'hydromulch' will be considered, particularly in drainage lines and steeper batter areas e.g. infrastructure "cut and fill" batters. For example, sugar cane mulch in a slurry provides cover for the soil to improve pasture growth, modifying the soil surface to control erosion, or a combination of both. Securely pressed against the surface of the soil, the mulch provides a high degree of erosion control and improves moisture availability to establishing pasture. The mulch also has the effect of protecting the soil surface against raindrop impact, improving the micro-environment for seed germination and establishment by reducing evaporation losses, and assisting in the control of surface erosion caused by raindrop impact and overland water flow.

## Decommissioning of Infrastructure, Plant and Buildings

### Site Services

All services including power, water, data and telephone for the Project site will be isolated, disconnected and terminated to make them safe. The inspection pits and junction boxes for underground services will be sealed. Generally all underground services will be made safe and left buried in the ground. Overhead power lines will be removed and the materials (i.e. poles and wire) recovered for potential re-sale or recycling as applicable. Switch room buildings will be disconnected and demolished. The substations will be removed from the site and either used on another project or sold as a going concern.

### Infrastructure and Buildings

All sumps will be de-watered and the excess coal removed prior to the commencement of demolition. In addition all items of equipment will be de-oiled, degassed, depressurised and isolated and all hazardous materials (HAZMATs) removed from the site.

All buildings, including the main administration building, workshop, CHPP and fixed plant (including stacker / reclaimers, conveyors & gantries, transfer points, thickener tank, coarse reject hopper, vehicle wash, etc) will be required to be demolished and removed from the site. Where possible assets may be re-used or sold to other mines.

The remaining items will be demolished, removed and transported from the site as required. All recoverable scrap steel will be sold and recycled, with the remaining non-recyclable wastes either being taken to a licensed landfill or buried in the backfill of the final voids. Only inert wastes will be placed in the backfill.

All concrete footings and pads will be broken up to at least 1.5 m below the surface and removed with the "non contaminated" waste material being buried in the open cut void before it is rehabilitated.

The bitumen roadways, car parks and hardstand areas around the CHPP, workshop and administration areas will be ripped up with the inert waste material being placed in the open cut voids and buried.

### Roads, Car Parks and Hardstands

The bitumen roadways, car parks and hardstand areas around the CHPP, workshop and administration areas will be ripped up with the inert waste material being placed in the open cut voids and buried. Contaminated, carbonaceous or unsuitable (gravel, etc) material will be removed from the haul roads and hardstand surfaces and disposed of and covered in the low wall area.

Minor dozer reshaping work will be undertaken to ensure surface level consistency with the surrounding areas. Any creek crossings (i.e. culverts, etc) will be removed and the pre-existing drainage line re-instated where applicable. The site will be rock raked to remove all surface rocks to a size of less than 500 mm and ripped to a depth of at least 1 m. Fertiliser and pasture/tree seed will be applied to assist establish pasture post-mine land use.

A light vehicle access road is to be maintained to enable inspections of the site following closure of the mine. All roadside markers (tyres and guideposts) and signs are also to be removed from within the area once mine closure activities within the pit area have been completed.

**Dams and Surface Water Features**

All sedimentation dams which assist in the water flow from the final rehabilitated surface will be retained following mine closure. The other dams will be removed and the original drainage paths re-established wherever possible.

The TSF cap will be designed and constructed so that the surface will sustain vegetation but allow excess stormwater to be free draining. The tailings will be capped with a layer of compacted clay or similar impermeable substance over which a layer of coarse material will be placed. Topsoil will then be used to resurface the area which will then be revegetated. This process will inhibit the ponding and infiltration of surface water and limit the risk of seepage from the TSF.

**Void Management**

A void management strategy will be developed and provide:

- Measures to minimise potential impacts associated with the final void;
- Measures for monitoring and management of potential impacts of the void over time; and
- Options for the final post-mine use of the void.

**Void Water Quality**

Groundwater and surface water assessments indicate that the water quality in the final void will be saline. The following aspects will be considered with respect to managing final void water quality:

- Stratification of the water column;
- Concentration of dissolved salts and any AMD resulting from the mining of the coal seams;
- Surface flow into the void;
- Recharge rates to the spoil aquifer and void;
- Movement of flow through the spoil aquifer;
- Groundwater inflows and outflows; and
- Rainfall and evaporation.

Post-closure, a ground and surface water monitoring program will remain in place to closely monitor any changes to water chemistry within the void.

**Low Wall Slope Stability**

Stability of the low wall will be achieved through implementing the following:

- The low wall will be battered back from the angle of repose to ensure that long term geotechnical stability of the face. Determination of geotechnical stability will be based on an assessment of the spoil material, the likely degree of settlement, and the degree of weathering expected in the long term. Where required the sides of the final void will be battered back to 17°;

- Drainage on and over the low wall will be minimised through the construction of drainage control structures;
- Erosion of the low wall will be controlled by limiting the length of slope, minimising the degree of slope, and by the establishment of suitable vegetation;
- Battering of the low wall against the bottom of the high wall will enhance stability; and
- Benching of the spoil material may need to be considered in some areas in order to achieve geotechnical stability and minimise erosion.

**High Wall Slope Stability**

To ensure the safety of the final void, the surrounding final slopes will be left in a condition where the risk of slope failure is minimised. The following will be considered when assessing the geotechnical stability of the highwall:

- Long term groundwater levels;
- Long term final void water levels;
- Height and inclination of slope and number and spacing of intermediate benches;
- Shear strength of the highwall soils and rocks;
- Density and orientation of fractures, faults, bedding planes, and any other discontinuities, and the strength along them; and
- The effects of the external factors, such as surface runoff.

Prior to closure, further investigations will be undertaken to confirm the criteria above and appropriate action will be taken to ensure effective long term safety, stability and management of the void.

**Spontaneous Combustion**

Spontaneous combustion above ground commonly can occur in waste dumps containing coal rejects, in unconsolidated heaps where oxygen can come into contact with the coal and the heat generated cannot dissipate. The problem is compounded when rainfall events cause erosion, progressively exposing the coal. Spontaneous combustion may also potentially occur in coal seam exposed in the remaining highwall of the final void.

The following will be undertaken to reduce the potential for spontaneous combustion to occur:

- Accumulations of coal material, particularly pyritic, will be buried under inert spoil;
- Any remaining coal spalling will be removed from the highwall where possible;
- If any coal on the highwall face is prone to spontaneous combustion, it will be sealed with water, clay or inert soil where possible; and
- Should any outbreaks of spontaneous combustion occur in the final void, details on the materials involved, presence of pyrites, location, date, time and climatic conditions will be recorded. This will be undertaken as part of the ongoing inspection and monitoring to occur post closure of the mine.

**Control of Surface Inflow**

The control of surface inflow into the final void is essential for the long term management of water quality within the pit and will also aid in the control of erosion to low walls and high walls.

Surface water flow can cause slope deterioration and ultimate failure. Drainage will be directed away from the highwall face through the construction of interceptor channel drains around the perimeter of the highwall and spoon drains will be utilised on the upslope side of all benches. Water will then be

directed to the void in a controlled manner. This will allow voids to only collect water direct from rainfall and runoff from rehabilitated areas through the surface water management system.

Drainage over the low wall will be minimised through constructing surface water diversions, and drainage on the wall will be limited and controlled to reduce the erosion potential.

The regraded low wall area will be stabilised with structural soil conservation earthworks (banks, drains, drop structures, etc), and vegetation endemic to the area. Pasture establishment will provide sufficient ground cover to minimise low wall erosion.

Low wall slopes with gradients of 17° or less will be sown conventionally via ground broadcasting. Low wall slopes exceeding 17°, and where structural soil conservation earthworks cannot be used, will be hydromulched to enhance the surface stability of the slopes by hastening vegetative germination and establishment.

**Safety**

At mine closure, voids will be rendered safe in terms of access by humans, livestock and wildlife. The following will be considered at the time of closure to ensure that the void is left in a safe manner:

- To ensure stability, the high walls and low walls will be battered back to a stable slope angle as required;
- Exposed coal seams will be covered with inert material to prevent ignition either from spontaneous combustion, bush fires or human interference;
- A barrier at a safe distance from the perimeter of the void to prevent human access will be constructed. The highwall areas will be secured by the construction of a trench and a 2 m safety berm, as well as a 2.1 m security fence along the entire length of the remaining high wall. This is to provide an engineered barrier between the pit and the surrounding area. The trench and berm is to be constructed in such a way that it will physically stop most vehicles;
- Suitable signs, clearly stating the risk to public safety and prohibiting public access will be erected at 50 m intervals along the safety fence;
- Surface runoff from land surrounding the void will be diverted from entering the void so as to prevent flooding of the pit and potential development of instability of the void walls;
- Shrub and/or tree planting along the outside edge of the bund wall will be implemented where practicable to lessen the visual impact of the wall, and will be in accordance with the agreed post-mining rehabilitation criteria and land use.

#### V.3.7.7.2 *Contaminated Land*

Mitigation measures to avoid the contamination of soil, surface water and groundwater, as well as the treatment for previously identified potentially contaminated land are given below:

- Prior to any development of the Project site taking place, the mining plan of operations shall be compared to the locations of the identified areas of potential contamination. A protocol will be developed to further assess (and manage as required) these areas in accordance with the DERM Draft Guidelines for the Assessment and Management of Contaminated Land in Queensland. These assessments will include site inspections as deemed necessary and possible soil and groundwater testing where required.
- Stockpiles, workshop areas, chemical stores, fuel tanks and waste disposal/storage areas will be located on hardstand or compacted soil. As runoff from these areas may be contaminated, runoff

will be collected using appropriate drainage and water management structures. Potentially contaminated runoff may be remediated or disposed of in an approved manner.

- Relevant Australian Standards (e.g. for the storage and handling of flammable and combustible liquids and dangerous goods) will be complied with, and all chemical and fuel storage areas will be bunded.
- Where possible, hazardous chemicals and materials will be replaced with less harmful alternatives. Material Safety Data Sheets (MSDSs) for chemicals used or brought to site will be kept in a central register on site and at the area of use and be readily available to workers at all times.
- Putrescible waste will be disposed on site into an approved engineered landfill. Site personnel will be trained in the operation and procedures for this installation to reduce the potential for unauthorised waste disposal at this site.
- Spills will be cleaned up as soon as possible. In particular, designated site vehicles and appropriate facilities will be equipped with appropriate spill kits. For significant chemical or fuel spills, the site emergency response plan will be followed and the appropriate authorities notified as soon as possible.
- Detailed records will be kept of any activities or incidents that have the potential to result in land contamination. Records will be kept in an inventory that contains information on storage locations, personnel training and disposal procedures for appropriate chemicals, fuel and other potential contaminants used on site. Records will be maintained by the proponent and reviewed regularly. Regular inspections of containers, bund integrity, valves and storage and handling areas will be carried out.
- All staff will be trained as part of their site induction in appropriate handling, storage and containment practices for chemicals, fuel and other potential contaminants as relevant.

### V.3.7.8 Monitoring

#### V.3.7.8.1 *Rehabilitation*

Rehabilitation will be monitored regularly in accordance with the preliminary monitoring program identified below. Monitoring results will be compared against the nominated success criteria to track the progress of rehabilitation towards the objective of a self-sustaining ecosystem. Rehabilitation techniques will be continually developed and refined over the life of mine through an ongoing process of monitoring at the site and recognition of other industry experiences. A corrective action program will be implemented to address areas of failed rehabilitation and periodic and final rehabilitation reports will be submitted to the DERM as detailed in the Rehabilitation Management Plan.

**Success Criteria**

Preliminary success criteria (or closure criteria) for the rehabilitation of the main mine areas have been proposed in Table V-62 below. The success criteria are performance objectives or standards against which rehabilitation success in achieving a sustainable system for the proposed post-mine land use is demonstrated. Satisfaction and maintenance of the success criteria (as indicated by monitoring results) will demonstrate that the rehabilitated landscape is ready to be relinquished from the mine's financial assurance and handed back to stakeholders in a productive and sustainable condition.

The success criteria have been developed to comprise indicators for vegetation, fauna, soil, stability, land use and safety on a landform-type basis that reflects the nominated post-mine land use of bushland and grassland. For each element, standards that define rehabilitation success at mine closure are provided. Based on the generic indicators in Table V-62, each criterion will be further developed to be specific, measurable, achievable, realistic and outcome based, and to reflect the principle of sustainable development. The further development of each criterion will be based on results of research, monitoring of progressive rehabilitation areas and risk assessments. The success criteria will be reviewed every three to five years with stakeholder participation to ensure the criteria remain realistic and achievable.

### V.3.7.9 Commitments

- At closure the mine will achieve the agreed rehabilitation success criteria.
- Progressive rehabilitation of the disturbed areas will be undertaken on an availability basis.
- An ongoing rehabilitation monitoring program will be undertaken against the agreed criteria.
- Prior to closure information to support final void configuration will be developed.
- The final voids will be designed to render them safe, stable and sustainable.

**Table V-62 Rehabilitation Success Criteria**

| Rehabilitation Element | Indicator | Criteria |
|---|---|---|
| **1. In–Pit and Out-of-Pit Spoil Dumps and Dragline Spoil Areas** | | |
| Landform stability | Slope gradient | No less than 75% of the area has slopes <10° and up to 25% of the area has slopes >10°. Where reject layers are present and exposed, the landform is capped. |
| Landform stability | Erosion control | Erosion control structures are installed commensurate with the slope of the landform.<br><br>Average annual soil loss is <40 tonnes/ha/yr (sheet erosion).<br><br>Dimensions and frequency of occurrence of erosion rills and gullies are no greater than that in reference sites* that exhibit similar landform characteristics. |
| Landform stability | Surface Water Drainage | Use of contour banks and diversion drains to direct water into stable areas or sediment control basins. |
| Water quality | | Ensure receiving waters affected by surface water runoff have contaminant limits of electrical conductivity maximum of 2,000 µS/cm and pH range of 5.5 to 9.5, or as determined to be sustainable subject to future investigations and setting water quality objectives. |
| Water Storages, Creek Diversions | | Clean water storages and diversions to be stabilised and left as required.<br><br>Dirty water storages to be cleaned out and rehabilitated to a stable non-polluting condition. |
| Topsoil | Salinity (electrical conductivity) | Soil salinity content is <0.6 dS/m. |
| Topsoil | pH | Soil pH is between 5.5 and 8.5. |
| Topsoil | Sodium content | Soil Exchange Sodium Percentage (ESP) is <15%. |
| Topsoil | Nutrient cycling | Nutrient accumulation and recycling processes are occurring as evidenced by the presence of a litter layer, mycorrhizae and/or other microsymbionts. Adequate macro and micro-nutrients are present. |
| Vegetation | Land use | Area accomplishes and remains as a healthy working bushland ecosystem. |
| Vegetation | Surface cover | Minimum of 70% vegetative cover is present (or 50% if rocks, logs or other features of cover are present). No bare surfaces >20 $m^2$ in area |

| Rehabilitation Element | Indicator | Criteria |
|---|---|---|
| | | or >10 m in length down slope. |
| Vegetation | Species composition | Comprise a mixture of native trees, shrubs and grasses representative of regionally occurring woodland to open forest where possible. |
| Vegetation | Community structure | Groundcover, understorey and overstorey structure similar to that of appropriate reference site(s)*. |
| Vegetation | Resilience to disturbance | Established species survive and/or regenerate after disturbance. Weeds do not dominate native species after disturbance or after rain. Pests do not occur in substantial numbers or visibly affect the development of native plant species. |
| Vegetation | Sustainability | Species are capable of setting viable seed, flowering or otherwise reproducing. Evidence of second generation of tree/shrub species. Vegetation develops and maintains a litter layer evidenced by a consistent mass and depth of litter over subsequent seasons. More than 75% of shrubs and/or trees are healthy when ranked healthy, sick or dead. |
| Fauna | Vertebrate species | Representation of a range of species characteristics (e.g. activity pattern, habitat usage, diet, dispersal character etc (WMB, 2003; Kimber et. al., 1999)) from each faunal assemblage group (e.g. reptiles, birds, mammals), present in the ecosystem type, based on pre-mine fauna lists and sighted within the three-year period preceding mine lease relinquishment.<br>Sighting of species of conservation significance or indicators of the presence of species of conservation significance (e.g. tracks) likely to be present in the established ecosystem type within the three-year period preceding mine closure (assuming non-mine related disturbance has not eliminated local populations thereby removing the colonising source).<br>The number of vertebrate species does not decrease by more than 25% in the successive seasons prior to mine lease relinquishment or by more than 40% over the two successive seasons prior to mine lease relinquishment. |
| Fauna | Invertebrate species | Presence of representatives of a broad range of functional indicator groups involved in different ecological processes (including termites for soil structure, Collembola for decomposition, Hemiptera for herbivory and predatory groups such as arachnids, centipedes, earwigs, cockroaches and ants as indicators of a range of other processes (Bisevac and Majer, 1998). |
| Fauna | Habitat structure | Typical food, shelter and water sources required by the majority of vertebrate and invertebrate inhabitants of that ecosystem type are present, including: a variety of food plants; evidence of active use of habitat provided during rehabilitation such as nest boxes, stags and logs and signs of natural generation of shelter sources including leaf litter. |
| Safety | | Risk assessment has been undertaken in accordance with relevant guidelines and Australian Standards and risks reduced to levels agreed with the stakeholders. |
| **2. Final Voids (including Ramps)** | | |
| Landform stability | Slope gradient | Highwall faces exhibit long-term geotechnical stability and a geotechnical report has been completed. Competent rock Highwall to have slope of <65°. Incompetent rock highwall to have slope of <17°. Low wall to have slope of <17°. Ramp walls not backfilled exhibit long-term geotechnical stability and a geotechnical report has been completed. In-pit rejects and spoil slope gradients can exceed 15%. |
| Landform stability | Erosion control | Erosion mitigation measures have been applied to ensure slope stability |
| Landform stability | Surface Water Drainage | Use of contour banks and diversion drains to direct water into stable areas or sediment control basins. |
| Water quality | | Electrical conductivity of any void water may exceed 2,000 µS/cm if an ecological assessment shows the long-term ecological stability and groundwater quality is not adversely affected. |
| Water Storages, Creek Diversions | | As for 1. |

| Rehabilitation Element | Indicator | Criteria |
|---|---|---|
| Topsoil | | As for 1. |
| Vegetation | Land use | Where ramps and in-pit spoil design allow, area accomplishes and remains as a healthy working bushland ecosystem (although naturalised grasses may be used). |
| Vegetation | Surface cover | As for 1. |
| Vegetation | Species composition | Comprise a mixture grasses, shrubs and trees (where possible) suitable for establishment on steeper slopes |
| Vegetation | Community structure | Groundcover and understorey structure to that of appropriate reference site(s)*. |
| Vegetation | Resilience to disturbance | As for 1. |
| Vegetation | Sustainability | More than 75% of individual grasses and shrubs are healthy when ranked healthy, sick or dead. |
| Safety | | Risk assessment has been completed and risk mitigation measures have been implemented.<br>Where risk mitigation measures include bunds, safety fences and warning signs, these have been erected generally in accordance with relevant guidelines and Australian Standards. |
| **3. Tailings Storage Facility** | | |
| Landform stability | Erosion control | Tailings are capped to a depth to be defined in field trials, that includes a minimum topsoil depth of 200mm on the cap.<br><br>Erosion mitigation measures have been applied. Average soil loss per annum per domain unit is <40 tonnes/ha/yr (sheet erosion). |
| Landform stability | Surface Water Drainage | Drainage control measures are installed.<br><br>No water is observed leaching from the facility. |
| Water quality | | As for 1. Area accomplishes and remains as sustainable grazing. |
| Topsoil | | As for 1. |
| Vegetation | Land use | Area accomplishes and remains as sustainable grazing. |
| Vegetation | Surface cover | Minimum of 70% vegetative cover is present (or 50% if rocks, logs or other features of cover are present). No bare surfaces >20 $m^2$ in area or >10 m in length down slope. |
| Vegetation | Species composition | Grasses representative of regionally occurring vegetation communities where possible OR palatable, nutritious pasture grass and legume species are present. |
| Vegetation | Resilience to disturbance | Established species survive and/or regenerate after disturbance. Weeds do not dominate native species after disturbance or after rain. Pests do not occur in substantial numbers or visibly affect the development of native plant species. |
| Vegetation | Sustainability | Species are capable of setting viable seed, flowering or otherwise reproducing. |
| Fauna | Vertebrate species | Representation of a range of species characteristics from each faunal assemblage group (e.g. reptiles, birds, mammals), present in the ecosystem type, based on pre-mine fauna lists and sighted within the three-year period preceding mine lease relinquishment. The number of vertebrate species does not show a decrease over a number of successive seasons prior to mine lease relinquishment. |
| Fauna | Invertebrate species | Presence of representatives of a broad range of functional indicator groups involved in different ecological processes. |
| Safety | | As for 1. |
| **4. Mine Plant/Industrial Areas** | | |
| Landform stability | Slope gradient | Area has gradient of <2°. |
| Landform stability | Erosion control | Erosion mitigation measures have been applied. |
| Landform stability | Surface Water Drainage | Use of contour banks and diversion drains to direct water into stable areas or sediment control basins. |

| Rehabilitation Element | Indicator | Criteria |
|---|---|---|
| Water quality | | As for 1. |
| Water Storages, Creek Diversions | | As for 1. |
| Topsoil | | As for 1. |
| Vegetation | Land use | Buildings, water storage, roads (except those used by the public) and other infrastructure have been removed unless stakeholders have entered into formal written agreements for their retention. Areas are readily accessible and conducive to safe cattle management activities. Predicted economics and /or benefits have been defined and agreed by the stakeholders. |
| Vegetation | Surface cover | As for 1. |
| Vegetation | Species composition | Palatable, nutritious pasture grass species are present. |
| Vegetation | Community structure | Desirable grass species comprise at least 60% of total grass cover. Tree density and height of >25 stems per 5 ha each being >2 m in height. |
| Vegetation | Resilience to disturbance | As for 1. |
| Vegetation | Sustainability | Nitrogen fixing grass species present. More than 75% of shrubs and/or trees are healthy when ranked healthy, sick or dead. |
| Fauna | Vertebrate species | Representation of a range of species characteristics (e.g. activity pattern, habitat usage, diet, dispersal character etc (WBM, 2003; Kimber et. al., 1999)) from each faunal assemblage group (e.g. reptiles, birds, mammals), present in the grassland ecosystem type, based on pre-mine fauna lists and sighted within the three-year period preceding mine lease relinquishment.<br>The number of vertebrate species does not decrease by more than 25% in the successive seasons prior to mine closure or by more than 40% over the two successive seasons prior to mine lease relinquishment. |
| Fauna | Invertebrate species | Presence of representatives of a broad range of functional indicator groups involved in different pastoral ecological processes (including termites for soil structure, Collembola for decomposition, Hemiptera for herbivory and predatory groups such as arachnids, centipedes, earwigs, cockroaches and ants as indicators of a range of other processes (Bisevac and Majer, 1998). |
| Fauna | Habitat structure | Typical food, shelter and water sources required by the majority of vertebrate and invertebrate inhabitants of pastoral ecosystem type are present, including: a variety of food plants and signs of natural generation of shelter sources including leaf litter. |
| Safety | | Risk assessment has been undertaken in accordance with relevant guidelines and Australian Standards and risks reduced to levels agreed with the stakeholders.<br>Closure documentation includes the contaminated sites register which identifies contaminated sites and the treatment applied. |

Note: * Reference sites discussed below.

## Monitoring Program

Regular monitoring of the rehabilitation will be required during the vegetation establishment period, to demonstrate whether the objectives of the rehabilitation strategy are being achieved and whether a sustainable landform has been provided.

In addition to rehabilitated areas, reference sites will be identified and monitored to allow a comparison of the development and success of the rehabilitation against a control. Reference sites indicate the condition of surrounding un-mined areas or areas successfully rehabilitated that the mine sites must replicate.

Monitoring will be conducted periodically by independent, suitably skilled and qualified persons at locations which will be representative of the range of conditions on the rehabilitating areas. Annual reviews will be conducted of monitoring data to assess trends and monitoring program effectiveness. Monitoring of the rehabilitated areas will broadly involve the following:

- Ongoing chemical analysis of topsoil;
- Comparison of soil erosion rates and rill and gully dimensions with measurements taken from reference sites;
- Comparison of vegetation measurements with measurements taken from reference sites;
- Ongoing analysis of water quality parameters in accordance with the development consent and environmental protection licence conditions from data collected monthly at water storages, ramps and pits, sediment basins and sewage effluent outfalls on-site, and from creeks (upstream and downstream of mine); and
- Visual surveillance including the use of digital photogrammetry / low level oblique or vertical aerial photography to monitor changes over time in the rehabilitation (e.g. changes in vegetation structure, erosion rates and landform drainage).

More specifically, monitoring of the elements in Table V-63 will be undertaken to determine the level of achievement of success criteria.

### Table V-63 Rehabilitation Monitoring Program

| Aspect of Rehabilitation | Elements to be Monitored |
|---|---|
| **Ecosystem Establishment** | |
| Ground cover | Percentage of ground covered by vegetation, rocks, logs and other obstructions.<br><br>Obstruction lengths and widths (indicates the amount of ground cover that is present to collect, hold and disseminate available resources necessary for ecosystem function) for use in Landscape Function Analysis (LFA).<br><br>Fetch lengths (measure of distances of soil surface that is bare of matter that could slow water velocity) for use in LFA. |
| Community structure and composition | Species composition.<br><br>Number and form of ground cover and under storey species per plot.<br><br>Density, height, canopy cover and DBH of tree and large shrub species.<br><br>Numbers, heights and species identity (where able to be determined) of any seedlings.<br><br>Evidence of reproduction/regeneration (e.g. flower heads, fruits/seeds, germination of seedlings etc).<br><br>Assessment of individual plant health (healthy, sick or dead). |
| Habitat | Availability and variety of food sources (e.g. flowering/fruiting trees, presence of invertebrates etc).<br><br>Availability and variety of shelter (e.g. depth of leaf litter, presence of logs, hollows etc).<br><br>Presence/absence of free water. |
| Fauna | Presence and approximate abundance and distribution of functional indicator invertebrate species. |

| | |
|---|---|
| | General observations of vertebrate species (including species of conservation significance).<br><br>Detailed fauna surveys including presence and approximate abundance and distribution of vertebrate species (focussing on species of conservation significance). |
| Weeds and pests | Species identity.<br><br>Approximate numbers/level of infestation.<br><br>Observations of impact on rehabilitation (if any). |
| Erosion Monitoring and Soil Characteristics | |
| Soil | Stability, infiltration and nutrient cycling undertaken according to LFA procedure.<br><br>Electrical Conductivity, as a measure of salinity.<br><br>pH.<br><br>Soil exchangeable Na potential. |
| Erosion | Location and extent of sheet wash.<br><br>Location and extent of rill and gully erosion including measurements of depth, width and length.<br><br>Extent of bare areas with potential to erode.<br><br>Sediment movement and runoff. |
| Geotechnical Stability | |
| | Stability of batter and surface settlements, in particular where these features could impact on the performance of any surface water management system.<br><br>Surface integrity of landform cover/capping (measurement of extent of integrity failure).<br><br>Landform slumping (distance of material movement and extent). |
| Surface and Ground Water | |
| | Groundwater quality and depth.<br><br>Efficiency of landform surface water drainage systems.<br><br>Presence and quality of any surface water and seepage at selected locations at the lower part of any potentially acid producing landforms such as spoil dumps containing coarse rejects.<br><br>Water quality including pH, EC and total suspended solids of water in water storages, ramps and pits, sediment basins and sewage effluent outfalls onsite.<br><br>Water quality including pH, salinity and turbidity of water entering creek/river systems on site. |
| Creeks and Diversions | |
| | Vegetation density, diversity and vigour<br><br>Structural stability of channel<br><br>Water quality including pH, salinity and turbidity of water entering creek/river systems on site. |

### Maintenance

Maintenance of rehabilitated areas will be undertaken where necessary and in response to results of the monitoring program, to ensure success criteria are met, or in the case of progressive rehabilitation, are projected to be met at the time of mine closure. Depending on the criteria to be achieved, examples of maintenance works could include re-seeding or planting of tube stock of tree and/or shrub

species to meet required revegetation parameters and implementation of erosion protection measures to reduce erosion rates

Post-mining surveys of the rehabilitation will be undertaken across the site to determine whether the site meets success criteria and whether this result is being maintained over time. Once this occurs and the site is relinquished, the land will be returned to the relevant stakeholders and maintenance of the rehabilitation will no longer be required.

### V.3.7.10 Proposed Environmental Authority Conditions

**Schedule F – Land**

**Department Interest: Land**

**(F1) Preventing contaminant release to land**

Contaminants must not be released to land in a manner which constitutes nuisance, material or serious environmental harm.

**(F2) Topsoil**

Topsoil must be strategically stripped ahead of mining in accordance with a topsoil management plan.

(**F3**) A topsoil inventory which identifies the topsoil requirements for the mining project and availability of suitable topsoil on site must be detailed in the Plan of Operations.

**(F4) Rehabilitation landform criteria**

Progressive rehabilitation must commence within two (2) years of when areas become available within the operational land.

**(F5) Residual void studies**

a) The holder of the environmental authority must prepare a residual void model for approval by the administering authority during the fifth year after commencement of operation.

b) The model in a) must be subject to review each subsequent five years while the mine continues to operate.

c) Any amendment to the approved residual void model that may arise from the reviews in b) must be based on any significant changes to groundwater characteristics or other data considered relevant by the administering authority that becomes available from the groundwater monitoring program.

d) Notwithstanding obligations under a), b) and c), the holder of the environmental authority must undertake residual void water balance modelling during mine closure planning, in consultation with the administering authority, to ensure assumptions regarding surface water runoff and groundwater ingress are suitable for the site.

**(F6) Residual void outcome**

Complete an investigation into residual voids and submit a report to the administering authority proposing acceptance criteria to meet the outcomes in conditions F4 and landform design criteria for Departmental review and comment. On acceptance of the criteria proposed in the residual void management plan, the criteria must be specified in the Environmental Authority.

The investigation must at a minimum include the following:

a) a study of options available for minimising final void area and volume;
b) develop design criteria for rehabilitation of final voids;
c) a void hydrology study, addressing the long-term water balance in the voids, connections to groundwater resources and water quality parameters in the long term;
d) a study of the measures to protect the residual voids, uncompacted overburden and workings from the 'probable maximum flood' level based on the Bureau of Meteorology's 'probable maximum precipitation' forecast for the locality;
e) a pit wall stability study, considering the effects of long-term erosion and weathering of the pit wall and the effects of significant hydrological events;
f) a study of void capability to support native flora and fauna; and
g) a proposal/s for end of mine void rehabilitation success criteria and final void areas and volumes.

These studies will be undertaken during the life of the mine, and will include detailed research and modelling.

**(F7) Rehabilitation monitoring program**

Once rehabilitation has commenced, the environmental authority holder must conduct a Rehabilitation Monitoring Program on a two (2) yearly basis, which must include sufficient spatial and temporal replication to enable statistically valid conclusions as established under the rehabilitation program.

(**F8)** The Rehabilitation Monitoring Program must be developed and implemented by a person possessing appropriate qualifications and experience in the field of rehabilitation management, nominated by the environmental authority holder.

**(F9)** The Rehabilitation Monitoring Program must be included in the Plan of Operations and updated with each subsequent Plan of Operations, describing:

a) how the rehabilitation objectives will be achieved; and
b) verification of rehabilitation success.

**(F10) Post closure management plan**

A Post Closure Management Plan for the site must be prepared at least **eighteen (18) months** prior to the final coal processing on site and implemented for a nominal period of:

a) at least twenty (20) years following final coal processing on site, or

b) a shorter period if the site is proven to be geotechnically and geochemically stable and it can be demonstrated to the satisfaction of the administering authority that no release of contaminants from the site will result in environmental harm.

**(F11)** The Post Closure Management Plan should include the following elements:

a) operation and maintenance of:
   i. wastewater collection and reticulation systems;
   ii. wastewater treatment systems;
   iii. the groundwater monitoring network;
   iv. final cover systems; and
   v. vegetative cover.

b) monitoring of:
   i. surface water quality;
   ii. groundwater quality;
   iii. seepage rates;
   iv. erosion rates;
   v. the integrity and effectiveness of final cover systems; and
   vi. the health and resilience of native vegetation cover.

**(F12) Mining waste management**

A Mining Waste Management Plan together with the certification by an appropriately qualified person must be developed and implemented during the continuation of the environmental authority. The Mining Waste Management Plan must at a minimum include:

l) characterisation programs to ensure that all mining waste is progressively characterised during disposal for the following parameters: pH, Electrical Conductivity (EC), Acid Neutralising Capacity (ANC), appropriate Net Acid Generation (NAG) testing (reporting NAG capacity and NAG pH after oxidation), Net Acid Producing Potential (NAPP), Total Sulfur (S), Chromium Reducible Sulfur (Scr), Boron (B) Cadmium (Cd), Iron (Fe), Aluminium (Al), Copper (Cu), Magnesium (Mg), Manganese (Mn), Calcium (Ca), Sodium (Na), Zinc (Zn) and Sulfate ($SO_4$);

m) characterisation programs to ensure that the physical properties of the mining waste is progressively characterised during disposal;

n) the availability or leachability of metals from the mining waste;

o) quantity of potentially acid forming (PAF) mining waste;

p) review potential impacts of PAF mining waste on the success of proposed rehabilitation methods;

q) management actions for mining waste that has been identified as having a high availability or leachability of metals;
r) management actions for mining waste that has been defined as PAF;
s) identification of environmental impacts and potential environmental impacts;
t) control measures for routine operations to minimise likelihood of environmental harm;
u) contingency plans and emergency procedures for non-routine situations; and
v) periodic review of environmental performance and continual improvement.

**(F13) AMD and leachate management**

Subject to the release limits defined in Department Interest: Water, all reasonable and practicable measures must be implemented to prevent hazardous leachate being directly or indirectly released or likely to be released as a result of the activity to the environment.

**(F14) Storage and handling of flammable and combustible liquids**

All flammable and combustible liquids must be contained within an on-site containment system and controlled in a manner that prevents environmental harm and maintained in accordance with the current version *of AS 1940 – Storage and Handling of Flammable and Combustible Liquids*.

**(F15)** Spillage of all flammable and combustible liquids must be controlled in a manner that prevents environmental harm.

**(F16) Storage and handling of chemicals**

All chemicals must be contained within an on-site containment system and controlled in a manner that prevents environmental harm and maintained in accordance with the current version of the relevant Australian Standard.

**(F17)** Spillage of all chemicals must be controlled in a manner that minimises environmental harm.

**(F18) Exploration**

Disturbance due to exploration activities in areas not scheduled to be mined must be rehabilitated in accordance with provisions detailed in the administering authority's *Code of Environmental Compliance for Exploration and Mineral Development Projects.*

## V.3.8 Terrestrial Ecology

### V.3.8.1 Background and Environmental Values

#### Floral Environmental Values

A total of 418 flora species and 12 mappable vegetation communities were identified on and adjacent to the Project site. No threatened flora species were identified on the Project site. Species listed under

the *Land Protection (Pest and Stock Route) Management Act 2002* include the Common Pest Pear (*Opuntia stricta*), Velvety Tree Pear (*Opuntia tomentosa*) and Parkinsonia (*Parkinsonia aculeata*). All of the vegetation communities that have been identified on the Project site are widespread and common.

Vegetation community specific values include:

- The fringing riparian woodland offers refuge for fauna by providing water, shade and mature, hollow bearing tree species;
- Vegetative communities that exhibit a high diversity of floral structure (in particular the Fringing Riparian Woodland, Silver-leaved Ironbark Woodland, Weeping Bottlebrush Heath and Queensland Yellowjacket Low Open Woodland) add value to the regional integrity of each community;
- Landscapes such as floodplains (in particular the Poplar Box Open Woodland, RE 10.3.27), skeletal hills (represented by the Lancewood Woodland, RE 10.7.3) and tertiary sand plains (best represented by the Queensland Yellowjacket Low Open Woodland, RE 10.5.1) are intact and devoid of degradation by grazing; and
- The relatively intact patches of Poplar Box Open Woodland, Gidgee Open Woodland, Fringing Riparian Woodland and Thozet's Box Open Woodland are listed as 'Of Concern' under DERM's Biodiversity Status and have the potential to contribute to the overall preservation of threatened ecosystems.

### Faunal Environmental Values

A total of 167 vertebrate fauna species were identified on the Project site during the surveys. This total figure is comprised of 94 birds, 3 mammals (six introduced), 27 reptiles and 10 amphibians (one introduced). Species of conservational significance include the Squatter Pigeon (southern subspecies) (*Geophaps scripta scripta*), which is listed under the *EPBC Act 1999* and *NCWR 1994* as Vulnerable, and Little Pied Bat (*Chalinolobus picatus*), which is listed as Near Threatened under the *NCWR 1994*, and number of avian species listed under the *EPBC Act 1999* as migratory and /or marine.

Faunal values associated with the Project site include:

- Suitable habitat is located on the Project site for threatened species. Fallen timber within the Brigalow open woodland and Gidgee open woodland have the potential to provide a distinct microhabitat for certain fauna, including the listed Yakka Skink (*Egernia rugosa*) and Brigalow Scaly Foot (*Paradelma orientalis*). A permanent water source with open woodland and surrounding grassland has the potential to provide habitat for the Star Finch (*Neochmia ruficauda ruficauda*) and Black-throated Finch (*Poephila cincta cincta*);
- Small and medium sized mammals are well represented on the Project site. The abundance of these species are low, which is normal due to the decline in this weight range, following the introduction of pest fauna such as the Feral Cat (*Felis catus*), Dingo (*Canis lupus dingo*) and Red Fox (*Vulpes vulpes*); and
- The avian species recorded on the Project site are mostly typical woodland birds, and represent a healthy population and diversity of species within the region.

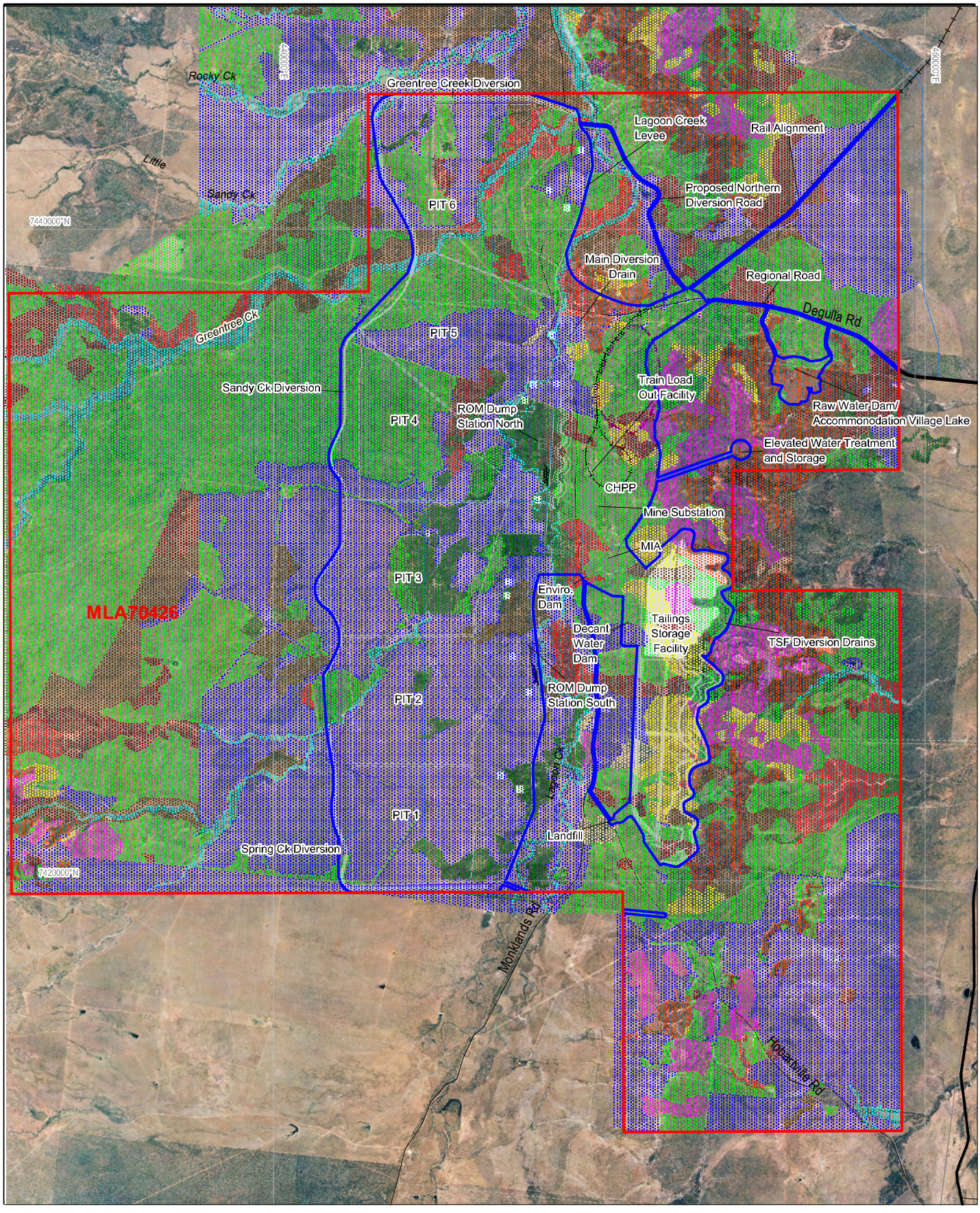
### V.3.8.2 Potential Impacts on Environmental Values

#### Impacts on Flora

The areas subject to the greatest disturbance on the Project site are a section of Lagoon Creek, where mine infrastructure is proposed, the area associated with the tailings storage facility, the alignment of Lagoon Creek diversion and the land proposed for the open cut pit.

Vegetation communities directly affected by the Project are the Brigalow Open Woodland (RE 10.3.3), Silver-leaved Ironbark Open Woodland (RE 10.3.28 and RE 10.5.5a), Poplar Box Open Woodland (RE 10.3.27a and RE 10.5.12), Silver-leaved Ironbark and Poplar Box Mixed Woodland (RE 10.5.5 / 10.5.12), White Cypress Pine Woodland (11.5.5b), Gidgee Open Woodland (RE 10.3.4), Fringing Riparian Woodland (RE 10.3.14), Weeping Bottlebrush Heath (RE 10.7.7), Lancewood Woodland (RE 10.7.3), Queensland Yellowjacket Low Open Woodland (RE 10.5.1) and Non-remnant Grassland. Refer to Figure V-24 for the Project infrastructure and vegetation communities.

The total surface area of disturbance is approximately 22,500 ha, with a 50 m buffer surrounding mine infrastructure and 30 m buffer for roads on either side of the centre line. Disturbance within each vegetation community is outlined in Table V-64.




Mining Lease Application (MLA70426) Boundary
Fringing Riparian Woodland (10.3.14)
Non-remnant Grassland
Silver-leaved Ironbark Open Woodland (RE 10.3.28 / 10.5.5a)
Thozet's Box Woodland (10.7.5)
Poplar Box Open Woodland (RE 10.3.27a)
Poplar Box Open Woodland (RE 10.5.12)
Brigalow Open Woodland (RE 10.3.3)
Silver-leaved Ironbark / Poplar Box Mixed Woodland (RE 10.5.5a / 10.5.12)
Lancewood Woodland (RE 10.7.3)
Weeping Bottlebrush Heath (RE 10.7.7)
Gidgee Open Woodland (RE 10.3.4)
White Cypress Pine Woodland (RE 11.5.5b)
Queensland Yellowjacket Low Open Woodland (RE 10.5.1)

Source: See Copyright Details below and for full disclosure Please Refer to the SEIS ***Volume 2, Appendix B***

0 2 4Km
Scale 1:160 000 (A4)
Datum: GDA94, MGA Zone55

N W E S

**HANCOCK PROSPECTING PTY LTD**
Alpha Coal Project
Supplementary Environmental Impact Statement

# ALPHA COAL PROJECT (MINE) PROJECT INFRASTRUCTURE AND VEGETATION COMMUNITIES

Job Number 4262 6680
Revision C
Date 07-06-2011

Figure: V-24

File No: 42626680-g-2062c.wor

**Table V-64 Vegetation Disturbance Figures**

| Vegetation Community | RE or Ecological Community | Disturbance with in Vegetation Community (ha) | VMA (1999) Status | DERM Biodiversity Status |
|---|---|---|---|---|
| Brigalow Open Woodland | 10.3.3 | 1,576.8 | Least Concern | No Concern at Present |
| Silver-leaved Ironbark Open Woodland | 10.3.28 | 7,534.5 | Least Concern | No Concern at Present |
| Silver-leaved Ironbark Open Woodland | 10.5.5a | 7,534.5 | Least Concern | No Concern at Present |
| Poplar Box Open Woodland | 10.3.27a | 575.7 | Least Concern | Of Concern |
| Poplar Box Open Woodland | 10.5.12 | 570.9 | Least Concern | No Concern at Present |
| Non-remnant Grassland | Not Classed | 9,017.2 | Not Listed | Not Listed |
| Silver-leaved Ironbark / Poplar Box Mixed Woodland | 10.5.5a | 969.3 | Least Concern | No Concern at Present |
| Silver-leaved Ironbark / Poplar Box Mixed Woodland | 10.5.12 | 969.3 | Least Concern | No Concern at Present |
| White Cypress Pine Woodland | 11.5.5b | 112.0 | Least Concern | No Concern at Present |
| Gidgee Open Woodland | 10.3.4 | 160.4 | Least Concern | Of Concern |
| Fringing Riparian Woodland | 10.3.14 | 417.8 | Least Concern | Of Concern |
| Fringing Riparian Woodland | 11.3.2 (south eastern watercourse only) | 0.0 | Of Concern | Of Concern |
| Fringing Riparian Woodland | 11.5.3 (south eastern watercourse only) | 0.0 | Least Concern | No Concern at Present |
| Weeping Bottlebrush Heath | 10.7.7 | 1,011.0 | Least Concern | No Concern at Present |
| Thozet's Box Open Woodland | 10.7.5 | 0.0 | Least Concern | Of Concern |
| Lancewood Woodland | 10.7.3 | 380.4 | Least Concern | No Concern at Present |
| Queensland Yellowjacket Low Woodland | 10.5.1 | 174.0 | Least Concern | No Concern at Present |

Edge effects resulting from the proposed works can include the establishment of weeds, alteration to microclimatic conditions (such as greater light intensity, more wind penetration, lower humidity) and a reduction in plant health through loss of photosynthetic potential (as a result of plants being covered by dust generated from vehicle movement on unsealed tracks). In the absence of appropriate control measures, the Project has the potential to cause impacts in relation to edge effects, particularly with reference to the introduction and / or spread of weed species throughout the Project site.

Earthmoving activity, particularly along watercourses, can promote weed invasion and may increase sedimentation in riparian woodlands downstream of the mine. Higher levels of erosion can lead to a loss of morphological diversity in streams, which in turn reduces habitat quality and may result in biodiversity losses in affected areas. Any importation of seeds as well as the use of earthmoving equipment in conjunction with land disturbance will provide an opportunity for the introduction of

invasive weed species, until native species become established. If invasive weeds were to establish at the Project site, these may compete against the establishment of native vegetation.

#### Impacts on Fauna

The construction of the open pit and mine infrastructure near Lagoon Creek will result in a loss of some Fringing Riparian Woodland along this watercourse. Such development will remove some surface pools on the Project site, which persist longer than the smaller water courses and provide nesting habitat for a number of migratory bird species. The disturbance along Lagoon Creek also has the potential to disrupt habitat connectivity, affecting the ability of some small species to move along the riparian corridor.

Barrier effects on fauna occur when a species is unable or unwilling to move between suitable habitats. This is caused by increased habitat fragmentation due to roadways and other mine infrastructure. Species most vulnerable to barrier effects are habitat specific fauna and low mobility species (where even a small reduction in movements can reduce genetic continuity within a population, hence reducing the effective population size). Species least vulnerable to barrier effects tend to be those that are highly mobile, including birds and larger mammals, although even these species can vary in their response to barriers. Low mobility species utilising the Project site have the potential to become genetically isolated. This occurs when individuals from a population within one fragment are unable to interbreed with individuals from populations in adjoining fragments.

Noise, vibration and dust associated with the construction and operational phases of the Project may cause some species to avoid habitats which they currently utilise. Noise effects can be highly species dependent and may vary widely. These impacts will be concentrated around the open pit, tailings storage facility, overburden emplacements and mine infrastructure area, leaving most of the Project site and some important habitat areas unaffected. These impacts are therefore not considered significant.

Artificial lighting can affect both nocturnal and diurnal animals, because it disrupts light-induced activity patterns. The effect of artificial lighting varies with different species. The attraction of predator species to insects around lights was observed at both the accommodation village and the mining operation during the field surveys. The illumination of bat-roosting habitats can influence bat emergence development in young bats, whilst higher light intensity can affect frog behaviour.

Access to the final void will be restricted to fauna via a bund that will be established around the final void post closure. It is unlikely that avian species will readily access the pit lake, as this water body will develop physical and chemical properties that are not suitable for avian wading and drinking.

### V.3.8.3 Environmental Protection Objective

The key environmental protection objective is to minimise significant Project impacts upon any significant species or communities of flora or fauna on the Project site.

### V.3.8.4 Performance Criteria

The performance criteria for terrestrial ecology are:

- Compliance with the requirements of the Project's environmental authority.
- Protection of conservation significant species, communities and habitat.
- No unplanned or unapproved disturbance/clearing of flora and fauna.

### V.3.8.5 Control Strategies

#### V.3.8.5.1 *Control Strategies for Flora*

Suggested strategies to minimise the impacts on native flora and recommendations regarding rehabilitation of the Project site, are outlined below.

- As much as possible, only areas absolutely necessary for the construction and the operation of the Project will be cleared;
- Environmentally sensitive areas (ESAs) will be clearly identified and managed in order to avoid, minimise or mitigate potential impacts. ESAs include all patches of remnant vegetation which may provide likely habitat for rare or threatened species, areas rehabilitated as an offset requirement and any non-remnant vegetation incorporated in offsets and buffers to these areas;
- Where there is residual loss or degradation of vegetation, habitat or land use upon completion of mine decommissioning, compensation in the form of further habitat rehabilitation, compensatory habitat, land rehabilitation, contribution to research or offsets will be employed;
- Rehabilitation / re-vegetation works of the Project will use the most appropriate endemic species for the landscape elements of the site. Species to be chosen through habitat matching based on communities present onsite, to ensure rehabilitation success. Seeding to utilise a broad mixture of species to promote a high diversity and recovery rate;
- The maintenance of retained native-vegetation areas could provide a source of seed for mine rehabilitation works;
- Recreated landforms will be contoured to resemble original regional topographic where possible;
- Standard dust suppression techniques to be used to minimise flora damage; and
- Reference flora monitoring sites will be established and maintained, prior to any disturbance.

A number of weed management strategies to be included in a Weed Management Plan, developed by the Proponent in order to minimise the potential of future weed infestations include:

- Monitoring in the form of annual observations by site personnel for weeds of management concern, to be undertaken;
- If weeds of management concern are identified, they will be eradicated from the site in accordance with local best management practice from the Barcaldine Regional Council (formerly Jericho Shire) Pest Management Plan (Maunsell, 2008) and / or the DEEDI Pest Fact sheets (DEEDI 2007);
- Observations to be undertaken at weed treated areas to determine the success of the declared weed eradication program; and
- Promotion of awareness of weed management, by inclusion of weed issues, pictures and procedures into the Project's Site Induction Program.

#### V.3.8.5.2 *Control Strategies for Fauna*

Suggested control strategies that are required in order to minimise and mitigate for impacts on native and non-native fauna are outlined below:

- Every effort will be made to clearly delineated and maintain the borders of the proposed disturbance area, particularly along riverine areas such as Lagoon Creek and Sandy Creek.
- Clearing of vegetation in the Lagoon Creek will be minimised to maintain habitat connectivity and provide a movement corridor for small, terrestrial fauna species.

- Native vegetation removal will be conducted only after the areas to be cleared have been clearly delineated and identified to equipment operators and supervisors.
- Care will be taken to minimise harm to affected fauna communities by employing environmental staff to inspect the vegetation to be disturbed, prior to clearing, in order to determine whether or not any fauna are present. If fauna are present, they should be given the opportunity to move on, before vegetation clearing occurs. Clearance from environmental staff will be obtained prior to disturbance in any area.
- Measures will be taken to minimise harm to affected fauna communities by inspecting the vegetation to be disturbed prior to clearing to ascertain whether any fauna are present. If fauna is present, it will be given the opportunity to move on naturally before clearing occurs.
- Hollow logs and hollow bearing trees will be cleared of wildlife by a licensed wildlife spotter, and wherever possible these should be stockpiled for use in rehabilitation activities or otherwise carefully placed in adjoining bushland;
- Trees with large raptor nests will not be cleared, where possible, after consideration of safety, operational and maintenance issues.
- In order to maintain the integrity of vegetated land that is not cleared, appropriate erosion and sediment controls are recommended, in order to prevent sediment erosion or deposition in remaining habitat.
- Recreated landforms will be contoured to resemble the original local topography and re-contoured either flat to undulating plains or undulating hills.
- Floral species that are used for rehabilitation will be carefully selected, so that rehabilitated areas resemble pre-mining vegetation communities.
- Personnel will made aware though the Project induction program and care will be taken to ensure the Squatter Pigeon (*Geophaps scripta scripta*) (Vulnerable under both the EPBC Act 1999 and Schedule 3 of the NCWR 1994) is not impacted by vehicle or plant mortality, and that Squatter Pigeon nests, eggs or young, if located, be translocated by qualified personnel to a suitable nearby habitat.
- The design, location and construction of such infrastructure will meet the following performance criteria:

    a. No vegetation communities listed as endangered at either the Commonwealth or State level will be affected, where suitable alternatives exist;
    b. Impacts on State-listed vegetation 'of concern' will be minimised;
    c. Fragmentation of remnants of vegetation/habitat will be avoided;
    d. Disturbance will be located at the edge of existing remnants; and
    e. Where possible, access tracks and other infrastructure will be located in areas that have already been disturbed.

- The Little Pied Bat (*Chalinolobus picatus*) (Near Threatened under Schedule 5 of the NCWR 1994) control strategies include:

    – Fauna spotters with experience with relocating bats will conduct a thorough survey of the site prior to any vegetation clearing;

    – Vegetation clearing will be staggered and follow a protocol specific to bats;

    – Remaining roost sites will be supplemented by artificial roost sites such as bat boxes;

  - Undertake a monitoring program to assess the presence of the Little Pied Bat in areas adjacent to the proposed blasting areas; and
  - Blasting regimes and methods will consider the location of Little Pied Bat (*Chalinolobus picatus*) roost sites and aim to direct the blast / vibration front away from the roost location.
- A site-specific feral-animal control plan will be created and implemented for the Project site to target the seven non-native fauna species identified on the Project site: Feral Goat, Feral Cat, Dingo / Wild Dog, Feral Pig, European Rabbit, House Mouse, and Cane Toad.

### V.3.8.6 Monitoring

#### V.3.8.6.1 *Vegetation Monitoring*

Vegetation monitoring to include the following:

- Vegetation reference sites and rehabilitation sites, consisting of 50 m transect lines, will be established and monitored on an annual basis. Vegetation reference sites are used to create a comparable benchmark for rehabilitated sites to determine rehabilitative success. Vegetation reference sites were chosen based on being representative of the respective land disturbances such as topography, soil characteristics, vegetation type and structure. Rehabilitation sites will be chosen as appropriate and when possible. Data recorded will include:
  - Tree Density (Trees/ha);
  - Crown Cover Percentage (%);
  - Shrub Density (shrubs/ha);
  - Herb / Grass Density (grasses/ha);
  - Groundcover (%);
  - Species Composition;
  - Erosion indicators (depth of rills or erosion lines, surface crusting, slopes); and
  - Photographic records of the site.
- All vegetation data that is collected will be undertaken according to the Queensland Herbarium's Methodology for Survey and Mapping of Regional Ecosystems and Vegetation Communities in Queensland Version 3.1 (2010).

#### V.3.8.6.2 *Weed Monitoring*

Weed monitoring to include the following:

- A weed audit of up to 20% of the Project footprint, at high risk locations, will be conducted after the Project footprint has been confirmed, and preferably at a time when annual weeds can be recognised;
- A post-construction weed audit of the Project footprint will be undertaken at the end of the first wet season following construction completion.
- Implementation of a site-specific pest management plan, as part of the Weed Management Plan, including the following assessment criteria:
  - Estimated pest population increases and / or decreases over the LOM;
  - The optimal times/seasons to carry out particular control actions; and
  - The effects that pests may be having on the Project site and the broader catchment area.

- The following factors will be included in weed monitoring events:
  - date of monitoring event;
  - recent weather conditions;
  - individual pest sizes;
  - approximate pest density;
  - whether seeding or flowering is noticeable; and
  - notes of any pest management actions and re-occurrence of pests to any areas which have been previously treated.
- Monitoring records will be kept for a period of at least five years, to aid in the assessment of the long-term success of the Project's pest management program.

### V.3.8.7 Commitments

The Proponent commitments that are necessary to ensure that Project impacts upon the local terrestrial ecology are minimised, are detailed below.

#### V.3.8.7.1 *Flora Commitments*

- Species that are chosen for re-vegetation will be selected from the dominant flora of each community and matched with the intended final land-use;
- Recreated landforms will be contoured to resemble original regional landscape where possible;
- Vegetation reference monitoring sites will be established and maintained, prior to any site disturbance taking place;
- A weed management plan will be developed and implemented prior to the commencement of construction activities. The weed management plan must describe how the weeds are to be managed in accordance with the *Land Protection (Pest and Stock Route Management) Act 2002* and / or local government requirements for weeds that are not declared under state legislation;
- In order to maintain the integrity of vegetated land that is not cleared, appropriate erosion and sediment controls will be implemented, in order to prevent sediment erosion or deposition in any remaining habitat; and
- Cleared vegetation from the site must be managed in accordance with the following hierarchy:
  - Reuse, e.g. use of logs and tree stumps as shelter for fauna in rehabilitated areas;
  - Recycle, e.g. mulching of vegetation and use for on-site rehabilitation; and
  - Other alternative management options implemented in a way that causes the least amount of environmental harm.

#### V.3.8.7.2 *Fauna Commitments*

- Fauna spotters will conduct a thorough survey of the site prior to native vegetation clearing, in order to determine the location of any Squatter Pigeon (Geophaps scripta scripta) nests; and
- Native vegetation removal will be conducted only after the areas to be cleared have been obviously delineated and identified to equipment operators and supervisors.
- Project persons operating vehicles in and adjacent to the Project site will be made aware of the presence of this threatened species and the potential for it to be encountered on vehicle tracks.

- Measures to assist with control of the Feral Cat (Felis catus) will be applied in areas where the Squatter Pigeon (Geophaps scripta scripta) is known to reside.
- A section of the staff induction program will be dedicated to raising awareness of this avian species, including photos, descriptions and areas of preferred habitat.
- In particular, roost trees and dead stag trees will be preserved where practicable (in their entirety or in part) and if possible, the population of the Little Pied Bat (*Chalinolobus picatus*) monitored prior to vegetation clearance.

#### V.3.8.7.3 *Weed Control Commitments*

Proposed weed management strategies will include:

- The present location of weeds will be highlighted and a comprehensive weed spraying program be implemented, prior to the commencement of works. Declared weed species will be treated per the relevant Queensland Department of Employment, Economic Development and Innovation (DEEDI) fact sheet for each particular species;
- Monitoring in the form of annual observations by site personnel for weeds of management concern will be undertaken. These will also be conducted following significant rain events particularly in disturbed areas, roadsides, riparian zones and wash down facilities once safe access can be provided;
- Wash down facilities will be constructed at access points for vehicles arriving and departing from the Project site. These facilities will be bunded, on hard stand, and located away from drainage lines to minimise the risk of weed spread;
- All vehicles entering the Project site and leaving properties known to contain declared weeds will be thoroughly washed down before entering clean areas; ensuring wheels, wheel arches and the undercarriage are free of mud and plant material;
- Radiators, grills and vehicle interiors will be cleaned for accumulated seed and plant material;
- All materials coming from high risk areas will be certified as weed-free prior to acceptance on-site;
- Soil and fill material from weed-affected areas will not be transported to clean sites. Minimising soil disturbance has the potential to limit the ability of weeds to become established;
- If weeds of management concern are identified, they will be eradicated from the site in accordance with local best management practice from the Burdekin Dry Tropics Regional Pest Management Strategy (Maunsell Australia Pty Ltd, 2008) and / or the DEEDI Pest Fact Sheets (DEEDI, 2007).

## V.3.9 Cultural Heritage

### V.3.9.1 Background

#### V.3.9.1.1 *Non-Indigenous Cultural Heritage*

The identification of known and potential non-Indigenous cultural heritage resources within the study area was based on historical research, an analysis of historical plans, aerial photographs, review of heritage registers and databases, and consultation with a number of local historical societies and museums.

Eleven non-Indigenous cultural heritage sites were identified during the field survey of the study area. A summary description of these sites is presented in Table V-65 and Figure V-25.

### Table V-65 Identified non-Indigenous cultural heritage sites within study area

| Site No. | Name | Description |
|---|---|---|
| A-1 | Lagoon Creek Bush Camp | High concentration of artefacts, likely a stock route camp, although in proximity to coach route and hotel site. |
| A-2 | Kate Doonan's Grave | Gravesite of the wife of proprietor of Doonan's Hotel (1885). |
| A-3 | Bottle Dump | Likely dates to late 19th century, likely association with Doonan's Hotel or another inn site on coach route. |
| A-4 | Old Paddock Fence line | Remnant split post, three (or four?) barb fence, although no wire remains. Posts approximately 110 cm tall. Landowner identified fence on site, apparently old paddock, likely to have been associated with Doonan's Hotel. |
| A-5 | Hotel Site | High concentration of 19th century artefacts, as well as structural remains, likely a traveller's inn site along coach route. High degree of site integrity. |
| A-6 | Cart ruts | In situ remnant wagon/cart ruts along nineteenth century coach route. |
| A-7 | Wendouree Homestead | Homestead complex circa 1960. |
| A-8 | Hobartville Homestead | House (circa 1895) relocated from Mt. Morgan, original complex features remaining include gravesites (1884), artefact scatter. |
| A-9 | Greentree Dam | Improvement feature, evidence of pastoral activity, Hobartville, circa 1902. |
| A-10 | Marsupial Fence | Improvement and condition of lease, early twentieth century. Varying degrees of integrity. |
| A-11 | Murdering Lagoon | Water management feature, Hobartville, early twentieth century. |

These eleven identified sites can be considered temporally and thematically within three categories, as follows:

- Five sites directly associated with the late nineteenth century coach route network;
- Two sites indirectly associated with the late nineteenth century coach route network and one likely to be associated with the late 19th and early twentieth century stock route network; and
- Four sites relating to twentieth century pastoral activity and improvements, with no identified association with the coach route network.

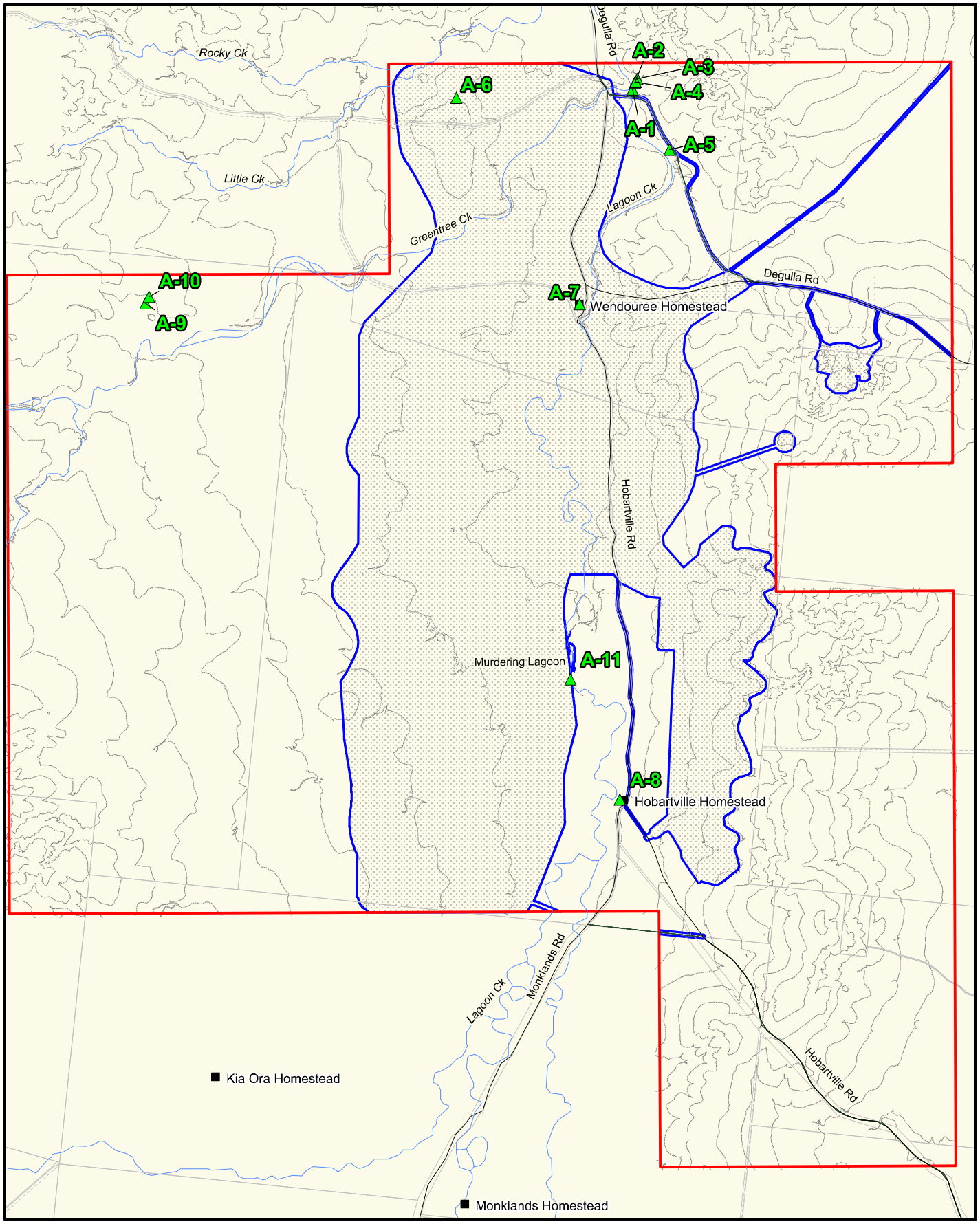
### Archaeological Potential

The term 'archaeological potential' is defined as the likelihood that a site may contain physical evidence related to an earlier phase of occupation, activity or development. There is a generally high potential for archaeological remains to exist across the majority of the identified sites within the study area, as presented in Table V-66.

**Table V-66 Archaeological potential within the Project study area**

| Site No. | Name | Archaeological Potential |
|---|---|---|
| A-1 | Lagoon Creek Bush Camp | High potential – surface scatter. |
| A-2 | Kate Doonan's Grave | High potential – human remains, possible grave goods. |
| A-3 | Bottle Dump | High potential – surface scatter as well as subsurface remains. |
| A-5 | Hotel Site | High potential – surface scatter, structural remains, subsurface remains such as postholes, dumps, wells, privies. |
| A-6 | Cart ruts | Moderate. |
| A-8 | Hobartville Homestead | High potential – human remains and potential grave goods, surface scatter, subsurface remains such as postholes, dumps, wells, privies. |

Furthermore, there is high potential for archaeological remains in the form of artefactual surface scatter and possible 'rest stop' areas between hotel sites to exist along the entire coach route alignment(s).




Source: See Copyright Details below and for full disclosure Please Refer to the SEIS ***Volume 2, Appendix B***

0 2 4Km

Scale 1:150 000 (A4)

Datum: GDA94, MGA Zone55

N W E S

**HANCOCK** PROSPECTING PTY LTD

Alpha Coal Project
Supplementary Environmental Impact Statement

# ALPHA COAL PROJECT (MINE) LOCATION OF NON-INDIGENOUS SITES AND PLACES

| | |
|---|---|
| Job Number | 4262 6680 |
| Revision | C |
| Date | 07-06-2011 |

Figure: V-25

File No: 42626680-g-2063c.wor

### V.3.9.1.2 *Indigenous Cultural Heritage*

Indigenous cultural heritage has been organised in a phased approach, commencing with the development of Cultural Heritage Management Plans (CHMP), and proceeding into cultural heritage surveys and the development of management plans that will encapsulate survey results and provide direction on management.

Desktop searches of the following registers and databases were also undertaken: the DERM register and database; the (former) Register of the National Estate; World Heritage List; National Heritage List, the Commonwealth Heritage List and the Queensland Heritage Register.

One site was found to be located within Mining Development Licence (MDL) 285 (Table V-67). This was an artefact scatter that will be re-found during cultural heritage surveys in the area, and will be assessed in greater depth at that time. In line with the process developed to manage all cultural heritage in impacted on by the Project, a management plan will be developed for the site.

**Table V-67 Location data for Department of Environment and Resource Management (DERM) registered sites within Mining Development Licence (MDL) 285.**

| Tenement | Site ID | Datum: Geocentric Datum of Australia 1994 (GDA94) | | Attribute |
|---|---|---|---|---|
| | | Latitude | Longitude | |
| MDL 285 | FF:A05 | -23.21647 | 146.38052 | STONE |

The nature and distribution of many forms of Indigenous cultural heritage in a landscape is in part associated with environmental factors such as geology, climate and landforms which affect the availability of plants, animals and water, the location of suitable camping places and suitable surfaces upon which rock art could be performed. Such environmental factors also affect the degree to which cultural remains have survived natural and human-induced processes. In addition, non-Indigenous land-use practices often disturb or destroy cultural heritage.

As per the CHMP agreement, the Indigenous cultural heritage survey of the mine site commenced on 16 August 2010, and it is predicted that this survey will result in the identification of a variety of Indigenous cultural heritage areas and objects.

Considering this information, it may be extrapolated that the study area, when intensively surveyed, will contain a number of areas and objects of Aboriginal cultural heritage. The types of areas and objects predicted to be contained within the study area include:

- Isolated stone artefacts consisting of individual find spots of a single artefact that have been assessed by the archaeologist and the survey team as being separated and unrelated to other artefacts and/or archaeological features;
- Stone artefact scatters incorporating a group of 2 or more artefacts located on the ground surface within an arbitrary linear distance nominated by the archaeologist that is subject to factors such as artefact type, environment, visibility, integrity and previously recorded site characteristics occurring within the larger study area;
- Scarred trees incorporating trees where the bark has been removed for a variety of reasons including for use in the preparation of bark sheets for shelters, making canoes, shields and coolamons (containers), or to gain access to possums, honey and other food sources. Due to extensive historic clearing combined with bushfires scarred trees are becoming an increasingly rare cultural resource, and living scarred trees are even rarer;

- Carved trees featuring carvings that were often associated with burial and ceremonial areas. As so many trees have been lost to bushfires, clearing and natural attrition, any carved trees should be regarded as having high levels of both cultural and scientific significance;
- Camp sites incorporating archaeological features such as hearths (fireplaces) and stone artefact scatters that represent occupation areas. Hearths are not common in most areas, but where located have the potential to contain important datable organic material (charcoal, burnt seeds, etc) which may assist in determining the age of the campsite. If a number of fireplaces are found, then the potential to find dates through periods of time is potentially of scientific significance;
- Natural features in the landscape that hold cultural significance for the Wangan & Jagalingou People. These may include creeks or billabongs carrying permanent water, mountains or rock features;
- Quarries and stone resource areas where stone utilised in the production of stone tools were being sourced; and
- Ceremonial areas in addition to the known bora ground at Wendouree Station.

Detailed cultural heritage survey reports will be prepared for the Wangan & Jagalingou People. Each report will culminate in a management plan established through consultation between the endorsed parties and their technical advisers, and accepted by the Proponent, which will provide guidance for the way in which Aboriginal cultural heritage defined by the cultural heritage survey will be managed before construction commences and during the Project.

### V.3.9.2 Environmental Value

The environmental value to be protected is the sites and places of cultural heritage significance (i.e. aesthetic, historic, scientific and social) of Indigenous and non-Indigenous use and occupation of the Project site. Sites and places of Indigenous cultural heritage significance are determined within the CHMP process.

### V.3.9.3 Potential Impacts on the Environmental Value

#### V.3.9.3.1 *Non-Indigenous Cultural Heritage*

Potential impact on recognised and potential cultural heritage sites by the Project will generally be in the nature of removal of the ground surface and sub-surface disturbance, vegetation clearance related to the mine's expansion and the development of associated infrastructure, and the consequent destruction and/or removal of the structures/features which form the non-Indigenous cultural heritage of the area. Table V-68 provides analysis of the proposed project's impact on identified sites of non-Indigenous cultural heritage.

**Table V-68 Project impact on sites and places of non-Indigenous cultural heritage significance within the study area**

| Site No. | Name | Significance Grading3 | Impact Assessment |
|---|---|---|---|
| A-1 | Lagoon Creek Bush Camp | Moderate | Not impacted |
| A-2 | Kate Doonan's Grave | Moderate – High | Not impacted |
| A-3 | Bottle Dump | Moderate – High | Not impacted |
| A-4 | Old Paddock Fence line | Moderate – High | Not impacted |
| A-5 | Hotel Site | Moderate – High | Not impacted – (but in close proximity to disturbed area) |
| A-6 | Cart ruts | Moderate – High | Directly impacted |
| A-7 | Wendouree Homestead complex | Low | Directly impacted |
| A-8 | Hobartville Homestead | Moderate | Not impacted – (but in close proximity to disturbed area) |
| A-9 | Greentree Dam | Low | Not impacted |
| A-10 | Marsupial Fence | Low | Not impacted |
| A-11 | Murdering Lagoon | Low | Directly impacted |

#### V.3.9.3.2 *Indigenous Cultural Heritage*

All potential impacts are assessed in regards to the value or significance of the cultural heritage place. Cultural heritage significance relates to people's perspective of place and sense of value, within the context of history, environment, aesthetics and social organisation, as discussed in Section 18.2.3.1. The scientific and Aboriginal assessments of significance and impacts will be carried out as part of the CHMP process. Protection, management and mitigation measures will be discussed and incorporated into the cultural heritage survey report, following the completion of cultural heritage surveys, which will include Wangan & Jagalingou traditional owners and archaeologists to ensure that all areas of significance are identified, commencing in August 2010.

The study area will potentially be the site of an open cut mine, and as such it is reasonable to predict that areas and objects of Aboriginal cultural heritage in that study area will be directly impacted on by mining operations.

It is also reasonable to predict that during the Project, further Aboriginal cultural heritage will also become apparent. The CHMP has a New Finds section that provides the Wangan & Jagalingou and HPPL with guidance on what courses of action to follow in the event that this occurs. This process, in conjunction with cultural awareness training, will provide appropriate management of all new finds of cultural heritage during construction and mining operations.

### V.3.9.4 Environmental Protection Objective

The environmental protection objective is to preserve the cultural heritage values (Indigenous and non-Indigenous) of the Project study area.

---

**3 Sites A2-A6**, which have direct association with the nineteenth century coach route network, form a 'suite' or complex of sites. The coach route network is assessed as having moderate to high heritage significance, which will need to be managed with due regard to their associative significance.

### V.3.9.5 Performance Criteria

The performance criteria for cultural heritage management are:

- Avoidance where possible of all heritage sites and places. A particular focus will be made to ensure that no disturbance of any place of State and National significance, including archaeological places or sites and places listed on the Queensland Heritage Register in accordance with the requirements of the QHA.
- Cultural Heritage Management Plan(s) (CHMP), to be developed and administered for non-Indigenous sites and places potentially impacted by the Project.
- Bi-Annual monitoring of known sites of non-Indigenous cultural heritage significance for the duration of the Project.
- Compliance with the requirements of the ACA Act and the Cultural CHMP for Indigenous heritage matters.

### V.3.9.6 Control Strategies

#### V.3.9.6.1 *Non-Indigenous Cultural Heritage*

Where possible the Project design will take into account each of the significant heritage sites and places identified within the study area, and, where possible, avoid impacting these sites. If avoidance of these areas is not possible, the Proponent will implement relevant mitigation measures.

The following control strategies are envisaged:

**Strategy 1 - Coach Route CHMP**

The coach route network is assessed as having high potential for further sites and archaeological remains associated with its historic nature to exist within its proximity. One archaeological place (A-5 Hotel site) directly associated with the coach route has been assessed to be potentially of State significance.

Due to the size of the study area and access restrictions, it was neither possible nor practical to provide a comprehensive survey of the coach route within the study area. The Proponent will develop a Cultural Heritage Management Plan (CHMP) for the coach route network prior to ground disturbing activities taking place in the vicinity. The CHMP will consider including:

- Further and focussed contextual research of the coach route between Clermont-Aramac, to identify further potential for sites and places to exist within the study area;
- Further comparative research to determine other examples of coach route networks which might survive within Central Queensland, so that further conclusions can be made in respect to the exact nature of the coach route network within the study area;
- Brief survey of targeted sections of the Clermont-Aramac coach road (outside of the study area) to determine the likelihood of sites and places to survive of comparative nature and context to those in the study area;
- Further site inspection to record key features /sites within the study area which are considered to be associated with the route;
- On completion, provide a CHMP Report to HPPL which provides clear and achievable mitigation and management measures to protect and conserve cultural heritage values associated with the coach route network within the study area for the life of the Project;

- Record any sites located within the proposed disturbance area of the Project in detail to an archival standard by a qualified cultural heritage professional and in line with the draft DERM Guidelines for Archival Recording;
- Obligations for any sites which might be considered an Archaeological Place, under the provisions of Section 60 of the QHA, including liaison with DERM; and
- Consider the potential for archaeological excavation or further research opportunities for sites which exhibit archaeological values important to the region or to Queensland, which might be impacted by the Project.

Until such time that the CHMP has been completed, it is proposed that no ground disturbing activities be undertaken within 500 m either side of the coach route alignment.

### Strategy 2 - Former Hotel Site (A-5)

The former Hotel site (A-5) is considered to be an Archaeological Place of potential State significance. State significant archaeological sites require special consideration under the provisions of the QHA, as they represent a heritage asset that has potential to contain an archaeological artefact that is an important source of information about Queensland's history. Obligations under section 60 of the Act require the person (the Proponent) who finds the 'archaeological place' to report the find to the Chief Executive Officer of the DERM. .

Avoidance of these sites will be practised and all site personnel made aware of relevant obligations to avoid the area. If a place is registered on the Queensland Heritage Register (QHR), development at that place will fall under Queensland's Integrated Development Assessment System (IDAS). As a result, DERM may require an archaeological investigation to be conducted on an archaeological place as part of the consent conditions, particularly if the proposed development may damage or impact the significance of the site.

### Strategy 3 - Site A-7 (Wendouree Homestead) and Site A-11 (Murdering Lagoon)

Site A-7 (Wendouree Homestead) and Site A-11 (Murdering Lagoon) are directly impacted by the Project. Considered to each exhibit low levels of cultural heritage significance, strategies to mitigate impact prior to any development or ground disturbance takes place will include:

- Brief further research the history, including oral history, of the homestead complex;
- Record the complex in detail to an archival standard by a qualified cultural heritage professional and in line with the draft DERM Guidelines for archival recording;
- Consideration will be given to reuse of some buildings within the complexes; outside of the Project area of disturbance; and
- Provide an archival report to appropriate local organisations such as the Barcaldine Regional Council, DERM, and the John Oxley Library.

### Strategy 4 - Unexpected Finds

- The study area has the potential to contain non-Indigenous cultural heritage material, particularly in the vicinity of the nineteenth century couch route and homestead complexes. Accordingly, the following procedure for managing unexpected cultural heritage material or sites that may be encountered has been prepared.

### Strategy 5 - Archaeologist "On-Call"

A historical archaeologist will be appointed during construction phases of the Project, so that a call-out can be made if potential archaeological material is noted.

### Strategy 6 - Regular Monitoring

The Proponent will undertake a bi-annual survey of all heritage items identified on the study area. Any damage to items can be catalogued and actions taken to ensure that the process that caused the damage is not repeated and that training material for site personnel can be updated with current information. The Project will develop forms and databases, similar to those it has for Indigenous heritage, to monitor the condition, management and protection of the heritage sites.

Strategies to mitigate potential impacts on unexpected cultural heritage material or sites found during the construction and pre-clearing activities include the following:

- All new employees will be provided with suitable training in how to identify cultural heritage sites or objects and report the find to the Site Environmental Advisor;
- All employees will be informed of their obligations to notify the Site Environmental Advisor of any cultural heritage finds;
- Cultural heritage policies will be developed for the management of existing cultural heritage sites or finds;
- Site Environmental Advisors will be informed of their obligations to notify the DERM of any relevant finds; and
- Regular cultural heritage educational sessions will be conducted and educational material distributed as appropriate. This material will inform the employees of what cultural heritage material may look like, and give them clear instructions on what to do if they find any such material.

## Procedure for Discovery of a Non-Indigenous Item of Potential Cultural Heritage Significance

**Stop Work**

If potential items of non-Indigenous cultural heritage are located during works: stop work, mark and protect the site. Work can continue elsewhere if it will not affect the item.

↓

**Initial Contact**

Contact the HPPL Environment Officer (EO) immediately and notify them of the item.

↓

**Notification to Project archaeologist**

The HPPL EO to contact the Project Archaeologist, including details of the nature of the item. The Project Archaeologist should be commissioned in an 'on-call' capacity during construction.

↓

**Assess Significance**

The Archaeologist will attend the site (if necessary) as soon as possible to assess significance of item and recommend a course of action. These may include: i) protect and avoid; ii) excavate, record and remove; iii) investigate and preserve; or iv) no action if the item is deemed to have no significance. Recommendation i), ii) and iii) will require preparation of a work method statement in consultation with DERM Cultural Heritage Branch prior to any action commencing.

**Is Item Discovered Significant?**

| Yes ↓ | | No ↓ |
|---|---|---|
| **Report find to DERM Cultural Heritage Branch**<br>Reporting of archaeological find to DERM Cultural Heritage Branch is required by law. Depending on the nature of the find, the Project Archaeologist and DERM will negotiate requirements of find. | | **Recording**<br>Items deemed to have no significance will require recording as evidence. A photograph of the item and a description of why it is not of significance should be recorded by the Project Archaeologist and forwarded to the HPPL EO. |
| ↓ | | ↓ |
| **Complete recording/field Work**<br>Complete the archaeological or remedial works in accordance with the consent permit or agreed course of action. Advise HPPL EO when assessment complete. | | **Advice**<br>Advise HPPL Environment Officer when assessment complete. Confirm advice with DERM Cultural Heritage Branch if required. |
| ↓ | | ↓ |

**Work Recommences**

HPPL EO to advise when works can re-commence in the original or changed form.

↓

**Submit final report**

Archaeologist completes reporting in accordance with the appropriate guidelines and conditions. A copy of the report to go to relevant Government Authorities and HPPL EO.

(Converge 2010)

### V.3.9.6.2 *Indigenous Cultural Heritage*

Measures for the management of potential impacts range from avoidance and total protection through to a number of different mitigation methods that include the systematic recording, collection, removal and analysis of identified artefactual material from development areas. Avoidance of direct impact and long-term protection is the preferred form of management for the Wangan & Jagalingou People, and also offers the best way in which scientific significance can be preserved. However, the development of an open cut mine by implication suggests that avoidance and protection of many of the areas and objects that will be found during the cultural heritage survey will not be possible.

The Wangan & Jagalingou People have already recognised this situation in the Cultural Heritage Management Plan (CHMP) that exists between them and Hancock Prospecting Pty Ltd (HPPL). Section 5 within the CHMP states that the parties agree that the principles of effective recognition, protection and conservation of Aboriginal cultural heritage depend on avoidance where possible, but if it cannot reasonably be avoided, minimisation of harm through mitigation measures will be acceptable. The CHMP also accepts that disturbance of the ground during the development of the Project is a necessary component of the Project.

Under these circumstances, scientific advice to the Wangan & Jagalingou People will be to undertake mitigation methods that maximise protection of the values of Aboriginal cultural heritage found during the cultural heritage survey of the study area. Protection of values in this situation is dependent on a combination of cultural and archaeological approaches that may include:

- Detailed recording of areas and objects;
- Systematic collection and removal from the area of disturbance;
- Collection of any information (inclusive of archaeological excavation where appropriate) from the context of the area or object, e.g., material that could lead to more information through dating, pollen, residue and use wear analysis;
- Where potential exists for sub-surface cultural heritage, the development of a monitoring program during earth disturbance; and
- Preparation of detailed site-specific management plans prepared by the archaeologists to the Project that may recommend other measures such as sub-surface investigation through test-pitting or excavation and analysis of outcomes.

In addition, where avoidance is possible, the preparation of site-specific management plans that provide clear directions and processes for protection of the area or object will be drawn up so that accidental harm during project activities is avoided.

Cultural awareness training will be a crucial element of management, with the intention of training people involved in the Project in avoidance and protection of known cultural heritage sites, what cultural heritage may reasonably be in the landscape, and what to do in the event of a find of cultural heritage not previously defined during the cultural heritage survey.

#### Fossils

Should significant fossil specimens be identified within the mine then steps will be taken to secure and protect the fossils. The Queensland Museum will be notified to allow for the identification and correct preservation and removal.

#### V.3.9.7 Commitments

- Control strategies in the EIS will be implemented to manage known and potential cultural heritage sites and values located within the Project site.
- Conduct regular cultural heritage education sessions/trainings to employees.
- Implementation of the requirements of the agreed Cultural Heritage Management Plan (CHMP) in consultation with the traditional owners, and in accordance with the requirements of the ACH Act.

## V.4 Environmental Management

### V.4.1 Monitoring

Environmental monitoring will continue to occur in accordance with the requirements of the Environmental Authority.

The environmental monitoring will include rehabilitation success, surface water quality, groundwater quality and level, particulate and dust deposition and noise. Commitments and environmental authority conditions have been included in the relevant sections of this EM Plan.

An Environmental Monitoring Plan will be developed as part of Environmental Management System for the Project. The Monitoring Plan will outline the environmental monitoring to be undertaken, including monitoring sites, parameters and their frequency of measurement and also make reference to monitoring procedures and records. The Plan will be made available to the administering authority on request.

### V.4.2 Reporting

#### V.4.2.1 External

The Proponent aims to provide timely, relevant and appropriately presented information to government authorities, the local community and the general public on the environmental performance of the Project.

Reporting commitments under the Environmental Authority and other legislation will be complied with and includes:

- Prepare Annual Returns as required under the Environmental Protection Act 1994.
- Submit National Pollutant Inventory (NPI) reports as necessary.
- Report incidents that may potentially compromise compliance with the conditions of the Environmental Authorities immediately to operations management.

#### V.4.2.2 Internal

The site Environmental Manager will (in a timely manner) report any incidents or breaches of the EM Plan or EA conditions to key site personnel and report to the DERM in accordance with the requirements of the Project's environmental authority.

### V.4.3 Environmental Management System

The Project operations will take place under an environmental management system. The Proponents approach will be to certify the EMS against the ISO14001 Standard within the first years of operation.

The EMS is the cornerstone of the operation's due-diligence approach to environmental management, and encompasses the measures used to prevent or minimise environmental harm, ensure compliance and promote continuous improvement.

### V.4.4 Research

Mining in the Galilee Basin is only just developing and the Proponent is committed to developing appropriate areas of research, in particular in land rehabilitation, to enhance knowledge in this area.

### V.4.5 Staff Training

HPPL ensures that employees, contractors and visitors receive appropriate environmental awareness training. This is achieved through a variety of methods including induction training, formal presentations, and impromptu meetings.

Specifically, HPPL requires that employees, contractors and visitors are aware of:

- Their roles and responsibilities (including environmental incident reporting);
- The environmental impacts, potential or actual, of their activities on site;
- The potential consequences of poor environmental performance; and
- Site emergency procedures.

Environmental awareness training occurs at induction, and is a regular feature of site-wide training. Records of training content and attendance are also be maintained. Employees and contractors required to undertake work at the site must undergo an environment, health and safety induction. Relevant environmental topics include:

- Environmental Policy;
- Duty of Care and Duty to Notify;
- Hazard / Incident Reporting;
- Environmental Awareness (Your Responsibility);
- Risk Management;
- Chemicals and Hydrocarbon management;
- Land Management;
- Water Management; and
- Waste Management

### V.4.6 Environmental Auditing and Review

The Proponent will conduct environmental audits to assess compliance with regulatory requirements and the performance of the site EMS.

The objectives of the Environmental Auditing and Review programs are to:

- Monitor and report on compliance with statutes, EM Plan commitments and Plan of Operations, environmental policy, company standards, best practice guidelines and signatory codes;
- Monitor the EMS for consistency with the principles of ISO14001; and
- Ensure a senior management review of performance via consideration of the audit reports.

An environmental auditing program will continue to be implemented at the Mine. The program will include:

- Internal Environmental Audits - annually;
- Environmental Management System Review – annually;
- Plan of Operations Audits – with each Plan of Operations (usually annually); and
- Administering Authority Audits - at a frequency determined by DERM.

## V.5 Environmental Authority Definitions

Words and phrases used throughout this Environmental Authority are defined below except where identified in the *Environmental Protection Act 1994* or subordinate legislation. Where a word or term is not defined, the ordinary English meaning applies, and regard should be given to the Macquarie Dictionary.

'**acceptance criteria'** means the measures by which actions implemented are deemed to be complete. The acceptance criteria indicate the success of the decommissioning and rehabilitation outcomes or remediation of areas which have been significantly disturbed by the environmentally relevant activities. Acceptance criteria may include information regarding:

- Stability of final land forms in terms of settlement, erosion, weathering, pondage and drainage;
- Control of geochemical and contaminant transport processes;
- Quality of runoff waters and potential impact on receiving environment;
- Vegetation establishment, survival and succession;
- Vegetation productivity, sustained growth and structure development;
- Fauna colonisation and habitat development;
- Ecosystem processes such as soil development and nutrient cycling, and the recolonisation of specific fauna groups such as collembola, mites and termites which are involved in these processes;
- Microbiological studies including recolonisation by mycorrhizal fungi, microbial biomass and respiration;
- Effects of various establishment treatments such as deep ripping, topsoil handling, seeding and fertiliser application on vegetation growth and development;
- Resilience of vegetation to disease, insect attack, drought and fire; and
- Vegetation water use and effects on ground water levels and catchment yields.

**'acid and metalliferous drainage (AMD)'** means any contaminated discharge emanating from a mining operation formed through a series of chemical and biological reaction, when geological strata is disturbed and exposed to oxygen and moisture as a result of mining operations.

**'administering authority'** means the Department of Environment and Resource Management or its successor.

**'Annual Exceedance Probability'** or **'AEP'** means the probability that at least one event in excess of a particular magnitude will occur in any given year.

**'airblast overpressure'** means energy transmitted from the blast site within the atmosphere in the form of pressure waves. The maximum excess pressure in this wave, above ambient pressure is the peak airblast overpressure measured in decibels linear (dBL).

**'ambient (or total) noise'** at a place, means the level of noise at the place from all sources (near and far), measured as the Leq for an appropriate time interval.

**'ANZECC & ARMCANZ'** means the Australian and New Zealand Environment and Conservation Council (ANZECC) and Agriculture and Resource Management Council of Australia and New Zealand (ARMCANZ) 2000, Australian and New Zealand Guidelines for Fresh Marine Water Quality.

**'appropriately qualified person'** means a person who has professional qualifications, training, skills or experience relevant to the nominated subject matter and can give authoritative assessment, advice and analysis on performance relative to the subject matter using the relevant protocols, standards, methods or literature.

**'assess'** by a suitably qualified and experienced person in relation to a hazard assessment of a dam, means that a statutory declaration has been made by that person and, when taken together with any attached or appended documents referenced in that declaration, all of the following aspects are addressed and are sufficient to allow an independent audit at any time:

a) exactly what has been assessed and the precise nature of that assessment

b) the relevant legislative, regulatory and technical criteria on which the assessment has been based

c) the relevant data and facts on which the assessment has been based, the source of that material, and the efforts made to obtain all relevant data and facts, and

d) the reasoning on which the assessment has been based using the relevant data and facts, and the relevant criteria.

**'associated works'** in relation to a dam, means:

- operations of any kind and all things constructed, erected or installed for that dam, and
- any land used for those operations.

**'authority'** means environmental authority (mining activities) under the *Environmental Protection Act 1994*.

**'bed and banks'** for a waters, river, creek, stream, lake, lagoon, pond, swamp, wetland or dam means land over which the water of the waters, lake, lagoon, pond, swamp, wetland or dam normally flows or that is normally covered by the water, whether permanently or intermittently; but does not include land adjoining or adjacent to the bed and banks that is from time to time covered by floodwater.

**'beneficial use'** in respect of dams means that the current or proposed owner of the land on which a dam stands, has found a use for that dam that is:

a) of benefit to that owner in that it adds real value to their business or to the general community

b) in accordance with relevant provisions of the Environmental Protection Act 1994

c) sustainable by virtue of written undertakings given by that owner to maintain that dam, and

d) the transfer and use have been approved or authorised under any relevant legislation.

**'biosolids'** means the treated and stabilised solids from sewage.

**'blasting'** means the use of explosive materials to fracture:

a) rock, coal and other minerals for later recovery, or

b) structural components or other items to facilitate removal from a site or for reuse.

**'bunded'** means within secondary containment consistent with Australian Standard 1940.

**'certification', 'certifying'** or **'certified'** by a suitably qualified and experienced person in relation to a design plan or an annual report regarding dams, means that a statutory declaration has been made by that person and, when taken together with any attached or appended documents referenced in that declaration, all of the following aspects are addressed and are sufficient to allow an independent audit at any time:

(a) exactly what is being certified and the precise nature of that certification

(b) the relevant legislative, regulatory and technical criteria on which the certification has been based

(c) the relevant data and facts on which the certification has been based, the source of that material, and the efforts made to obtain all relevant data and facts, and

(d) the reasoning on which the certification has been based using the relevant data and facts, and the relevant criteria.

'**chemical**' means:

a) an agricultural chemical product or veterinary chemical product within the meaning of the *Agricultural and Veterinary Chemicals Code Act 1994* (Commonwealth), or

b) a dangerous good under the dangerous goods code, or

c) a lead hazardous substance within the meaning of the Workplace Health and Safety Regulation 1997, or

d) a drug or poison in the Standard for the Uniform Scheduling of Drugs and Poisons prepared by the Australian Health Ministers' Advisory Council and published by the Commonwealth, or

e) any substance used as, or intended for use as:
   i. a pesticide, insecticide, fungicide, herbicide, rodenticide, nematocide, miticide, fumigant or related product, or
   ii. a surface active agent, including, for example, soap or related detergent, or
   iii. a paint solvent, pigment, dye, printing ink, industrial polish, adhesive, sealant, food additive, bleach, sanitiser, disinfectant, or biocide, or
   iv. a fertiliser for agricultural, horticultural or garden use, or

f) a substance used for, or intended for use for:
   i. mineral processing or treatment of metal, pulp and paper, textile, timber, water or wastewater, or
   ii. manufacture of plastic or synthetic rubber.

**'commercial place'** means a work place used as an office or for business or commercial purposes, which is not part of the mining activity and does not include employees accommodation or public roads.

**'competent person'** means a person with the demonstrated skill and knowledge required to carry out the task to a standard necessary for the reliance upon collected data or protection of the environment.

**'construction'** or **'constructed'** in relation to a dam includes building a new dam and modifying or lifting an existing dam, but does not include investigations and testing necessary for purposes of preparing a design plan.

**'contaminate'** means to render impure by contact or mixture.

**'contaminated'** means the substance has come into contact with a contaminant.

'**contaminant'** A contaminant can be:

a) a gas, liquid or solid, or

b) an odour, or

c) an organism (whether alive or dead), including a virus, or

d) energy, including noise, heat, radioactivity and electromagnetic radiation, or

e) a combination of contaminants.

**'control measure'** means any action or activity that can be used to prevent or eliminate a hazard or reduce it to an acceptable level.

**'cover material'** means any soil or rock suitable as a germination medium or landform armouring.

**'dam'** means a land-based structure or a void that is designed to contain, divert or control flowable substances, and includes any substances that are thereby contained, diverted or controlled by that land-based structure or void and associated works. A dam does *not* mean a fabricated or manufactured tank or container designed to an Australian Standard that deals with strength and structural integrity of that tank or container.

**'design plan'** is the documentation required to describe the physical dimensions of the dam, the materials and standards to be used for construction of the dam, and the criteria to be used for operating the dam. The documents must include all investigation and design reports, plans and specifications sufficient to hand to a contractor for construction, and planned decommissioning and rehabilitation outcomes; so as to address all hazard scenarios that would be identified by a properly conducted hazard assessment for the structure. Documentation must be such that a 'suitable qualified and experience person' could conduct an independent review without seeking further information from the designer.

**'design storage allowance'** or **'DSA'** means an available volume, estimated in accordance with the Site Water Management Technical Guideline for Environmental Management of Exploration and Mining in Queensland (DME 1995), that must be provided in a dam as at the first of November each year in order to prevent a discharge from that dam to a probability (AEP) specified in that guideline. The DSA is estimated based on 100% runoff of wet season rainfall at the relevant AEP, taking account of process inputs during that wet season, with no allowance for evaporation.

**'development approval'** means a development approval under the *Integrated Planning Act 1997* in relation to a matter that involves an environmentally relevant activity under the *Environmental Protection Act 1994*.

**'domestic waste'** means waste, other than domestic clean-up waste, green waste, recyclable waste, interceptor waste or waste discharged to a sewer, produced as a result of the ordinary use or occupation of domestic premises.

**'dwelling'** means any of the following structures or vehicles that is principally used as a residence:

a) a house, unit, motel, nursing homer or other building or part of a building, or

b) a caravan, mobile home or other vehicle or structure on land, or

c) a water craft in a marina.

**'effluent'** treated waste water discharged from sewage treatment plants.

**'end-of-pipe'** means the location at which water is released to waters or land.

**'environmental authority'** means an environmental authority under Chapter 5 of the *Environmental Protection Act 1994.*

**'environmental authority holder'** means the holder of this environmental authority.

**'environmentally relevant activity'** means an environmentally relevant activity as defined under Section 18 of the *Environmental Protection Act 1994* and listed under Schedule 1 of the *Environmental Protection Regulation 1998.*

**'financial assurance'** means a security required under the *Environmental Protection Act 1994* by the Administering Authority to cover the cost of rehabilitation or remediation of disturbed land or to secure compliance with the environmental authority.

**'floodwater'** means water overflowing, or that has overflowed, from waters, river, creek, stream, lake, pond, wetland or dam onto or over riparian land that is not submerged when the watercourse or lake flows between or is contained within its bed and banks.

**'flowable substance'** means matter or a mixture of materials which can flow under any conditions potentially affecting that substance. Constituents of a flowable substance can include water, other liquids fluids or solids, or a mixture that includes water and any other liquids fluids or solids either in solution or suspension.

**'foreseeable future'** is the period used for assessing the total probability of an event occurring. Permanent structures and ecological sustainability should be expected to still exist at the end of a 150 year foreseeable future with an acceptable probability of failure before that time.

**'general waste'** means waste other than regulated waste.

**'hazard'** in relation to a dam as defined, means the potential for environmental harm resulting from the collapse or failure of the dam to perform its primary purpose of containing, diverting or controlling flowable substances.

**'hazard category'** means a category, either low significant or high, into which a dam is assessed as a result of the application of tables and other criteria in the Site Water Management Technical Guideline for Environmental Management of Exploration and Mining in Queensland (DME 1995).

**'hazardous waste'** means a substance, whether liquid, solid or gaseous that, if improperly treated, stored, disposed of or otherwise managed, is likely to cause environmental harm.

**'hydraulic performance'** means the capacity of a regulated dam to contain or safely pass flowable substances based on a probability (AEP) of performance failure specified for the relevant hazard category in the Site Water Management Technical Guideline for Environmental Management of Exploration and Mining in Queensland (DME 1995).

**'infrastructure'** means water storage dams, roads and tracks, buildings and other structures built for the purpose and duration of the conduct of the environmentally relevant activities, but does not include other facilities required for the long term management of the impact of those activities or the protection of potential resources. Such other facilities include dams other than water storage dams, waste dumps, voids, or stockpiles and assets, that have been decommissioned, rehabilitated, and lawfully recognised as being subject to subsequent transfer with ownership of the land.

**'LA 10, adj, 10 mins'** means the A-weighted sound pressure level, (adjusted for tonal character and impulsiveness of the sound) exceeded for 10% of any 10-minute measurement period, using Fast response.

**'LA 1, adj, 10 mins'** means the A-weighted sound pressure level, (adjusted for tonal character and impulsiveness of the sound) exceeded for 1% of any 10-minute measurement period, using Fast response.

**'LA, max adj, T'** means the average maximum A-weighted sound pressure level, adjusted for noise character and measured over any 10 minute period, using Fast response.

**'LAr,1 hour'** means the rating level, equal to LAeq,adj,1 hour.

**'lake'** includes:

a) lagoon, swamp or other natural collection of water, whether permanent or intermittent, and

b) the bed and banks and any other element confining or containing the water.

**'land'** in the **'land schedule'** of this document means land excluding waters and the atmosphere.

**'land capability'** as defined in the DME 1995 Technical Guidelines for the Environmental Management of Exploration and Mining in Queensland.

**'land suitability'** as defined in the DME 1995 Technical Guidelines for the Environmental Management of Exploration and Mining in Queensland.

**'land use'** term to describe the selected post mining use of the land, which is planned to occur after the cessation of mining operations.

**'landfill'** means land used as a waste disposal site for lawfully putting solid waste on the land.

**'levee', 'dyke' or 'bund'** means a long embankment that is designed only to provide for the containment and diversion of stormwater or flood flows from a contributing catchment, or containment and diversion of flowable materials resulting from releases from other works, during the progress of those stormwater or flood flows or those releases; and does not store any significant volume of water or flowable substances at any other times.

**'mandatory reporting level'** or **'MRL'** means a warning and reporting level determined in accordance with the Site Water Management Technical Guideline for Environmental Management of Exploration and Mining in Queensland (DME 1995). An MRL is the lowest level required in a regulated dam to allow either of the following to be retained:

a) the runoff from a 72 hour duration storm at the AEP, or

b) a wave allowance at that AEP as estimated using a recognised engineering method.

**'mg/L'** means milligrams per litre.

**'mineral'** means a substance which normally occurs naturally as part of the earth's crust or is dissolved or suspended in water within or upon the earth's crust and includes a substance which may be extracted from such a substance, and includes:

a) clay if mined for use for its ceramic properties, kaolin and bentonite

b) foundry sand

c) hydrocarbons and other substances or matter occurring in association with shale or coal and necessarily mined, extracted, produced or released by or in connection with mining for shale or coal or for the purpose of enhancing the safety of current or future mining operations for coal or the extraction or production of mineral oil therefrom

d) limestone if mined for use for its chemical properties

e) marble

f) mineral oil or gas extracted or produced from shale or coal by in situ processes

g) peat

h) salt including brine

i) shale from which mineral oil may be extracted or produced

j) silica, including silica sand, if mined for use for its chemical properties

k) rock mined in block or slab form for building or monumental purposes

But does *not* include:

a) living matter

b) petroleum within the meaning of the Petroleum Act 1923

c) soil, sand, gravel or rock (other than rock mined in block or slab form for building or monumental purposes) to be used or to be supplied for use as such, whether intact or in broken form

d) water.

**'mine water'** means process water and contaminated storm water.

**'natural flow'** means the flow of water through waters caused by nature.

**'nature'** includes:

a) ecosystems and their constituent parts, and

b) all natural and physical resources, and

c) natural dynamic processes.

**'noxious'** means harmful or injurious to health or physical well being.

**'offensive'** means causing reasonable offence or displeasure; is disagreeable to the sense; disgusting, nauseous or repulsive, other than trivial harm.

**'operational land'** means the land associated with the Project for which this environmental authority has been granted.

**'operational plan'** means a document that amongst other things sets out procedures and criteria to be used for operating a dam during a particular time period. The operational plan as defined herein may form part of a plan of operations or plan otherwise required in legislation.

**'palletised'** means stored on a movable platform on which batteries are placed for storage or transportation.

**'peak particle velocity (ppv)'** means a measure of ground vibration magnitude which is the maximum rate of change of ground displacement with time, usually measured in millimetres/second (mms-1).

**'protected area'** means:

a) a protected area under the *Nature Conservation Act 1992*, or

b) a marine park under the *Marine Parks Act 1992*, or

c) a World Heritage Area.

**'progressive rehabilitation'** means rehabilitation (defined below) undertaken progressively or a staged approach to rehabilitation as mining operations are ongoing.

**'process water'** means water used or produced during the mineral development activities.

**'receiving environment'** means all groundwater, surface water, land, and sediments that are not disturbed areas authorised by this environmental authority.

**'receiving waters'** means all groundwater and surface water that are not disturbed areas authorised by this environmental authority.

**'recycled water'** means appropriately treated effluent and urban stormwater suitable for further use.

**'reference site'** or **'analogue site'** may reflect the original location, adjacent area or another area where rehabilitation success has been completed for a similar biodiversity. Details of the reference site may be as photographs, computer generated images and vegetation models etc.

**'regulated dam'** means any dam in the significant or high hazard category as assessed using the Site Water Management Technical Guideline for Environmental Management of Exploration and Mining in Queensland (DME 1995).

**'regulated waste'** means non-domestic waste mentioned in schedule 7 of the *Environmental Protection Regulation 1998* (whether or not it has been treated or immobilised), and includes:

a) for an element – any chemical compound containing the element, and

b) anything that has contained the waste.

**'rehabilitation'** the process of reshaping and revegetating land to restore it to a stable landform and in accordance with the acceptance criteria set out in this environmental authority and, where relevant, includes remediation of contaminated land.

**'representative'** means a sample set which covers the variance in monitoring or other data either due to natural changes or operational phases of the mining activities.

**'residual void'** means an open pit resulting from the removal of ore and/or waste rock which will remain following the cessation of all mining activities and completion of rehabilitation processes.

**'saline drainage'** means the movement of waters, contaminated with salt(s), as a result of the mining activity.

**'self sustaining'** means an area of land which has been rehabilitated and has maintained the required acceptance criteria without human intervention for a period nominated by the administering authority.

**'sensitive place'** means:

a) a dwelling, residential allotment, mobile home or caravan park, residential marina or other residential premises, or

b) a motel, hotel or hostel, or

c) an educational institution, or

d) a medical center or hospital, or

e) a protected area under the *Nature Conservation Act 1992*, the *Marine Parks Act 1992* or a World Heritage Area, or

f) a public park or gardens.

**'sewage'** means the used water of person's to be treated at a sewage treatment plant.

**'spillway'** means a weir, channel, conduit, tunnel, gate or other structure designed to permit discharges form the dam, normally under flood conditions or in anticipation of flood conditions.

**'stable'** in relation to land, means land form dimensions are or will be stable within tolerable limits now and in the foreseeable future. Stability includes consideration of geotechnical stability, settlement and consolidation allowances, bearing capacity (trafficability), erosion resistance and geochemical stability with respect to seepage, leachate and related contaminant generation.

**'stormwater'** means all surface water runoff from rainfall.

**'suitably qualified and experienced person'** in relation to dams means a person who is a Registered Professional Engineer of Queensland (RPEQ) under the provisions of the Professional Engineers Act 1988, OR registered as a National Professional Engineer (NPER) with the Institution of Engineers Australia, OR holds equivalent professional qualifications to the satisfaction of the administering authority for the Act; AND the administering authority for the Act is satisfied that person has knowledge, suitable experience and demonstrated expertise in relevant fields, as set out below:

a) knowledge of engineering principles related to the structures, geomechanics, hydrology, hydraulics, chemistry and environmental impact of dams, and
b) a total of five years of suitable experience and demonstrated expertise in the geomechanics of dams with particular emphasis on stability, geology and geochemistry, and
c) a total of five years of suitable experience and demonstrated expertise each, in three of the following categories:
   - Investigation and design of dams.
   - Construction, operation and maintenance of dams.
   - Hydrology with particular reference to flooding, estimation of extreme storms, water management or meteorology.
   - Hydraulics with particular reference to sediment transport and deposition, erosion control, beach processes.
     - Hydrogeology with particular reference to seepage, groundwater.
     - Solute transport processes and monitoring thereof.
     - Dam safety.

**'trivial harm'** means environmental harm which is not material or serious environmental harm and will not cause actual or potential loss or damage to property of an amount of, or amounts totalling more than $5,000.

**'tolerable limits'** means a range of parameters regarded as being sufficient to meet the objective of protecting relevant environmental values. For example, a range of settlement for a tailings capping, rather than a single value, could still meet the objective of draining the cap quickly, preventing pondage and limiting infiltration and percolation.

**'void'** means any constructed, open excavation in the ground.

**'waste'** as defined in section 13 of the *Environmental Protection Act 1994*.

**'waste management hierarchy'** has the meaning given by the Environmental Protection (Waste Management) Policy 2000.

**'waste management principles'** has the meaning given by the Environmental Protection (Waste Management) Policy 2000.

**'waste water'** means used water from the activity, process water or contaminated storm water.

**'water quality'** means the chemical, physical and biological condition of water.

**'waters'** includes all or any part of a river, stream, lake, lagoon, pond, swamp, wetland, unconfined surface water, unconfined water in natural or artificial watercourses, bed and banks of a watercourse, dams, non-tidal or tidal waters (including the sea), stormwater channel, stormwater drain, roadside gutter, stormwater run-off, and groundwater.

**'µg/L'** means micrograms per litre.

**'µs.cm-1'** means microsiemens per centimetre.