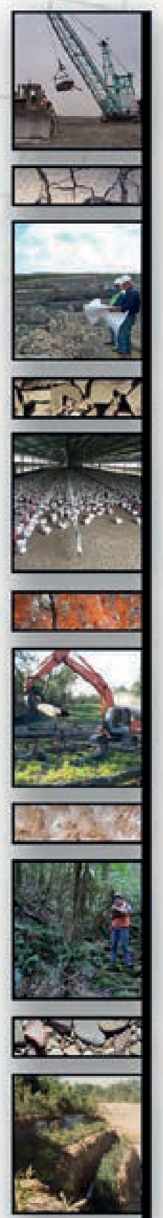
WATERMARK
COAL PROJECT
ENVIRONMENTAL IMPACT STATEMENT

February 2013

AA
Rehabilitation and Mine Closure Strategy



Rehabilitation Strategy

Watermark Coal Project

February 2013

HAN10-002

GSS ENVIRONMENTAL
Environmental, Land and Project Management Consultants

Prepared on behalf of Hansen Bailey Pty Ltd

GSS ENVIRONMENTAL
Environmental, Land and Project Management Consultants

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Date of Issue: 9th February 2013

GSSE Reference: HAN10-002

ISSUE AND AMENDMENT CONTROL HISTORY

Issue	Date	Description	Authors	QA/QC
1	07.06.2012	Rehabilitation Strategy Draft 1	AK/MH/RW	CR
2	24.07.2012	Rehabilitation Strategy Draft 2	AK/MH/RW	CR
3	27.08.2012	Rehabilitation Strategy Draft 3	AK/MH/RW	CR
4	16.10.2012	Rehabilitation Strategy Final V1	AK/MH/RW	CR
5	14.01.2013	Rehabilitation Strategy Final V2	AK/MH/RW/CR	CR
6	09.02.2013	Rehabilitation Strategy Final V3	AK/MH/RW/CR	CR

TABLE OF CONTENTS

TABLES

FIGURES

1.0 INTRODUCTION

1.1 Background

GSS Environmental was commissioned by Hansen Bailey Pty Limited, on behalf of Shenhua Watermark Coal Pty Limited (Shenhua Watermark) to prepare a Rehabilitation Strategy for the Watermark Coal Project (the Project). This assessment forms part of an Environmental Impact Statement (EIS) being prepared by Hansen Bailey Pty Ltd to support Shenhua Watermark's application for State Significant Development Consent under Division 4.1 of Part 4 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) for the construction and operation of the Project.

In October 2008, Shenhua Watermark was granted Exploration Licence (EL) 7223. Shenhua Watermark is a subsidiary of the Shenhua Corporation.

The Project is located within EL 7223, approximately 25 km south south-east of the township of Gunnedah and to the immediate west of the village of Breeza, within the Gunnedah Local Government Area (LGA). The Project is approximately 282 km by rail from the export Port of Newcastle. **Figure 1** illustrates the regional locality of the Project in relation to the nearest town centres of Breeza and Gunnedah.

The Project Boundary (herein referred to as the 'Study Area') is the focus of this Rehabilitation Strategy. All proposed disturbance associated with the Project (including buffer land, infrastructure areas, open cut mining areas and Overburden Emplacement Areas (OEA)) is encompassed in the Disturbance Boundary (Disturbance Area). Details of the Project are presented in **Section 2**.

This report should be read in conjunction with the Soil and Land Capability Impact Assessment prepared as part of the EIS for the Project by GSSE (2013).

1.2 Objectives of the Strategy

The purpose of this Rehabilitation Strategy is to establish objectives for the rehabilitation of land that will be disturbed due to the Project. The key objectives of the Rehabilitation Strategy are described below.

1.2.1 Achievement of acceptable post-mining land use suitability

Rehabilitation will aim to create a stable landform with the maximum possible post-mining land use capability and/or suitability, as per the EIS Soil Survey and Land Capability Impact Assessment (GSSE, 2013). 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.

1.2.2 Creation of stable post-mining landforms

OEA and other disturbed land will be rehabilitated to a condition that is self-sustaining or one where maintenance requirements are consistent with the agreed post-mining land use(s).

1.2.3 Preservation of downstream water quality

Rehabilitation will aim to ensure that surface water and groundwater that leaves the Study Area will 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 Study Area.

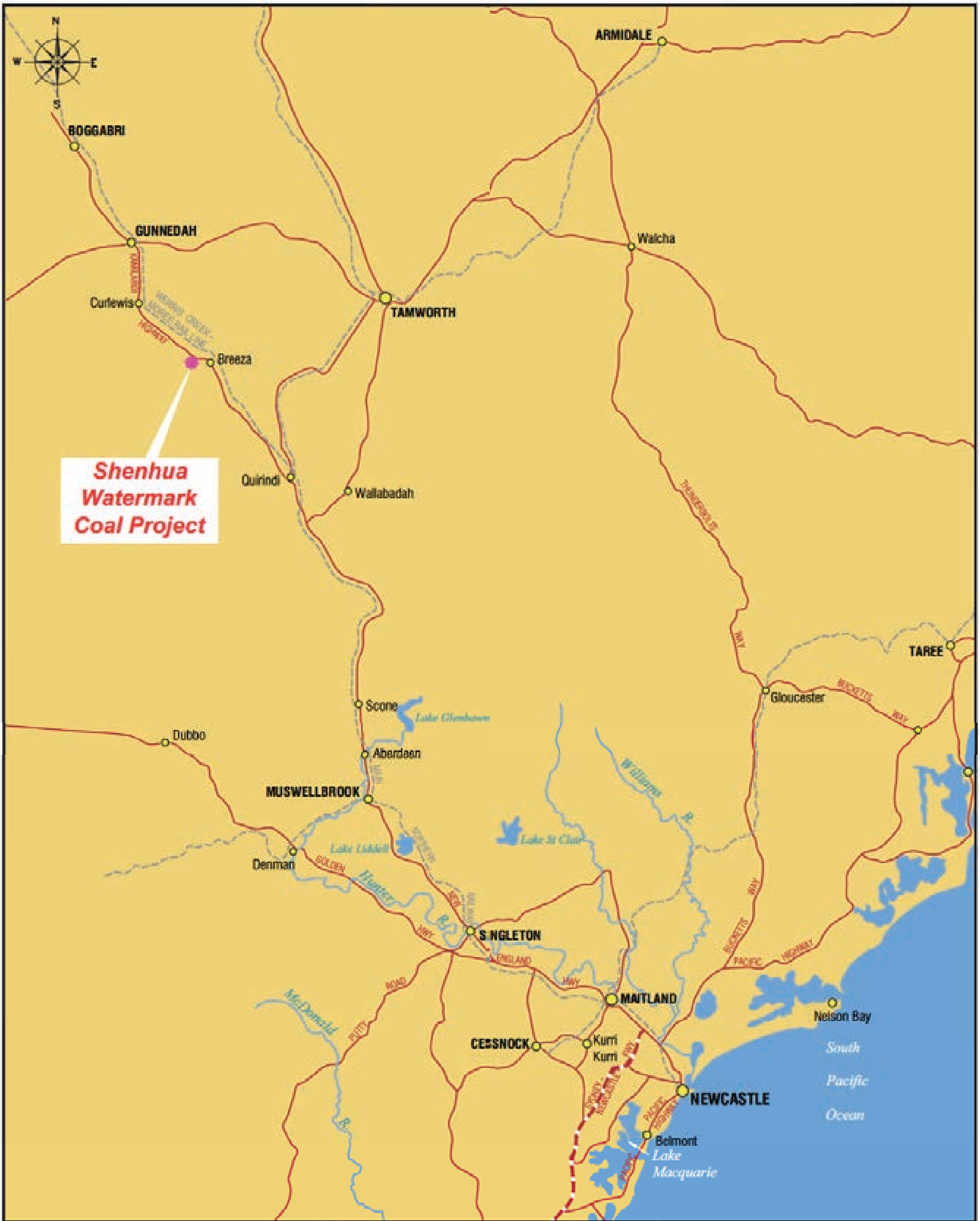


					FIGURE 1	Project: Shenhua Watermark Rehabilitation Strategy
					Locality Plan	Client: Hansen Bailey Pty Ltd (Singleton)
Version: 1, 2	Date: 07/06/12, 25/07/12	Author: ZJ, KC	Checked: MH, MH	Approved: CR, CR	GSS ENVIRONMENTAL Environmental, Land and Project Management Consultants	File: Fg1_HAN10-002_LocalityPlan_120725
						Projection:

To achieve these objectives, this strategy will recommend:

- Rehabilitation strategies for areas that are expected to be affected by surface disturbance;
- Short, medium and long term objectives for the rehabilitation of the Study Area;
- An effective revegetation program;
- An effective monitoring program to assess performance of the rehabilitated areas; and
- Objectives and preliminary success criteria for mine closure.

This report has generally been prepared in accordance with the requirements of the following relevant strategic land use planning and resource management plans and policies:

- EDG03 – Guidelines to the Mining, Rehabilitation & Environmental Management Process (NSW Department of Trade and Investment);
- The Strategic Framework for Mine Closure (ANZMEC & MCA, 2000);
- Mine Rehabilitation – Leading Practice Sustainable Development Program for the Mining Industry (Commonwealth of Australia, 2006); and
- Mine Closure and Completion - Leading Practice Sustainable Development Program for the Mining Industry (Commonwealth of Australia, 2006).

1.3 Director General's Requirements

This Rehabilitation Strategy has been prepared in accordance with the Director General's Requirements (DGRs) (SSD-4975) issued for the Project. **Table 1** below summarises the DGRs relevant to rehabilitation and indicates where specific issues have been addressed in this document.

This Rehabilitation Strategy has also been prepared in consideration of input to the DGRs from Trade & Investment – Resources & Energy, Department of Primary Industries – Agriculture, Namoi Catchment Management Authority (Namoi CMA) and NSW Office of Water. This is show in **Table 2** below.

Table 1
Summary of Director General's Requirements

DGRs	Addressed in Report
The Environmental Impact Statement (EIS) for this development must include the proposed rehabilitation strategy for this site, having regard of the key principles in the Strategic Framework for Mine Closure, including:	
1. Rehabilitation objectives, methodology, monitoring programs, performance standards and proposed completion criteria;	**Sections 4.0, 5.0, 6.0 & 7.0**
2. A nominated final land use, having regard to any relevant strategic land use planning or resource management plans or policies; and	**Sections 3.3, 4.0 & 6.0**
3. The potential for integrating this strategy with any other rehabilitation and/or offset strategies in the region.	**Section 4.0 & 5.0**

Table 2
Summary of Agency Comments to DGRs

Agency Comment	Addressed in Report
Trade & Investment – Resources & Energy	
Post Mining land Use – For the project area directly impacted (by mining facilities and infrastructure) the proponent must identify and assess post mining land use options and provide a statement of the preferred post mining land use outcome in the EIS. This should include a discussion of the benefits of the post mining land use to a subsequent landowner, the local community and the state of NSW.	**Section 4.0**
Rehabilitation Objectives and Domains – A set of project rehabilitation objectives must be included that clearly define the environmental outcomes required to achieve the post-mining land use. This should include identification of each rehabilitation domain and a description of rehabilitation objectives for each domain.	**Section 4.2**
Rehabilitation Methodology – Outline general rehabilitation methods and procedures that will be employed by the project to ensure the rehabilitation objectives for each domain are met.	**Section 5.0**
Strategic Rehabilitation Completion Criteria – Nominate strategic completion criteria for the five phases of the rehabilitation process, namely (1) Decommissioning; (2) Landform Establishment; (3) Growth Media Development; (4) Ecosystem Establishment; and (5) Ecosystem Development. If necessary, objective criteria may be presented as ranges rather than finite indicator levels. Subjective criteria may also apply where a gap in technical knowledge is experienced. It is expected that further refinement of these criteria will be undertaken and included in the Mining Operations Plan (MOP) or Rehabilitation and Environmental Management Plan (REMP).	**Section 7.0**

Agency Comment	Addressed in Report
Conceptual Final landform Design – A drawing at an appropriate scale with final landform contours should be provided. This drawing should identify, but not be limited to, the following attributes of the final landform; vegetation types, habitat features, contaminated areas, final voids, access and internal roads, fencing design and other remaining infrastructure such as sheds, dams, bores and pipelines.	**Section 2.0**
Namoi CMA	
Proposed methods of rehabilitation, land uses and final landforms which should be similar to current land uses and landforms. Detailed plans of proposed landforms including the location and specifications of emplacements and voids should be included in the EIS.	**Sections 4.0, 5.0, 10.0 & 11.0**
Impacts of clearing, access and rehabilitation on the current and proposed long term land uses. These activities have the potential to result in soil degradation and erosion and off site sedimentation, reduced water quality, weed invasion and changes to vegetation communities and therefore altered land use and management.	**Sections 4.0 & 5.0**
Reject disposal and the methods for rehabilitation and long term land uses, especially with regards to the potential for salinity and pH impacts on soils, surface and groundwater. Measures to mitigate impacts and safeguard against impacts need to be addressed in the EA.	**Sections 10.0 & 11.0** **Refer to Groundwater & Surface Water Impact Assessments (AGE, 2013 & WRM, 2013)** **Refer to Geochemical Assessment (RGS 2013)**
The EIS needs to consider the impacts, safeguards and contributions especially in consideration of the Catchment Targets within the Namoi CAP (2010-2020).	**Section 3.0, 4.0 & 5.0**
Department of Primary Industries - Agriculture	
The strategic approach to how the development is to be staged so as to minimise the placement of overburden on agricultural land is noted and commended. The commitment to placement of over burden on/in pre mined areas is commended. This staging of the development could be further highlighted along with any other initiatives to minimise the impact of final voids.	**Section 3.0, 4.0 & 5.0**
Mine Rehabilitation. The standard of mine rehabilitation being demanded by the community is to a higher standard. The significance of agricultural production of the area will also draw greater attention to the rehabilitation standard with particular focus on its productive potential component, including but not limited to subsoil constraints and soil fertility.	**Sections 3.0, 4.0 & 5.0**

Agency Comment	Addressed in Report
NSW Office of Water	
Justification of the proposed final landform with regard to minimising the impact on local and regional groundwater and surface water systems.	**Sections 11.0 & 10.0**
The measures that would be established for the minimisation of impacts on local and regional groundwater and surface water systems, and for the ongoing management of the site following the cessation of the project.	**Refer to Groundwater & Surface Water Impact Assessments (AGE, 2013 & WRM, 2013)**
Detailed modelling of potential groundwater volume, flow and quality impacts associated with the presence of an inundated final void on identified receptors, specifically considering those environmental systems that are likely to be groundwater dependent.	**Refer to Groundwater & Surface Water Impact Assessments (AGE, 2013 & WRM, 2013)**
A detailed description of the measures to be put in place to ensure that sufficient resources are available to implement the proposed rehabilitation of water related impacts.	**Refer to Groundwater & Surface Water Impact Assessments (AGE, 2013 & WRM, 2013)**

1.4 Structure of the Rehabilitation Strategy

The following sections summarise the key aspects addressed in this Rehabilitation Strategy:

Section 2 – Project Description describes:

- The key aspects of the Project proposed; and
- The general mining and rehabilitation sequence proposed for the Project.

Section 3 – Land use and Objectives describes:

- The nominated final land use of the Study Area; and
- The nominated rehabilitation objectives for the Project.

Section 4 – Rehabilitation Management provides:

- A methodology to integrate rehabilitation of the disturbed areas with surrounding land uses;
- Short and long term objectives for the rehabilitation of the Study Area;
- An effective rehabilitation program that includes targeted rehabilitation, landform establishment, topsoil management, revegetation and rehabilitation maintenance; and
- Industry best practice rehabilitation procedures.

Section 5 – Rehabilitation Monitoring provides:

- An effective monitoring programme to assess performance of the rehabilitated areas; and
- Individual aspects of the rehabilitation to be monitored.

Section 6 – Rehabilitation Success Criteria provides details of:

- Preliminary success criteria for specific areas of the operation; and
- Anticipated level of success.

Section 7 – Decommissioning and Mine Closure provides details of:

- The conceptual mine closure strategy for the Project; and
- Proposed measures to manage the environmental impacts of mine closure.

Section 8 – Final Void Management provides details of:

- The nature of the final void that will remain following cessation of mining;
- The final stability and rehabilitation of the final void;
- Actions to address long term final void water quality; and
- Post closure safety and final land use options for the final void.

1.5 Domain Plan

Rehabilitation of the final landform will be undertaken on a domain basis, which represent land management units or discrete rehabilitation areas or post-mine landforms that will be rehabilitated using varying techniques suited to the type of disturbance and the proposed post-mine land use. The domains are listed below.

Domain 1: Infrastructure Areas (153 ha). This domain consists of all buildings, structures, dams and hardstand areas associated with mining operations. The infrastructure is assumed to be removed following the cessation of mining and the land rehabilitated to the desired post mining land condition.

Domain 2: Open Cut Areas (2,440 ha). This domain refers to the area proposed to be disturbed by excavation for the extraction of coal. This domain includes areas within the Eastern, Southern and Western mining areas. The majority of this domain will be formed with overburden and rehabilitated to the desired post mining land condition. The final void is included in Domain 2.

Domain 3: Overburden Emplacements (944 ha). This domain consists of the areas where overburden is placed, which do not undergo excavation within the three mining areas. The rehabilitation and management of these overburden emplacement areas will be consistent with Domain 2.

Domain 4: Rail Loop (53 ha). This domain is limited to the area upon which the rail loop is located with a buffer of 20m either side to allow for the access track and ballast. The rail loop is assumed to be removed following the cessation of mining and the land rehabilitated to the desired post mining land condition.

Domain 5: Undisturbed Land (within Project Boundary) (5,910 ha) – This land will be managed to maintain its condition and to ensure it maintains its land capability as well as the biodiversity targets set for post mining rehabilitation.

Domain 6: Undisturbed Shenhua Owned Land (within EL 7223) – This land lies outside the project boundary however Shenhua will be ultimately responsible for the management of this land and therefore maintenance of the land condition and inclusion into the biodiversity objectives will be required.

2.0 PROJECT DESCRIPTION

2.1 Project Overview

Shenhua Watermark is seeking State Significant Development Consent under Division 4.1 of Part 4 of the *Environmental Planning & Assessment Act 1979* (EP&A Act) for the Project. The Project Application Boundary (Project Boundary) is shown on **Figure 2**.

The Project generally comprises:

- The construction and operation of an open cut mining operation extracting up to 10 Million tonnes per annum (Mtpa) of Run of Mine (ROM) coal for a 30 year period;
- An open cut mining fleet of excavators and shovels, supported by haul trucks, dozers, graders, drill rigs and water carts;
- Progressive rehabilitation of all disturbed areas;
- The construction and operation of a Coal Handling and Preparation Plant (CHPP) with a throughput of 10 Mtpa ROM coal;
- The co-disposal of tailings and coarse reject within the Overburden Emplacement Areas (OEA);
- The construction and operation of a rail spur, rail loop, Kamilaroi Highway rail overpass, associated load out facility and connection to the Werris Creek - Moree Railway Line;
- The construction and operation of a Mine Access Road;
- The construction and operation of administration, workshop and related facilities;
- The construction and operation of ground and surface water management and reticulation infrastructure including pipelines, pumping stations and associated infrastructure for access to water from groundwater aquifers, the Mooki River and private dams to the north-east of the Project Boundary;
- The installation of communications and electricity reticulation infrastructure; and
- A workforce of up to approximately 600 full-time equivalent employees during construction and up to 600 full-time equivalent employees during the operation of the Project.

2.2 Mining Description

Mining operations commence with an initial box cut in the north-west of the Eastern Mining Area. Overburden is planned to be removed by electric rope shovels, hydraulic excavators and haul trucks. Coal seams will be uncovered and selectively mined using front end loaders and rear dump trucks.

Overburden from this mining area is initially placed to the immediate north and east and expediently rehabilitated so as to visually shield the mining operation from the Kamilaroi Highway. Mining continues to progress down-dip of the coal seams towards the eastern extent of the Study Area until Year 12. The active mining area then shifts to the southern side of Eastern Mining Area and commences mining in reverse direction, up-dip back towards the initial box cut. Overburden is then progressively placed and rehabilitated behind the active mining area, up to RL 380. By Year 17, active mining is completed in the Eastern Mining Area.

In Year 17, mining operations commence in the northern end of Southern Mining Area, progressing to the south-west. Overburden from the Southern Mining Area is initially utilised to backfill the Eastern Mining Area void. By Year 21, the Eastern Mining Area is completely backfilled and rehabilitated up to RL 340. Overburden from the Southern Mining Area is then placed behind active mining so as to develop an OEA. By Year 24, active mining is completed in the Southern Mining Area.

In Year 24, mining operations commence in the eastern edge of the Western Mining Area, progressing to the west. All overburden from this area is initially utilised to backfill the Southern Mining Area void. By Year 26, the Southern Mining Area is completely backfilled and rehabilitated up to RL 380. Overburden from the Western Mining Area is then placed behind active mining so as to develop an OEA. By Year 30, active mining in this area is completed leaving a final void distant from the blacksoil plains.

The conceptual mine plan figures illustrating the progressive rehabilitation of the Study Area and final landform are presented in **Figure 3** to **Figure 9**.

2.3 Rehabilitation Description

Rehabilitation activities for the Project will be undertaken progressively and as early as practicable to ensure that the total area of disturbance at any one time is minimised. This will be conducted in concert with the open cut mining process. The general progression of rehabilitation over the life of the Project is shown in the conceptual mine plans in **Figure 3** to **Figure 9**.

Table 3 outlines the conceptual rehabilitation schedule for the Project, detailing the areas proposed to be rehabilitated throughout the mine life.

Table 3
Conceptual Rehabilitation Schedule

Project Year	Total Overburden (Mbcm)	ROM Coal (Mtpa)	Rehabilitation (Ha)
Year 1	9.70	0.1	0
Year 2	27.34	2.7	10
Year 5	43.36	10.0	159
Year 10	68.24	10.0	167
Year 15	67.98	9.8	202
Year 21	68.21	9.9	670
Year 25	63.52	10.0	1,136
Year 30	6.90	1.9	815
Total	**1,629**	**268.3**	**3,348**

Generally, overburden will be emplaced up to final rehabilitation surface level and bulldozers will progressively shape the overburden to 10 degree slopes or less. A slope analysis of the conceptual final landform is shown on **Figure 16**. This will allow continuous emplacement of subsoil and topsoil over the shaped surface to ensure a stable final landform, ready for seeding. Erosion and sediment control and water management structures will be incorporated into the landform as rehabilitation progresses.

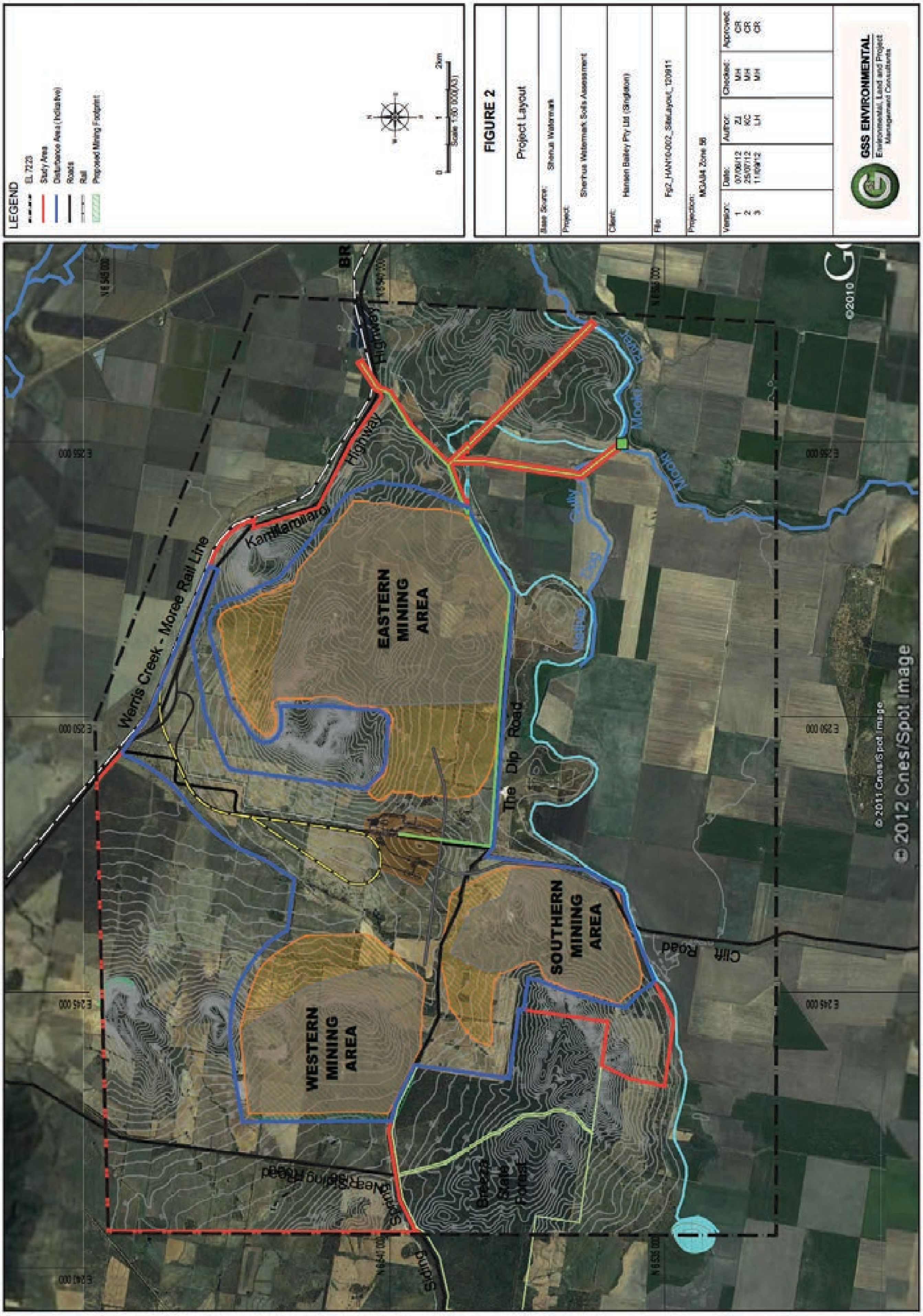
Further detail on the objectives of the rehabilitation and species selection is provided in **Section 5.0**.

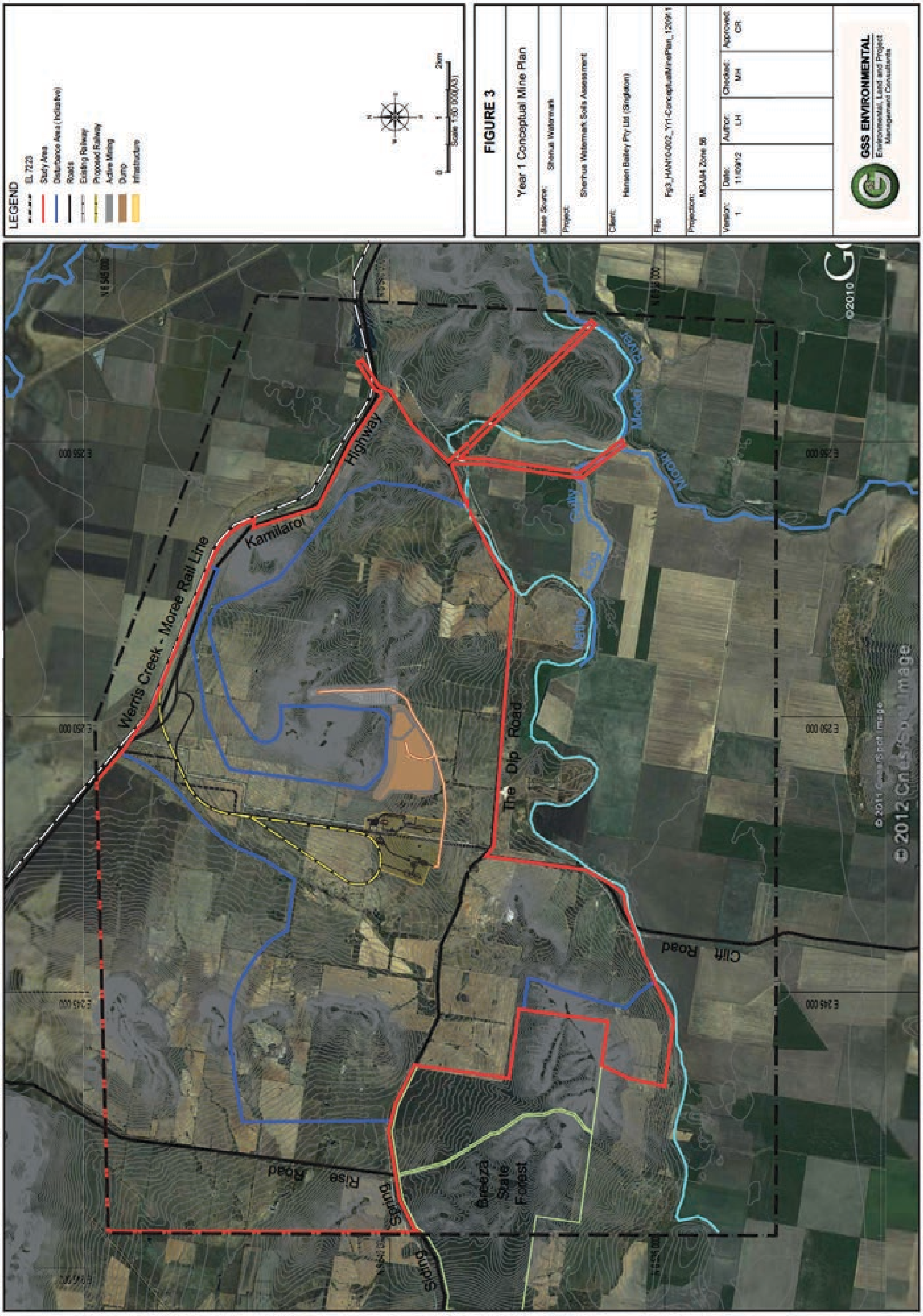
2.4 Biodiversity Offset Strategy

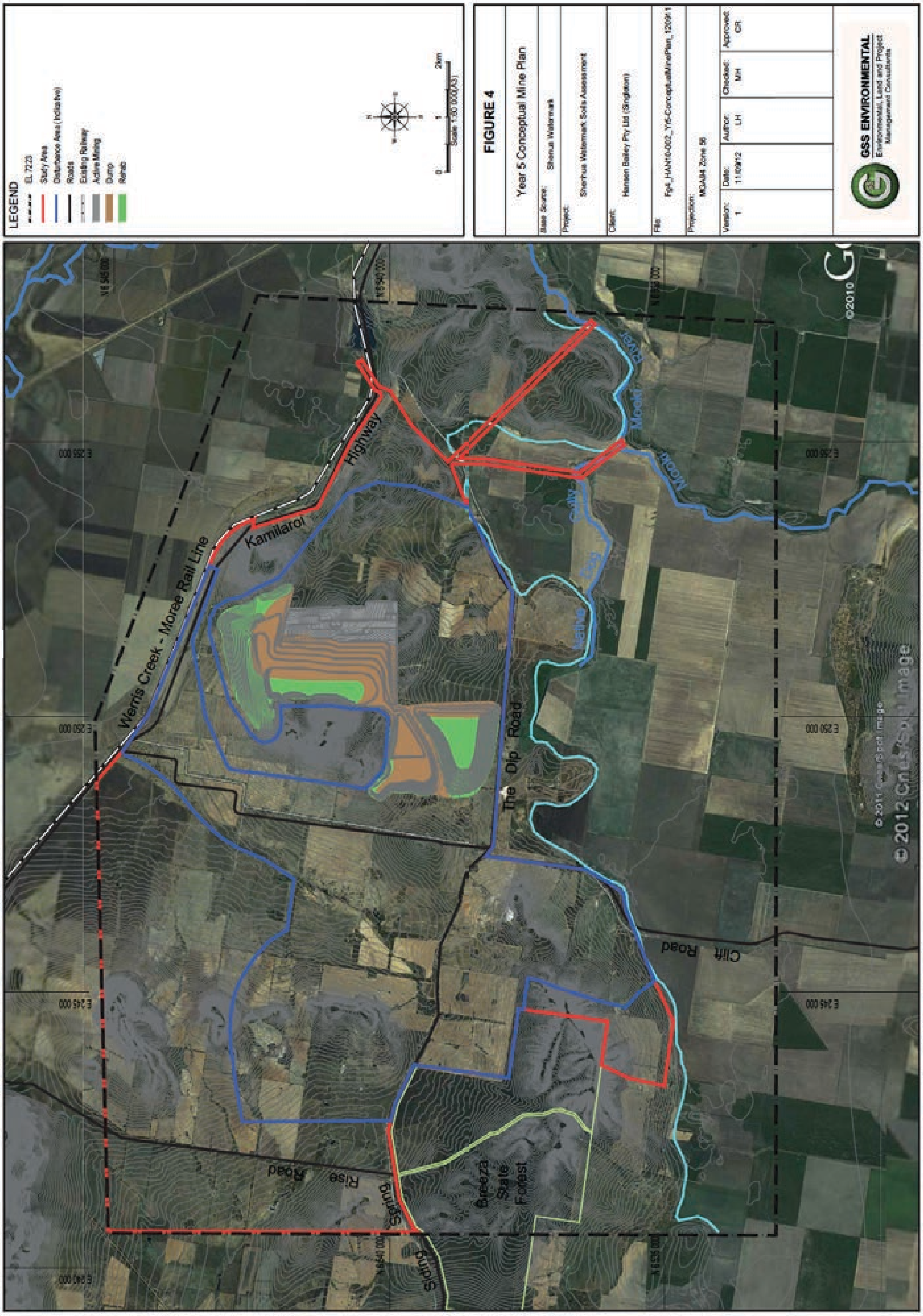
The Biodiversity Offset Strategy for the Project aims to provide a net improvement in the quality of vegetation, koala habitat corridors and Critically Endangered Ecological Communities (CEEC) in the local area. Key components of the Biodiversity Offset Strategy include:

- Re-establishing riparian vegetation along the Mooki River and improve river health;
- Re-establishing Box Gum Woodland CEEC as part of the mine rehabilitation process;
- Developing and contributing to research into Box Gum woodland re-establishment and Koala health;
- Establishing an offset area to the immediate north-west of the Study Area and re-establish areas where possible (referred to as Offset Area 6) (see **Figure 10**);
- Establishing an offset area around Mt Watermark;
- Establishing an off-site offset area near Barraba, in the north west of NSW (see **Figure 11**); and
- Establishing biodiversity corridors between the mine rehabilitation, Mt Watermark, Offset Area 6, Mooki River re-establishment areas and the Breeza State Forest.

As noted above, the successful rehabilitation of buffer areas and mining areas with native vegetation and CEEC is a key component of the Biodiversity Offset Strategy for the Project. This is addressed throughout this Rehabilitation Strategy.


LEGEND
FIGURE 2
Project Layout
EASTERN MINING AREA
SOUTHERN MINING AREA
WESTERN MINING AREA
Werris Creek - Moree Rail Line
Kamilaroi
Highway
The Dip Road
Clift Road
GSS ENVIRONMENTAL
© 2012 Cnes/Spot Image


LEGEND
EL 7223
Study Area
Disturbance Area (Indicative)
Roads
Existing Railway
Proposed Railway
Active Mining
Dump
Infrastructure
FIGURE 3
Year 1 Conceptual Mine Plan
Client:
Hansen Bailey Pty Ltd (Singleton)
Projection:
MGA94 Zone 56
Version:
1
Author:
LH
Checked:
MH
Approved:
CR
GSS ENVIRONMENTAL
Kamilaroi Highway
Werris Creek - Moree Rail Line
The Dip Road
Cliff Road
Spring Ridge Road
Breeza State Forest
Mooki River


LEGEND
EL 7223
Study Area
Disturbance Area (Indicative)
Roads
Existing Railway
Active Mining
Dump
Rehab
FIGURE 4
Year 5 Conceptual Mine Plan
Base Source:
Shenhua Watermark
Project:
Shenhua Watermark Soils Assessment
Client:
Hansen Bailey Pty Ltd (Singleton)
Projection:
MGA94 Zone 56
Version:
1
Date:
11/09/12
Author:
LH
Checked:
MH
Approved:
CR
GSS ENVIRONMENTAL
Werris Creek - Moree Rail Line
Kamilaroi
Highway
The Dip Road
Cliff Road
Rise Road
Spring
Breeza State Forest
Mooki
River
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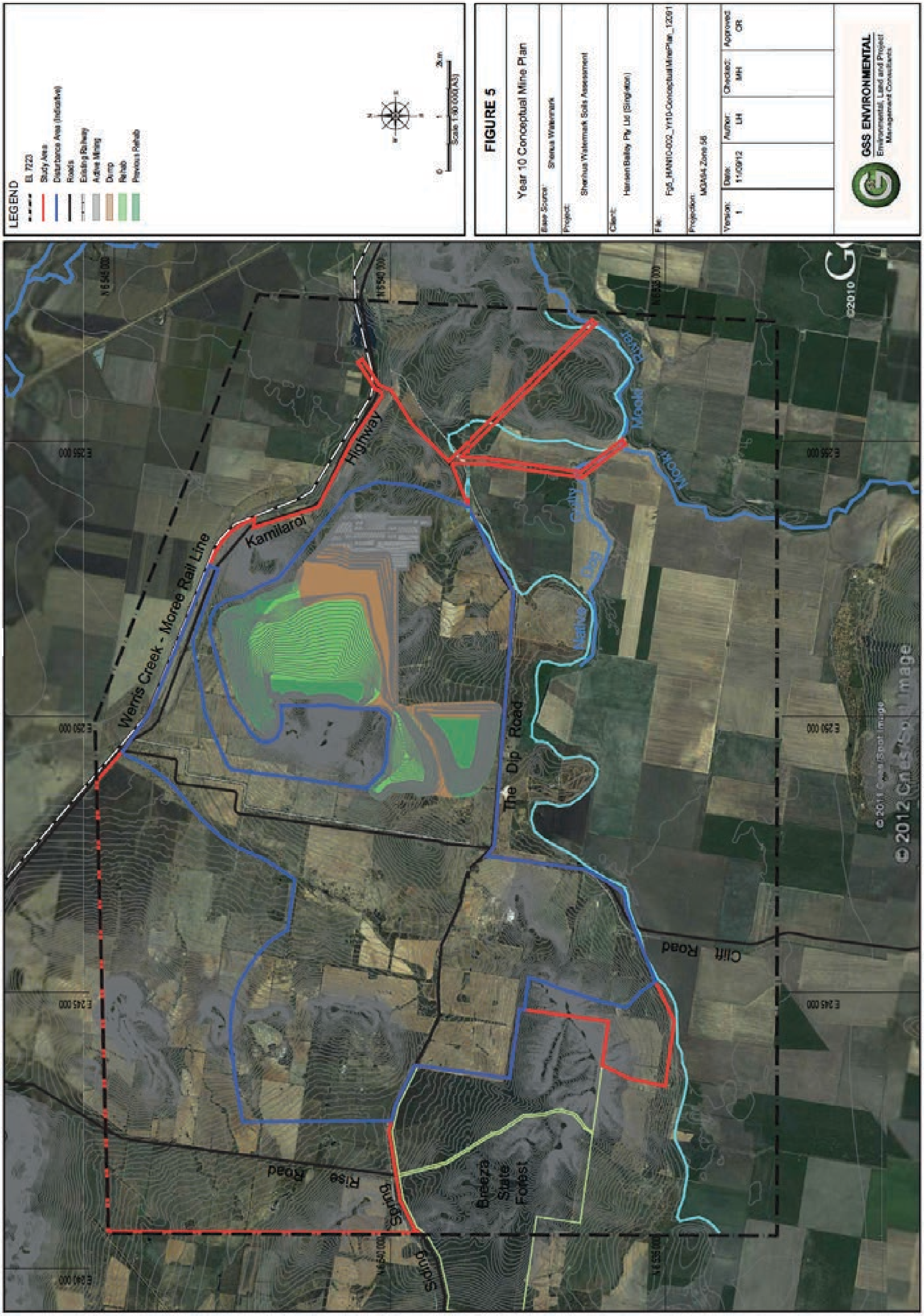
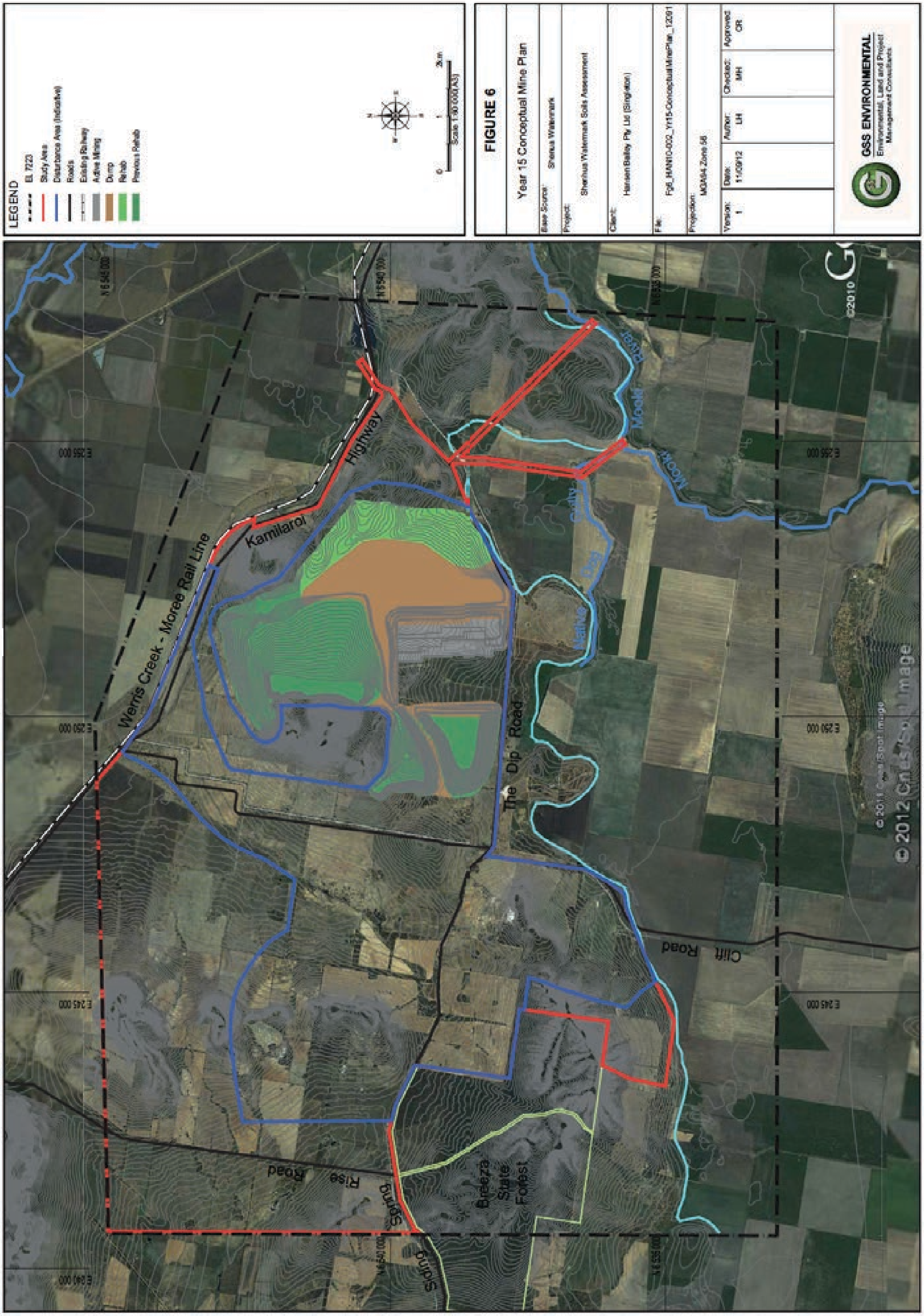
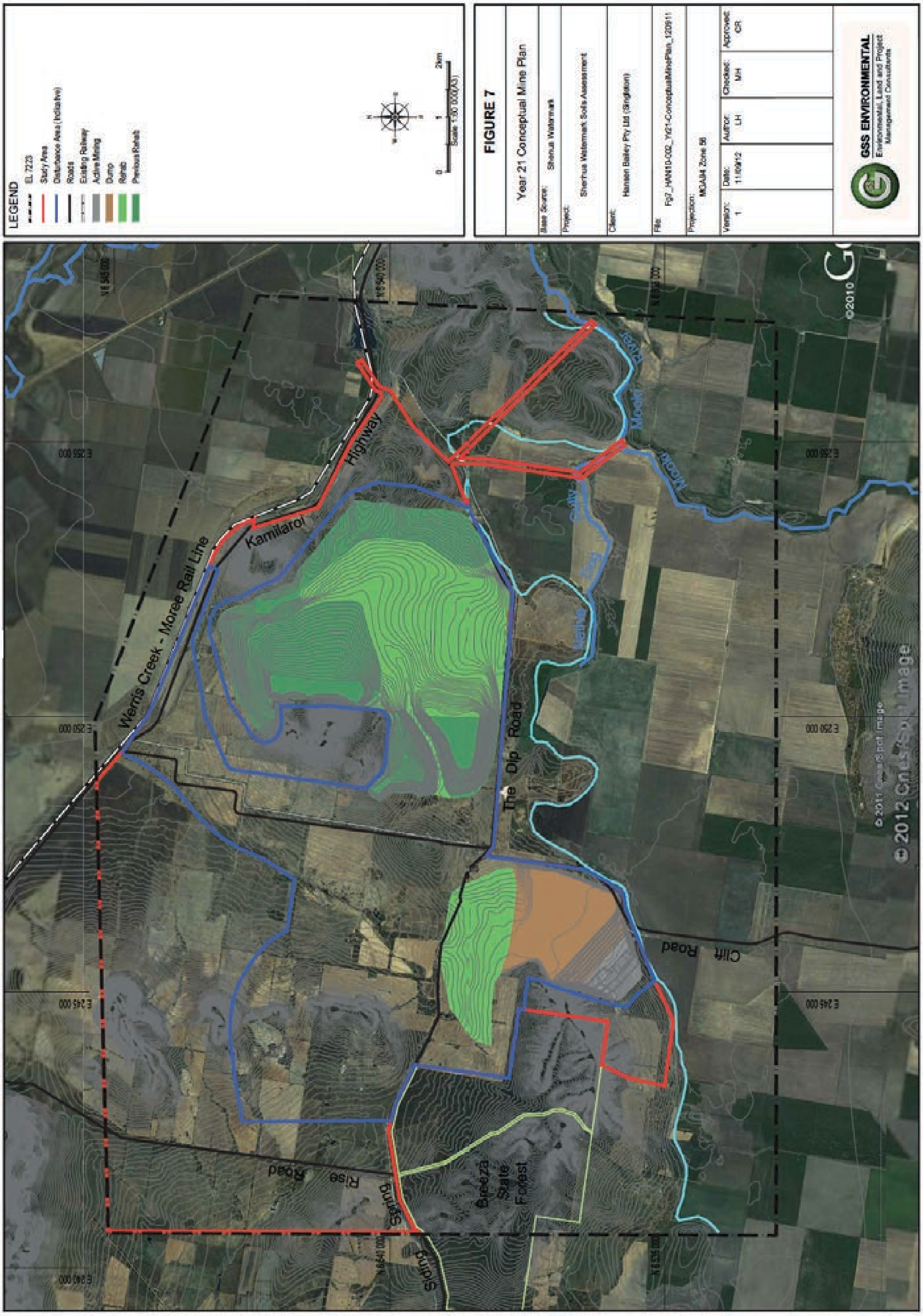
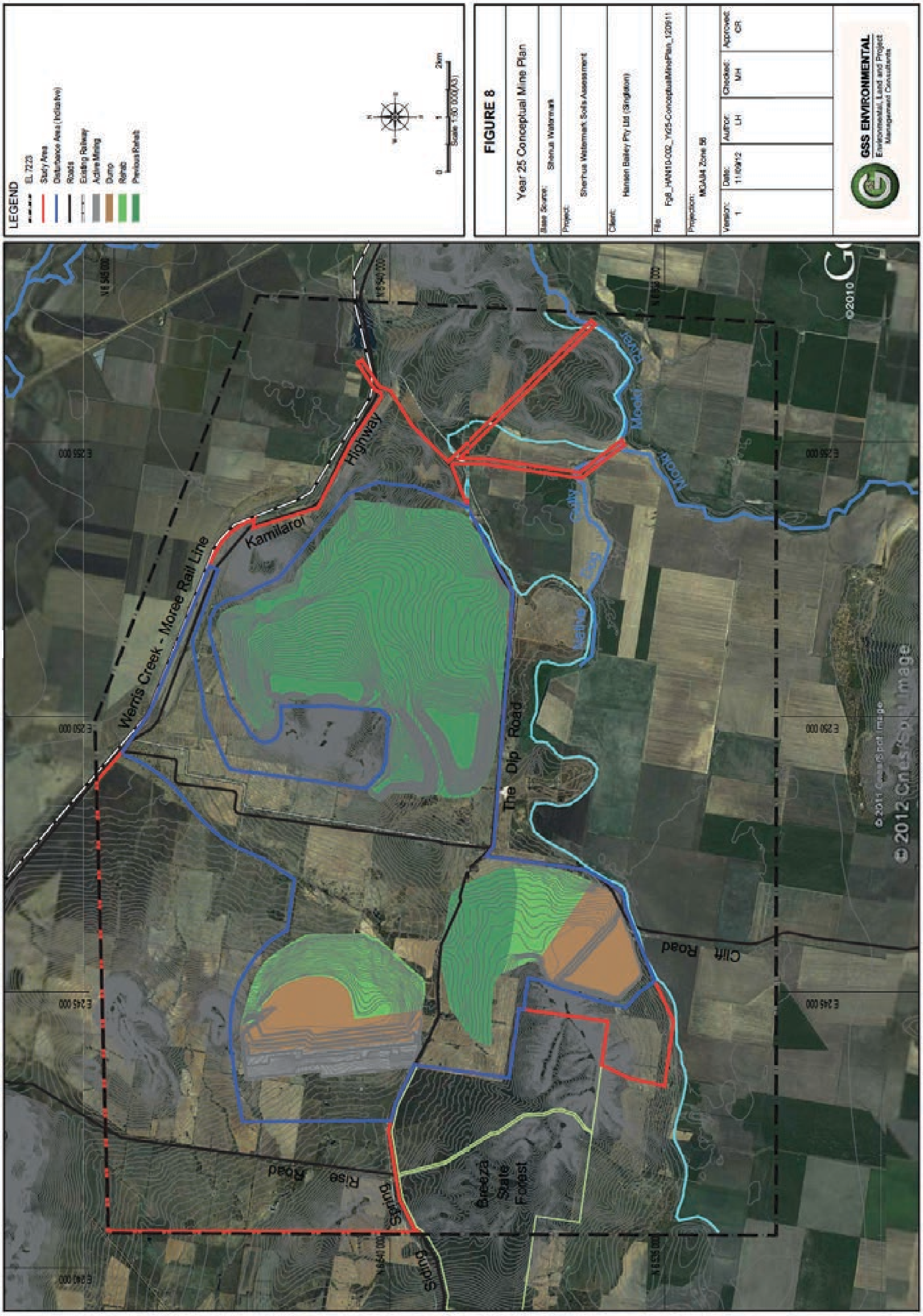


FIGURE 5
Year 10 Conceptual Mine Plan
Kamilaroi Highway
Werris Creek - Moree Rail Line
The Dip Road
Cliff Road
Rise Road
Spring
Breeza State Forest
Mooki


LEGEND
EL 7223
Study Area
Disturbance Area (Indicative)
Roads
Existing Railway
Active Mining
Dump
Rehab
Previous Rehab
FIGURE 6
Year 15 Conceptual Mine Plan
GSS ENVIRONMENTAL
Werris Creek - Moree Rail Line
Kamilaroi
Highway
The Dip Road
Cliff Road
Rise Road
Breeza State Forest
Native Dog Gully
Mooki
River


LEGEND
EL 7223
Study Area
Disturbance Area (Indicative)
Roads
Existing Railway
Active Mining
Dump
Rehab
Previous Rehab
FIGURE 7
Year 21 Conceptual Mine Plan
Kamilaroi Highway
Werris Creek - Moree Rail Line
The Dip Road
Cliff Road
Rise Road
Spring Ridge
Breeza State Forest
Mooki River
GSS ENVIRONMENTAL


LEGEND
EL 7223
Study Area
Disturbance Area (Indicative)
Roads
Existing Railway
Active Mining
Dump
Rehab
Previous Rehab
FIGURE 8
Year 25 Conceptual Mine Plan
Base Source: Shenhua Watermark
Project: Shenhua Watermark Soils Assessment
Client: Hansen Bailey Pty Ltd (Singleton)
Projection: MGA94 Zone 56
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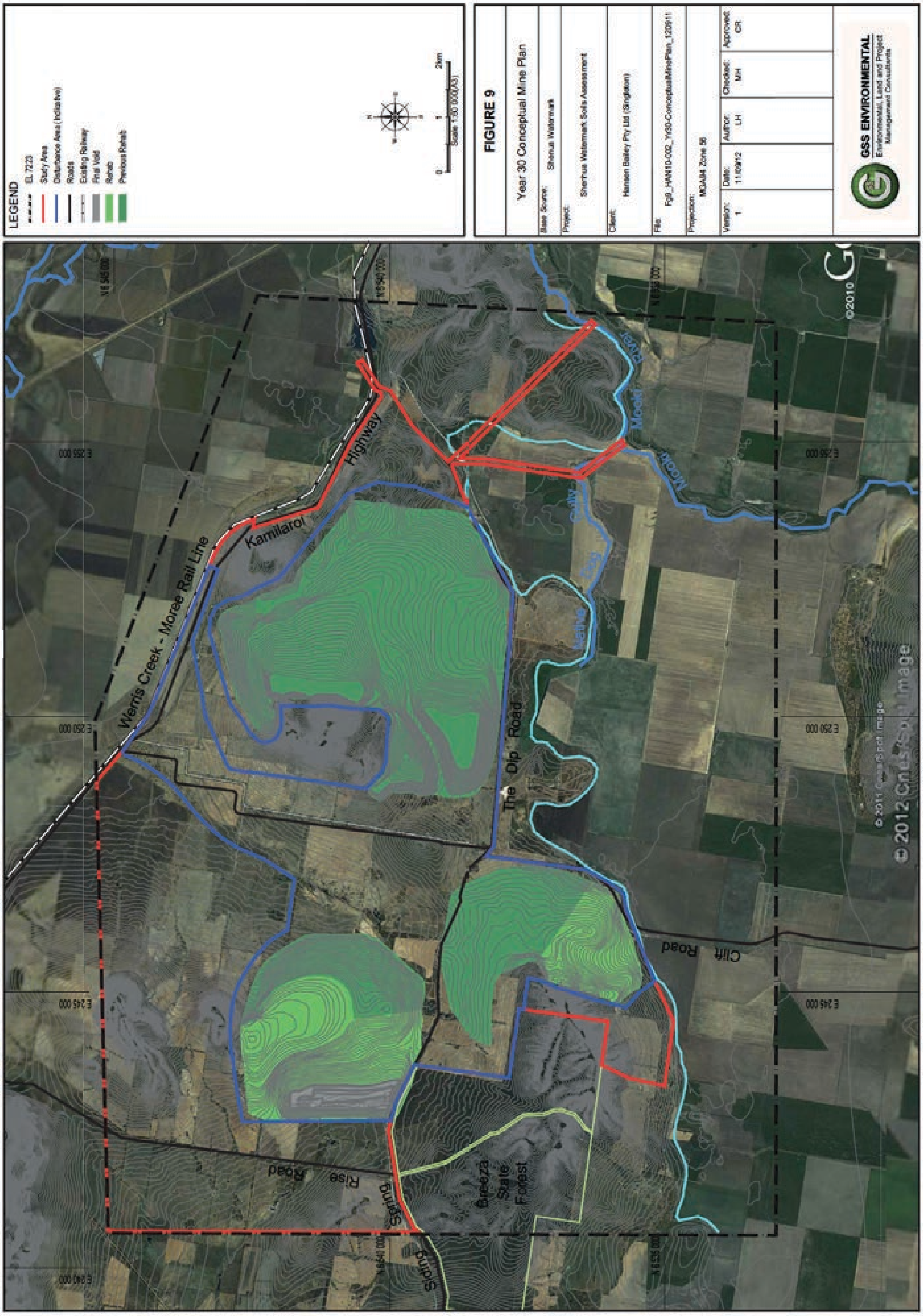
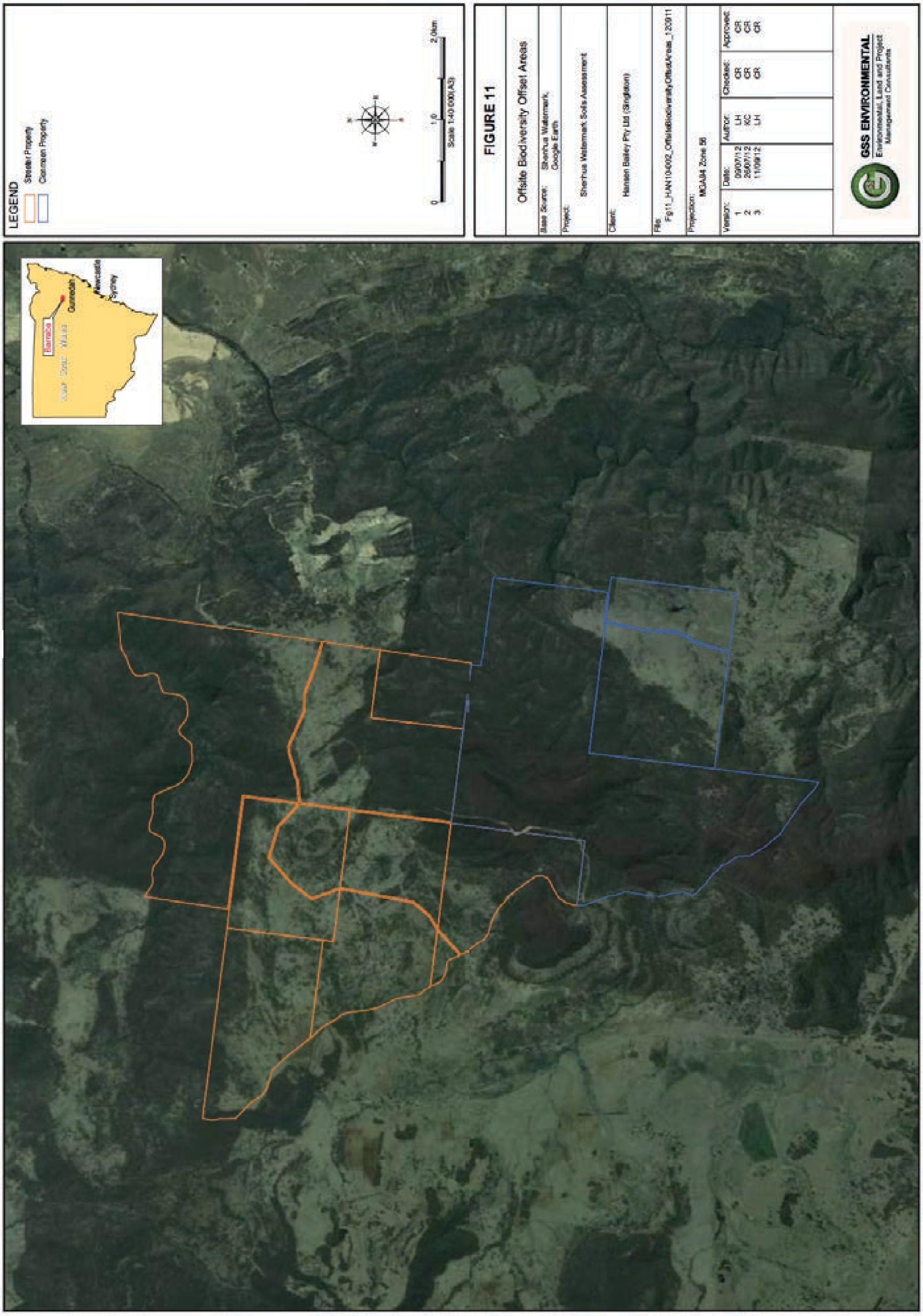
Environmental, Land and Project Management Consultants
Kamilaroi
Highway
Werris Creek - Moree Rail Line
The Dip Road
Cliff Road
Mooki
Breeza State Forest
Rise Road
Spring
Siding


LEGEND
FIGURE 9
Year 30 Conceptual Mine Plan
GSS ENVIRONMENTAL
Kamilaroi
Highway
Werris Creek - Moree Rail Line
The Dip Road
Cliff Road
Rise Road
Spring
Siding
Breeza
State
Forest
Mooki
River
©2010
© 2012 Cnes/Spot Image


LEGEND
EL 7223
Study Area
Disturbance Area (Indicative)
Roads
Rail
Proposed Mining Footprint
Onsite Biodiversity Offset Areas
FIGURE 10
Onsite Biodiversity Offset Areas
Base Source: Shenhua Watermark Coal Project, Google Earth
Project: Shenhua Watermark Rehabilitation Strategy
Client: Hansen Bailey Pty Ltd (Singleton)
Projection: MGA94 Zone 56
GSS ENVIRONMENTAL
Environmental, Land and Project Management Consultants
Highway
Kamilaroi
Werris Creek - Moree Rail Line
Mt Watermark Offset Area
The Dip Road
Cliff Road
Breeza State Forest
Offset Area 6
Google


LEGEND
FIGURE 11
Offsite Biodiversity Offset Areas
Base Source:
Shenhua Watermark,
Google Earth
Project:
Shenhua Watermark Soils Assessment
Client:
Hansen Bailey Pty Ltd (Singleton)
File:
Projection:
MGA94 Zone 56
Version:
Date:
Author:
Checked:
Approved:
GSS ENVIRONMENTAL
Gunnedah
Newcastle
Sydney

3.0 STATUTORY FRAMEWORK, PLANS & GUIDELINES

3.1 Statutory Planning Instruments

The Study Area is predominantly located on land zoned as RU1 (Primary Production) under the *Gunnedah Local Environment Plan 2012* (LEP). Small portions of the Study Area located to the immediate west of the Eastern Mining Area (Mt Watermark) and to the north of the Western Mining Area, are zoned as E3 (Environmental Management).

The objectives of RU1 (Primary Production) are to:

- *Encourage sustainable primary industry production by maintaining and enhancing the natural resource base;*
- *Encourage diversity in primary industry enterprises and systems appropriate for the area;*
- *Minimise the fragmentation and alienation of resource lands;*
- *Minimise conflict between land uses within this zone and land uses within adjoining zones;*
- *Provide for a range of ecologically sustainable agricultural and rural land uses and development on broad acre rural lands;*
- *Protect significant agricultural resources (soil, water and vegetation) in recognition of their value to Gunnedah's longer term economic sustainability; and*
- *Conserve and enhance the quality of valuable environmental assets, including waterways, riparian land, wetlands and other surface and groundwater resources, remnant native vegetation and fauna movement corridors as part of all new development and land use.*

The objectives of zone E3 (Environmental Management) are to:

- *Protect, manage and restore areas with special ecological, scientific, cultural or aesthetic values; and*
- *Provide for a limited range of development that does not have an adverse effect on those values.*

The conceptual final landform and rehabilitation strategy will be designed consistent with the above objectives from the Gunnedah LEP.

3.2 Relevant Guidelines

The following guidelines on mine site rehabilitation and closure are relevant to the Project:

- *EDG03 – Guidelines to the Mining, Rehabilitation & Environmental Management Process* (NSW Department of Trade and Investment, 2012);
- The *Strategic Framework for Mine Closure* (ANZMEC & MCA, 2000);
- *Mine Rehabilitation – Leading Practice Sustainable Development Program for the Mining Industry* (Commonwealth of Australia, 2006); and
- *Mine Closure and Completion - Leading Practice Sustainable Development Program for the Mining Industry* (Commonwealth of Australia, 2006).

Each is discussed briefly below.

3.2.1 Guidelines to the Mining Rehabilitation and Environmental Management Process

The *Guidelines to the Mining Rehabilitation and Environmental Management Process* (NSW Department of Trade and Investment – Division of Resources and Energy, 2012) (GMREMP) provide an overview of the approval process for mining developments in NSW and provides content and formatting requirements for Mining Operation Plans (MOPs) and Annual Reviews. The purpose of these documents is to "*ensure that all mining operations are safe, the resources are efficiently extracted, the environment is protected and rehabilitation achieves a stable and satisfactory outcome*." Specifically, the GMREMP provides the following criteria for mine site rehabilitation:

- *"Rehabilitation and rehabilitation outcomes should be consistent with the Environmental Impact Statement;*
- *Based on mine closure criteria and rehabilitation outcomes developed through stakeholder consultation;*
- *Integrates rehabilitated native vegetation with undisturbed native vegetation to provide larger areas and wildlife corridors;*
- *Suitable for an agreed subsequent land use as far as possible compatible with the surrounding land fabric and land use requirements;*
- *Addresses limitations on the use of rehabilitated land;*
- *Sustainable in terms of that land use;*
- *Stable and permanent landforms, with soils, hydrology, and ecosystems with maintenance needs no greater than those of surrounding land. (may include waste emplacements, voids, pits and water-bodies providing that they are part of the accepted final outcome);*
- *Securely and safely contain waste substances that have the potential to affect land use or result in pollution;*
- *Not present a hazard to persons, stock or native fauna;*
- *Addresses threatened species issues;*
- *Addresses heritage issues;*
- *Clean and tidy, and free of rubbish, metal and derelict equipment/structures, except for heritage and other agreed features; and*
- *Freedom from unacceptable air and water pollution, and other environmental effect outside the disturbed area."*

3.2.2 STRATEGIC FRAMEWORK FOR MINE CLOSURE

The *Strategic Framework for Mine Closure* (Australian and New Zealand Minerals and Energy Council & Minerals Council of Australia, 2000) (SFMC) was developed to promote nationally consistent mine closure management. SFMC provides guidelines for the development of a mine closure plan to ensure that all stages of mine closure are conducted appropriately, including stakeholder engagement, development of mine closure methodology, financial planning, and implementation of mine closure. The SFMC also describes the expected standards for mine closure and relinquishment of the mine to a responsible authority. The main objectives of the SFMC are:

- *"To enable all stakeholders to have their interests considered during the mine closure process;*
- *To ensure the process of closure occurs in an orderly, cost-effective and timely manner;*
- *To ensure the cost of closure is adequately represented in company accounts and that the community is not left with a liability;*

- *To ensure there is clear accountability, and adequate resources, for the implementation of the closure plan;*
- *To establish a set of indicators which will demonstrate the successful completion of the closure process;"* and
- *"To reach a point where the company has met agreed completion criteria to the satisfaction of the Responsible Authority."*

3.2.3 Mine Rehabilitation – Leading Practice Sustainable Development Program for the Mining Industry

The aim of *Mine Rehabilitation – Leading Practice Sustainable Development Program for the Mining Industry* (NSW Department of Industry, Tourism and Resources, 2006) (MR Handbook) is to provide guidelines to promote 'leading practice' sustainable mine plan and rehabilitation design, considering environmental, economic, and social aspects to support on-going sustainability of a mining development.

The MR Handbook recommends procedures and mitigation measures that should be considered during mine plan and rehabilitation design, including stakeholder consultation, material and handling, water balance, final landform design, topsoil management, vegetation and fauna habitat re-establishment and rehabilitation, and agriculture / commercial forestry suitability. The MR Handbook also provides relevant mine development case studies supporting the recommended procedures and mitigation measures.

3.2.4 Mine Closure and Completion - Leading Practice Sustainable Development Program for the Mining Industry

The aim of *Mine Closure and Completion – Leading Practice Sustainable Development Program for the Mining Industry* (NSW Department of Industry, Tourism and Resources, 2006) (MCC Handbook) is to provide guidelines to promote 'leading practice' sustainable mine closure and completion, minimising any long-term environmental, economic, and social impacts and resulting in a suitable final land form for an agreed land use. Specifically, the MCC Handbook provides that a progressive rehabilitation plan should be developed for mine closure, which ensures:

- *"the post-mined landscape is safe and is stable from physical, geochemical and ecological perspectives;*
- *the quality of the surrounding water resources is protected;*
- *the agreed sustainable post-mining land use is established and clearly defined to the satisfaction of the community and government" and*
- *success criteria are agreed with relevant stakeholders, monitored and reported to stakeholders".*

The MCC Handbook identifies the following aspects which are required to achieve sustainable mine closure:

- *"recognising and addressing the issues that a mining operation needs to consider in its planning for closure and completion;*
- *the development of a risk management approach to mine closure planning that applies from mine concept to post closure and integrated with whole-of-mine-life planning;*
- *the closure activities associated with each step in the mine life cycle including establishment of a progressive rehabilitation system;*
- *the processes and tools that can assist a mining operation achieve good practice in mine closure and completion; and*
- *the need for engagement with communities and regulators in establishing and implementing closure outcomes and practice".*

The MCC Handbook provides procedures and mitigation measures that should be considered during all stages of a mining development to ensure sustainable mine closure, including exploration, feasibility, planning and design, construction / commissioning, operations, decommissioning and closure.

3.3 Relevant Plans & Policies

3.3.1 Strategic Regional Land Use Policy – New England North West

In September 2012, the NSW Government released the *New England North West Strategic Regional Land Use Plan* (SRLUP). The SRLUP represents one component of the government's broader Strategic Regional Land Use Policy, which comprises multiple initiatives to address land use conflicts in regional areas, particularly focussed on managing coal mining and coal seam gas issues. While the New England/North West region is a highly productive agricultural region, it also has rapidly developing coal and coal seam gas industries. The SRLUP includes maps of the regions mineral resources and areas of Biophysical Strategic Agricultural Land (BSAL). The SRLUP presents strategies and action plans to balance agricultural and mining developments in the New England North West region.

3.3.2 Namoi Catchment Action Plan 2010 – 2020

The Namoi Catchment Action Plan (Namoi CAP) 2010 - 2020 is a strategic plan which guides sustainable natural resource management in the Namoi Catchment. The Namoi CAP complements other natural resource plans including water sharing plans, regional strategies and conservation plans. The Namoi CAP has a key role in addressing the environmental, social and economic priorities of the NSW State Plan and the Australian Government's Caring for our Country plan.

The Namoi CAP identifies the major natural resource management assets of the catchment, which are categorised into 4 themes: Biodiversity, Land, Water and People. Actions and targets are presented for each theme.

The relevant target for this Rehabilitation Strategy is Namoi CAP Catchment Target Land 1 which states: "*By 2020 there is an improvement in soil health as measured by an increase in groundcover at the paddock, sub-catchment and catchment scales.*"

4.0 POST MINING LAND USE & OBJECTIVES

4.1 Post-Mining Land use

4.1.1 Objectives

The final land use of the Study Area will be established for ecological conservation and agricultural purposes and will increase areas of Class III rural land capability throughout the Study Area and across all domains. This increase in land capability quality is a potential benefit for the local community and the state by increasing the area of land capable of sustaining cultivation and food production.

In this regard, the rehabilitation strategy for the Study Area will include the re-establishment of native woodland and grassland (including White Box Grassy Woodland CEEC) and areas designated for agricultural production. Non-disturbance areas of the Study Area will be enhanced to provide a suitable ecological habitat for CEEC and Koalas, with limited areas remaining as low diversity grassland grazing land to match that of surrounding land reference sites. This is reflected in the rehabilitation objectives presented below in **Section 4.2**.

The final land use proposed is consistent with the pre-mining land use strategies and the relevant planning instruments discussed in **Section 3.0**. Prior to disturbance, the land use of the Study Area was characterised by low diversity grassland and exotic pasture used for cattle grazing, limited rotational cropping and areas of remnant woodland vegetation.

4.1.2 Land Capability

A Soil Survey and Land Capability Assessment was undertaken by GSSE (2013) in accordance with the system administered by the NSW Department of Planning & Infrastructure (DP&I). This system was introduced by the former Soil Conservation Service of NSW and the relevant guideline is called S*ystems Used to Classify Rural Lands in New South Wales* (Cunningham et al., 1988).

The pre and post mining land capability assessment comparison focuses on the Disturbance Boundary, which includes all soils that have potential to be disturbed within the Study Area. The post mining prediction of the likely land capability classes to be achieved is based on soil profile parameters and industry best practice rehabilitation techniques as outlined in **Section 5.0** of this report.

The relevant land capability classes for the Study Area are displayed in **Table 4** and **Figure 12** and **Figure 13**.

Table 4
Pre & Post Mining Land Capability

Land Capability	Pre Mining		Post Mining		Change in Area	
	Area (ha)	Area (%)	Area (ha)	Area (%)	Area (ha)	Area (%)
Class II	351.3	6.2%	351.3	6.2%	0.0	0.0%
Class III	2,948.4	52.4%	3,233.0	57.4%	284.6	5.1%
Class IV	80.5	1.4%	22.7	0.4%	-57.8	-1.0%
Class V	1,751.5	31.1%	1,650.0	29.3%	-101.5	-1.8%
Class VI	426.8	7.6%	273.0	4.8%	-153.8	-2.7%
Class VII	55.4	1.0%	9.7	0.2%	-45.7	-0.8%
Class VIII	0.0	0.0%	86.8	1.5%	86.8	1.5%
Disturbed Land	16.6	0.3%	4.0	0.1%	-12.6	-0.2%
Total	**5,630.5**	**100.0%**	**5,630.5**	**100.0%**	**0.0**	**0.0%**

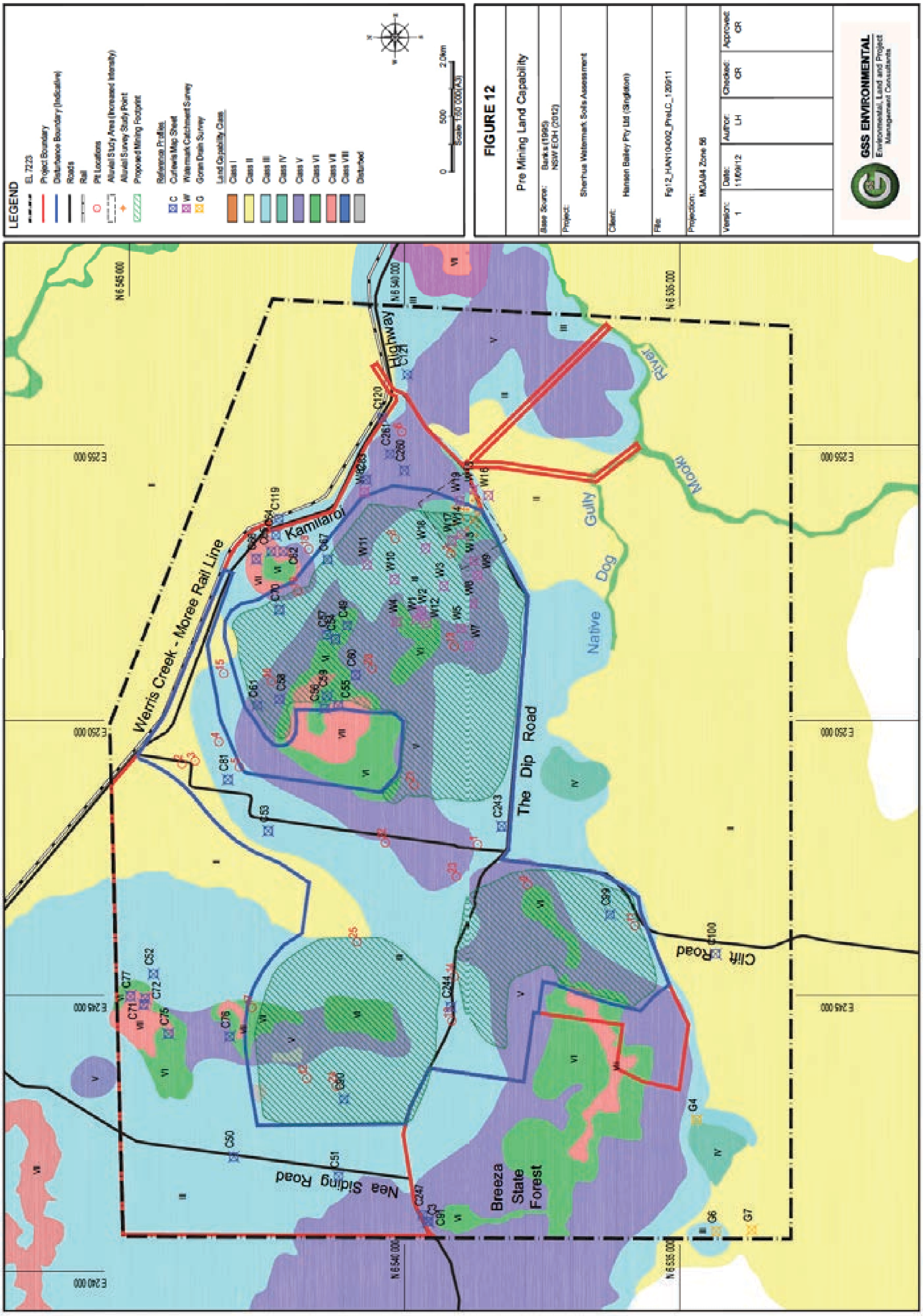
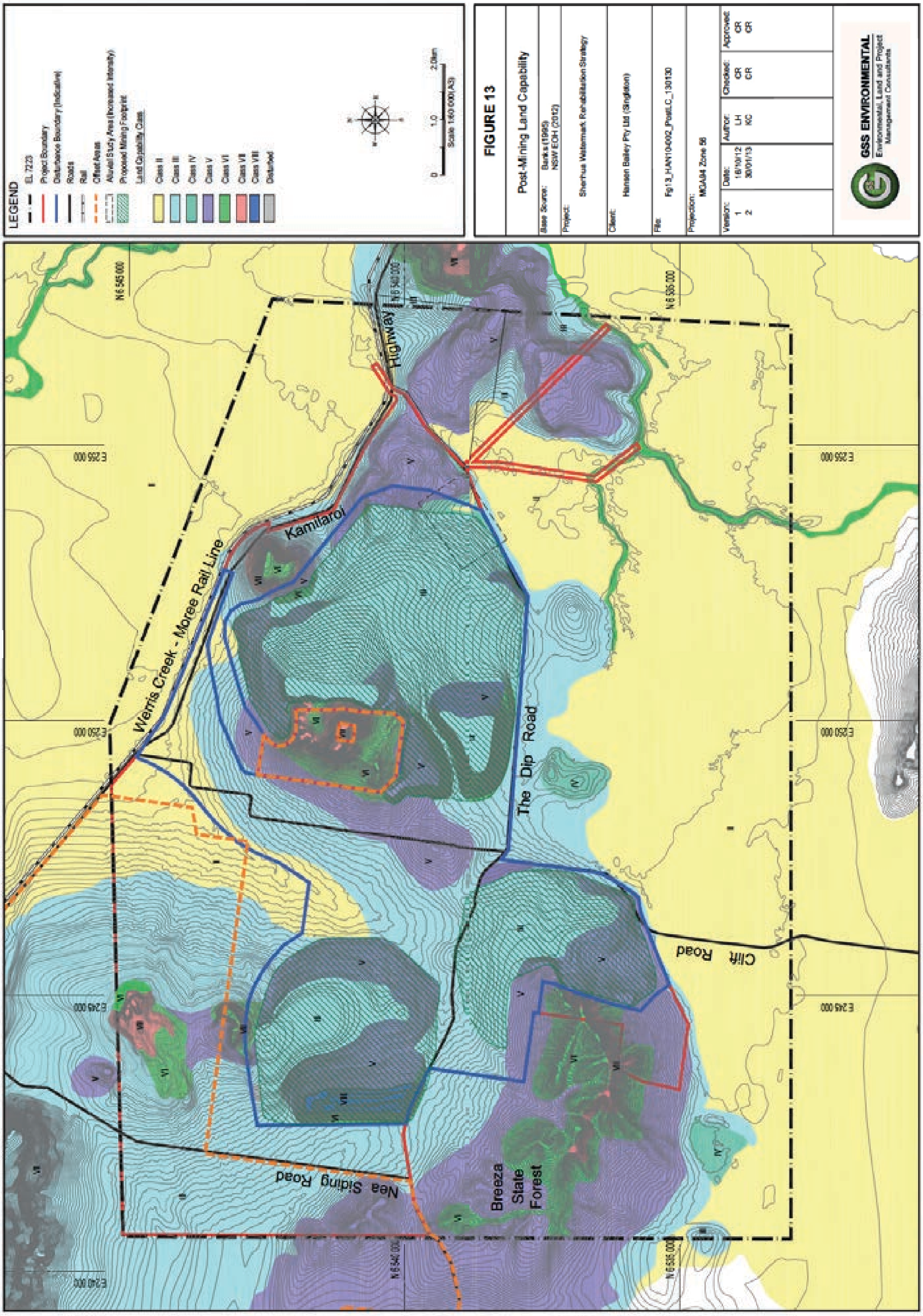


FIGURE 12
Pre Mining Land Capability
Base Source: Banks (1995) NSW EOH (2012)
Project: Shenhua Watermark Soils Assessment
Client: Hansen Bailey Pty Ltd (Singleton)
File: Fig12_HAN10402_PreLC_130911
Projection: MGA94 Zone 56
Version: 1
Date: 11/09/12
Author: LH
Checked: CR
Approved: CR
GSS ENVIRONMENTAL
Environmental, Land and Project Management Consultants
LEGEND
EL 7223
Project Boundary
Disturbance Boundary (Indicative)
Roads
Rail
Pit Locations
Alluvial Study Area (Increased Intensity)
Alluvial Survey Study Point
Proposed Mining Footprint
Reference Profiles
Land Capability Class
Class I
Class II
Class III
Class IV
Class V
Class VI
Class VII
Class VIII
Disturbed
Werris Creek - Moree Rail Line
Kamilaroi
Highway
Mooki
River
Native
Dog
Gully
The Dip Road
Nea Siding Road
Breeza State Forest
Cliff Road


LEGEND
EL 7223
Project Boundary
Disturbance Boundary (Indicative)
Roads
Rail
Offset Areas
Alluvial Study Area (Increased Intensity)
Proposed Mining Footprint
Land Capability Class
Class II
Class III
Class IV
Class V
Class VI
Class VII
Class VIII
Disturbed
FIGURE 13
Post-Mining Land Capability
GSS ENVIRONMENTAL
Kamilaroi
Highway
Werris Creek - Moree Rail Line
The Dip Road
Clift Road
Nea Siding Road
Breeza State Forest

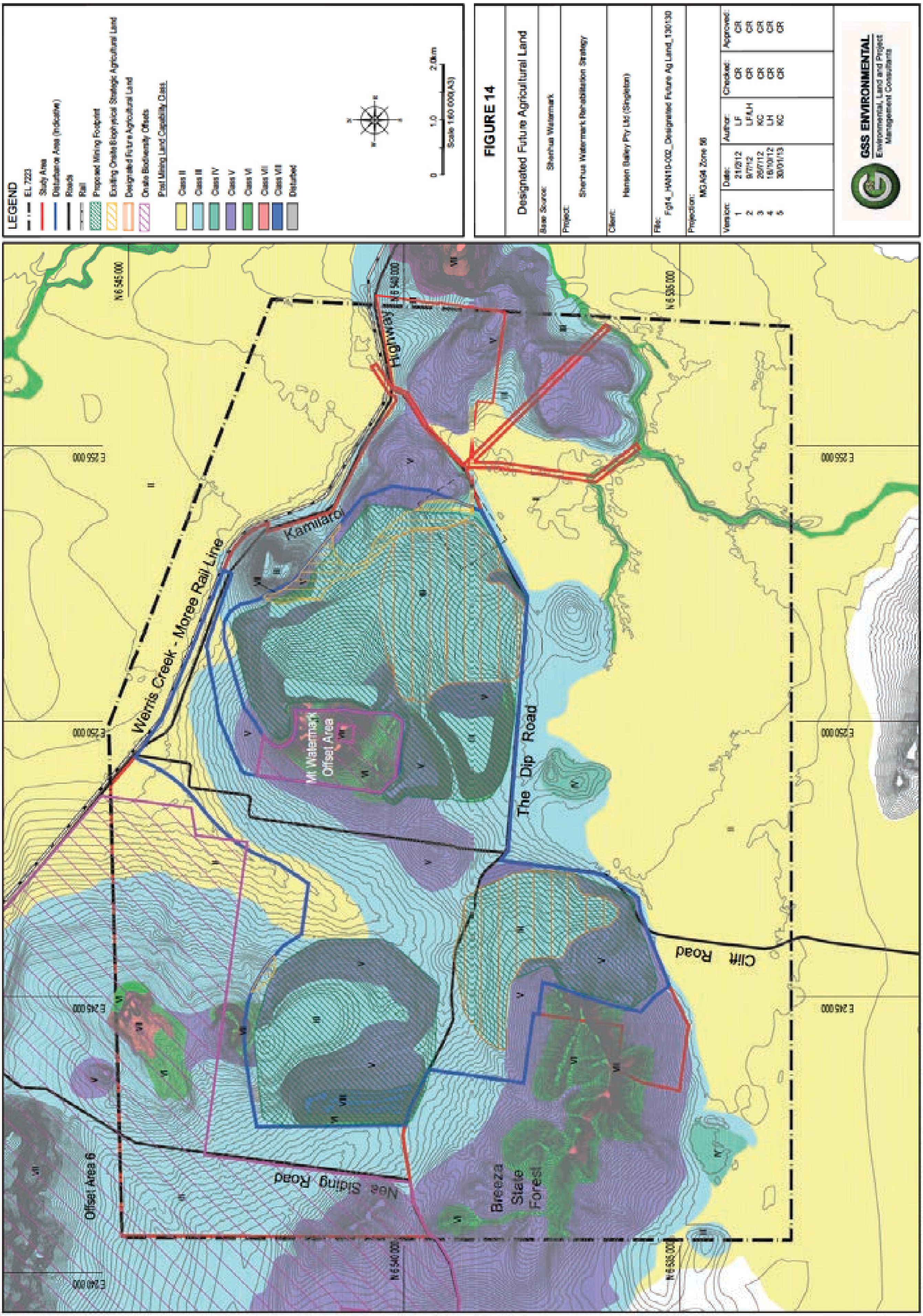
Within the Study Area, approximately 96 ha has been identified as BSAL during the fieldwork undertaken on the three GSSE site visits and the soil analytical results combined with background documentation. The identification process for BSAL was based on the SRLUP criteria (GSSE 2013). The land capability of the BSAL area is Class III land with 'Moderately High' fertility. The Rehabilitation Strategy for the Project has been specifically designed so as to reinstate approximately 3,233 ha of Class III rural land capability, of which approximately 1,000 ha will be dedicated for agriculture in order to maintain the ability to sustain rotational cropping in the area, as shown in **Figure 14**. Approximately 100 ha will be reinstated as BSAL ensuring the biophysical criteria stipulated in the SRLUP, is met.

By not disturbing Class II land and increasing Class III land by 284.6 ha, the proposed project is in line with the intent of Namoi CAP. The Namoi CAP has been developed using "resilience thinking", where resilience is defined as the capacity of a system to absorb disturbance and still retain its basic function and structure. Whilst there is no Namoi CAP target associated with maintaining or improving land capability, the existing area value of class III land will be reinstated post mining to ensure the Project is in line with the resilience commitment in the Namoi CAP.

4.2 Rehabilitation Objectives

Rehabilitation objectives have been developed to comply with the DGRs and reflect rehabilitation industry best practices applicable to the elected final land uses. The rehabilitation objectives are:

- Rehabilitation processes and outcomes will be consistent with the EIS, which forms the basis for any approvals;
- Rehabilitation will comply with the relevant regulatory requirements, and regulatory consensus will be attained on the successful closure and rehabilitation of the Study Area;
- Rehabilitation of specific vegetation species will be integrated with undisturbed native vegetation to provide consolidated areas and wildlife corridors where possible;
- The Study Area will be rehabilitated to an agreed final land use compatible with the surrounding land fabric and land use requirements;
- The rehabilitation process will address limitations of land capability that may arise as a consequence of mining;
- The rehabilitation will be sustainable in terms of final land use;
- The rehabilitated final landforms will be stable with soils, hydrology and ecosystems having maintenance needs no greater than those of the comparable surrounding land;
- Waste substances that have the potential to affect land use or result in pollution will be secured and safely contained;
- The rehabilitated Study Area will not present an unacceptable hazard to persons, stock or native fauna;
- The site will be clean and tidy and any remaining structures will be left in a condition that provides for the safety of the public; and
- Mine closure works are completed as quickly and cost effective as possible whilst ensuring that the above objectives are achieved.


LEGEND
FIGURE 14
Designated Future Agricultural Land
GSS ENVIRONMENTAL
Werris Creek - Moree Rail Line
Kamilaroi
Highway
Mt Watermark Offset Area
The Dip Road
Cliff Road
Nea Siding Road
Breeza State Forest
Offset Area 6

5.0 REHABILITATION MANAGEMENT

Shenhua Watermark is committed to the progressive rehabilitation of mining areas to achieve a final landform for future ecological conversation and agricultural purposes and which increases areas of Class III rural land capability throughout the Study Area. **Figure 15** depicts the rehabilitation management process to achieve this outcome. This section describes the stages of this process, while **Section 5** and **Section 6** detail the monitoring and success criteria elements relating to industry best-practice rehabilitation.

5.1 Targeted Rehabilitation

Shenhua Watermark is committed to integrating industry best-practice rehabilitation measures into its operational activities. Land that will be disturbed as a result of the Project will be subsequently rehabilitated to a stable, self-sustaining landform. The rehabilitation strategy plans to achieve the maximum land capability classification that can be practically achieved. To achieve this outcome conservation and management of topsoil and sub-soil resources will be required to optimise its effectiveness as rehabilitation media. This will include minimising the disturbance footprint ahead of active mining and implementing progressive rehabilitation of disturbed areas as soon as practicable. Further details of soil handling are outlined in the Soil Survey and Land Capability Impact Assessment (GSSE 2013).

The large area of land capability Class III to be reinstated is targeted to maintain and enhance the value of the land for post mining uses. Whilst not all the area on Class III rehabilitated land will be used for agriculture, there are ecological benefits for ecosystem resilience and higher drought resistance than less valued land capability classes.

5.2 Risk Identification

There are a number of reasons why a rehabilitated landform may fail to meet its rehabilitation objectives and intended final land use. The list below summarises causes of rehabilitation failure that have been identified in previous mining case studies in NSW and pose a specific risk to rehabilitation of the Project. By identifying these risks and adopting the processes outlined in the following sections, it is anticipated that these risks to rehabilitation will be greatly reduced. The risks identified include:

- Services are not properly disconnected, terminated or removed;
- Final slopes are too steep and not geotechnically stable;
- Slumping of upper surface / capping leading to surface no longer free draining.
- Inadequate ground preparation;
- Construction of inadequate drainage and erosion and sediment control structures;
- Insufficient quantities of topsoil/subsoil/growth medium;
- Soils are adversely affected by long term storage;
- Soils do not contain the right attributes to promote growth of vegetation;
- Inadequate soil amelioration to promote stability and support vegetation growth;
- Soil is not spread at adequate depths on re-contoured areas;
- Poor seed quality;
- Inappropriate species chosen for the type of rehabilitation;
- Ineffective seeding techniques;
- Infestation of rehabilitation by insects; and
- Weeds are not adequately controlled

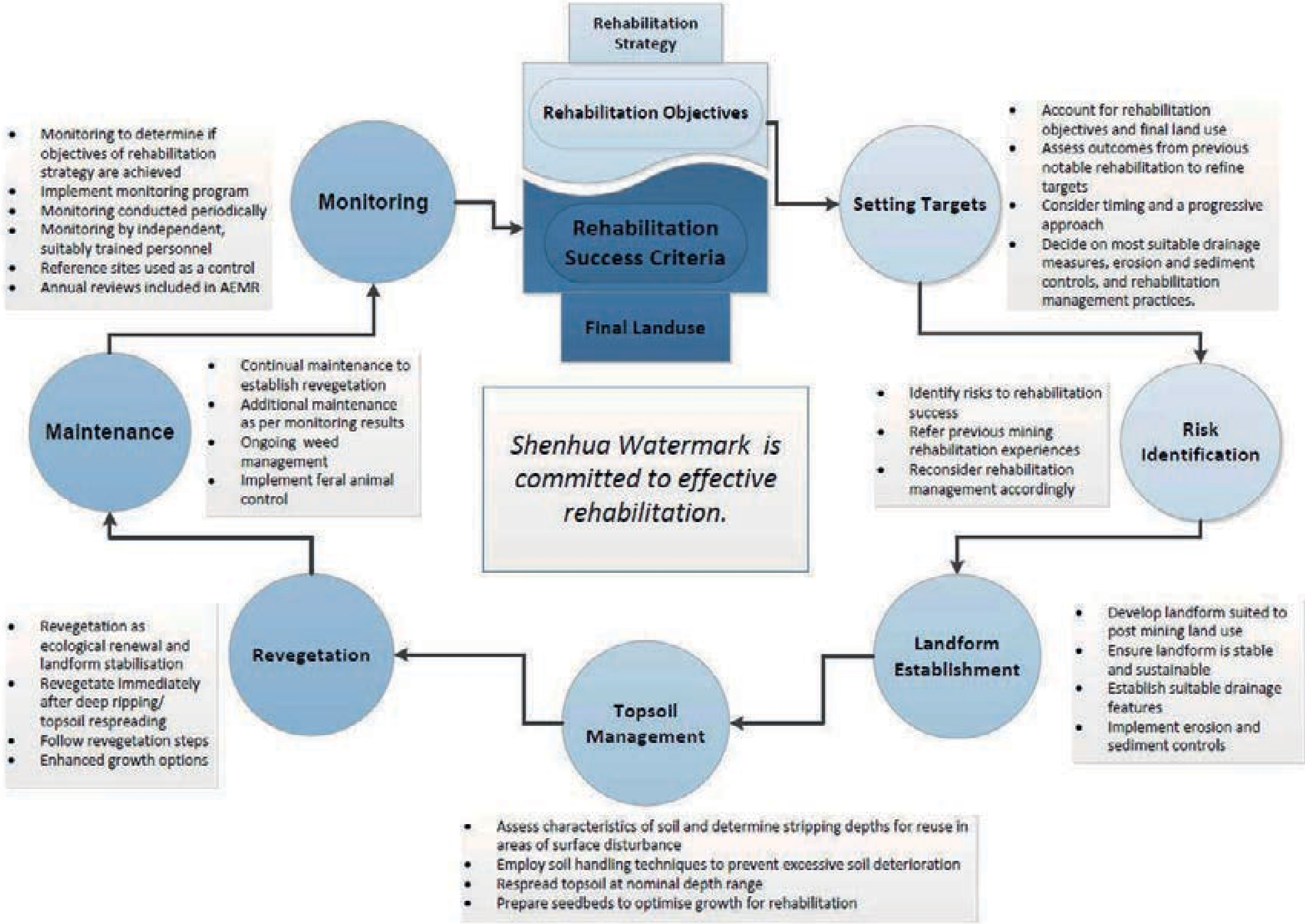
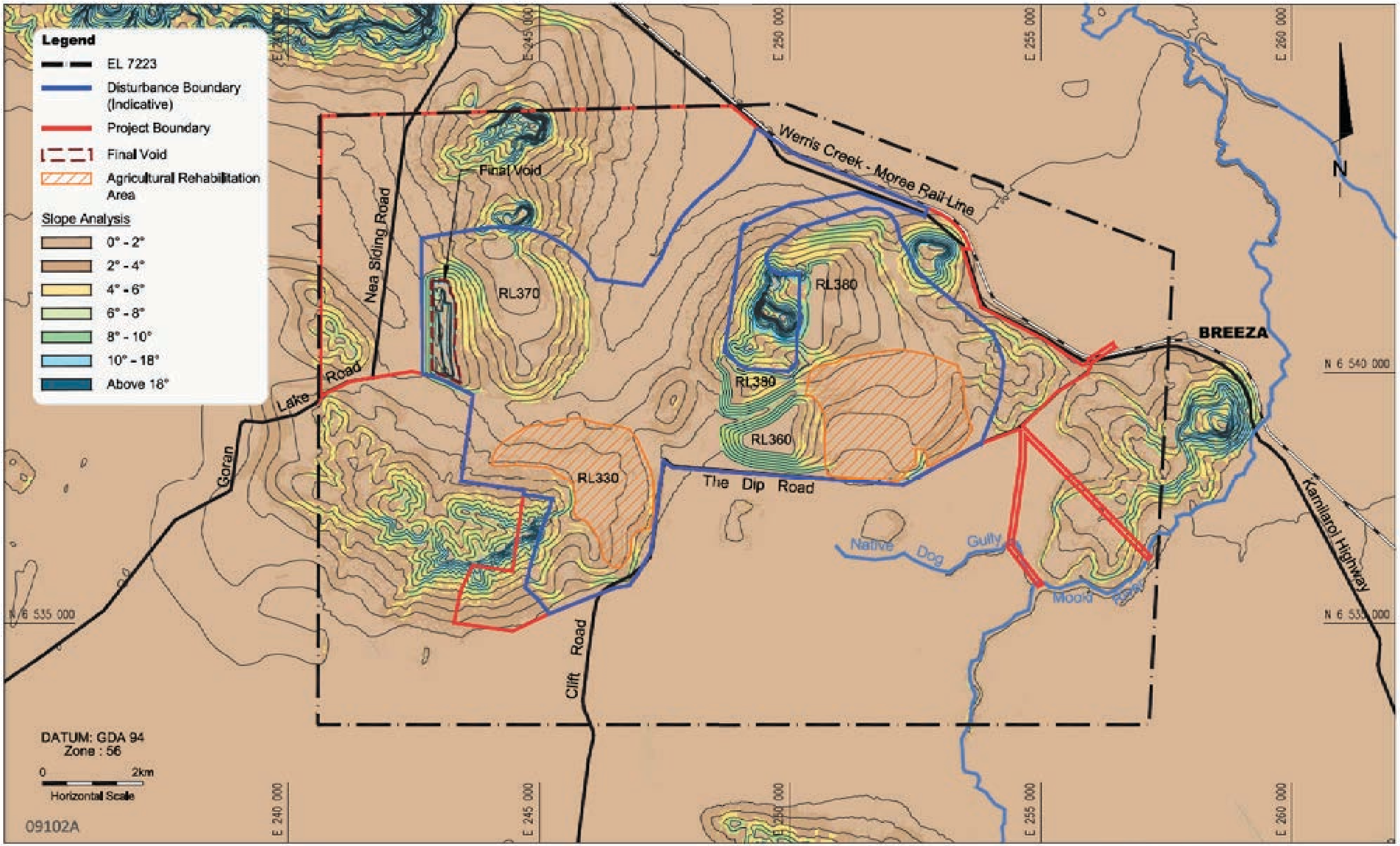


Figure 15: Rehabilitation Process Flowchart



WATERMARK COAL PROJECT

Conceptual Final Landform Slope Analysis

FIGURE 16

5.3 Landform Establishment

Placement and shaping of overburden to create slopes with gradients less than 10 degrees should be undertaken in a manner which, wherever practicable, ensures that any friable or weathered materials are placed below the subsoil and topsoil layers in order to provide a cover of more competent material and avoid the exposure of large rocks on the final surface. Any coal rejects placed as backfill in the mining areas should be covered with at least 3 metres of overburden material.

The Geochemical Impact Assessment prepared as part of the EIS for the Project (RGS, 2012) found that the majority of overburden/interburden and coal reject materials are expected to have low sulfur content, excess Acid Neutralising Capacity (ANC), and be classified as Non Acid Forming (NAF). A very small proportion of Potential Acid Forming (PAF) overburden/interburden and coal reject materials are likely to occur at the Project. Selective handling and covering/encapsulation of PAF overburden/interburden and coarse reject materials with NAF overburden/interburden material is therefore recommended.

All rehabilitation works will be scheduled to commence as soon as practicable, where access permits. Disturbance of native vegetation will be kept to a minimum and clearing will be constrained to the footprint area of the infrastructure items and active mining areas. The establishment of the final landform following the major surface disturbances will take place as soon as practical. OEAs will be progressively rehabilitated throughout mining operations.

Prior to the re-establishment of vegetation cover, temporary control measures will be utilised for erosion and sediment control. These measures may include sediment fences, sand bag sediment traps and rip rap scour protection. Consideration will be given to erosion and sedimentation control measures during the construction and operational phases such as restricting access or modifying activities during wet weather, establishing exclusion zones around areas undergoing rehabilitation, reporting erosion and sediment hazards and regular inspections and maintenance of structures.

The post mining landform contains relatively gentle slopes compared to the majority of mines within NSW and QLD, which allows for the potential successful establishment of land capability Class III on the rehabilitated landform. Furthermore these relatively gentle slopes will contain slope lengths and suitable soil depth designed to minimise erosion risk and ensure the land meets criteria for land capability Class III.

5.3.1 Water Management

Surface water management structures will be progressively installed on the rehabilitated landform. The heights (effective depths) and cross-sectional areas of the individual banks will be determined on the basis of individual sub-catchment areas, but will typically be less than 0.7 m^2 and 3.0 m^2, respectively. Rock-lined drains will be used, where required, to convey water safely from the rehabilitated landform into the surface water management system.

Where practicable, water management structures such as contour banks and drains should be constructed with longitudinal gradients that permit the transfer of water at non-erosive velocities (e.g. 1% slope). Consequently, specialised rehabilitation treatments should generally not be required. Similarly, rock lined drains constructed on the slopes of the emplacements and final void should be retained and allowed to revegetate naturally. However, in the event that unacceptable levels of erosion are observed, fast growing species identified as having a particular soil conservation application and/or specialised treatments such as bitumen/jute meshing or rock lining should be established.

The planting of trees and other vegetation around the various water management structures can enhance the filtration ability of these structures and surrounding areas and minimise the potential for erosion, as well as encouraging their use by native fauna.

5.4 Topsoil Management

Shenhua Watermark recognises the importance of appropriate soil identification, stripping, and management practices to achieve the desired post-closure land capability and land use. Soil resources will be utilised to rehabilitate areas of direct surface disturbance. A description of appropriate topsoil resources within the Study Area and their management is included in the Soil and Land Capability Impact Assessment (GSSE, 2013). An overview of topsoil management is provided below.

5.4.1 Topsoil Stripping and Handling

Where topsoil stripping and transportation is required, the following proposed topsoil handling techniques would be adopted to prevent excessive soil deterioration:

- Topsoil would be maintained in a slightly moist condition during stripping where possible. Material will not be stripped in either an excessively dry or wet condition;
- Soil would 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 because it minimises compression effects of the heavy equipment that is often necessary for economical transport of soil material;
- The surface of soil stockpiles would be left in a coarsely textured condition in order to promote infiltration and minimise erosion until vegetation is established;
- Topsoil stockpile heights would be designed to prevent biological and structural degradation. Where appropriate clayey soils will be stored in lower stockpiles for shorter periods of time compared to soils that have a coarser texture;
- Free-draining stockpiles would be created to minimise the formation of anaerobic zones;
- Stockpiles would be formed with batters graded to achieve slopes approaching 18°;
- Where long-term stockpiling is planned (i.e. greater than 12 months), stockpiles would be seeded and fertilised. An annual cover crop species that produces sterile florets or seeds would be sown. The annual pasture species would not persist in the rehabilitation areas but would provide sufficient competition for emerging weed species and enhance desirable microorganism activity in the soil. Additional ameliorants may be periodically applied (e.g. biosolids) to assist retain desirable microorganism activity in the soil;
- Prior to respreading stockpiled topsoil onto disturbed areas (particularly onto designated tree seeding areas), an assessment of weed infestation on stockpiles would be undertaken to determine if individual stockpiles require herbicide application and/or “scalping” of weed species prior to topsoil spreading; and
- Specific respreading depths for different landforms and land capability targets will be applied during rehabilitation activities.

5.4.2 Topsoil Respreading and Seedbed Preparation

Where possible, topsoil would be re-spread directly onto reshaped landforms. Topsoil and subsoil will be spread in accordance with the re-spreading depths indicated in the Soil and Land Capability Impact Assessment (GSSE 2013) for the desired land capability outcome.

Thorough seedbed preparation would be undertaken to optimise establishment and growth of vegetation. All topsoiled areas would be lightly contour-ripped (after topsoil spreading) to create a “key” between the topsoil and the subsoil.

Ripping will be undertaken on the contour and the tynes lifted for approximately 2 m every 200 m to reduce the potential for channelised erosion on slopes. Ripping should be undertaken when soil is moist and immediately prior to sowing to minimise surface crusting. The practice of scarifying the topsoil surface improves the topsoil/seed contact and increases infiltration which enhances germination / growth and reduces erosive runoff.

5.5 Revegetation

The Rehabilitation Strategy proposed for disturbed areas includes a separate species mix for native vegetation areas versus designated agricultural production areas. Endemic species mixes should be utilised where possible for reforested areas. Fertiliser will be applied with mixes to increase the likelihood of initial revegetation success.

All revegetation operations are preferably undertaken immediately after ripping so that the ripped surface has minimal time to crust prior to seed application. The most effective way of controlling erosion will be to establish and/or maintain a healthy vegetation cover. Vegetation will provide effective surface protection against raindrop impact, bind the underlying soil to resist detachment by surface flows, and improve and maintain the soil's infiltration capacity, thereby decreasing the velocity and volume of runoff. Vegetation will also improve the aesthetic appearance of each area and the operational efficiency of structural sediment and erosion control measures employed. The main revegetation steps will therefore include:

- Species selection;
- Sowing rates and species proportions;
- Seed pre-treatment;
- Equipment selection;
- Soil amelioration and fertiliser; and
- Timing.

Should natural revegetation require acceleration, the following rehabilitation methods and techniques may be implemented depending on the requirements. These include:

- Use of mulch for soil protection and mixing with topsoil;
- Use of brush matting to import seed into cleared areas;
- Use of open weave jute mesh pegged in with steel pegs;
- Brush harvesting from nearby areas; and
- Ripping of compacted wheel tracks.

5.5.1 Agriculture Land Pasture Sowing

The topsoiled surface of those areas designated for a post-mining agricultural land use (1,000 ha) will be sown with a mixture of pasture species appropriate for the season. Following establishment of these areas, it is anticipated rotational cropping of pasture and suitable crops will be undertaken at the discretion of the land manager.

Refer to **Figure 9** for the conceptual final land use.

5.5.2 Native Vegetation Establishment

The topsoiled surfaces of those areas (2,384 ha) designated to be restored as native vegetation will be initially stabilised with a non-persistent cover crop followed by planting of a selection of native species. Topsoil from CEEC areas will be respread on areas to be rehabilitated back to the CEEC where practical.

A seed mix proposed for native vegetation rehabilitation within the Study Area is derived from the Species list detailed in the Ecology Impact Assessment prepared as part of the EIS for the Project (Cumberland Ecology 2013). Rehabilitation will focus on re-instating White Box Grassy Woodland with small areas of other species to enhance diversity within the rehabilitated landform, as shown indicatively below in **Table 5**.

Table 5
Indicative Rehabilitation Vegetation Types

Vegetation Community	Indicative Rehabilitation Area (ha)
Box Gum Woodland Endangered Ecological Community	
White Box Grassy Woodland (C/EEC)	1,631
Blakely's Red Gum Grassy Woodland (C/EEC)	313
Yellow Box Grassy Woodland (C/EEC)	31
Sub-Total	1,975
Other Endangered Ecological Communities	
Inland Grey Box Grassy Woodland (EEC)	46
Fuzzy Box Woodland (TSC - EEC)	36
Sub-Total	82
Other Woodland	
Poplar Box Woodland	73
Whitewood Woodland	27
Tumbledown Red Gum Grassy Open Woodland	39
White Box Shrubby Woodland	171
Blakely's Red Gum Shrubby Woodland	17
Sub-Total	327
TOTAL	**2,384**

The Biodiversity and Offset Management Plan, along with the Rehabilitation Management Plan, will include further details and delineation where each vegetation community is proposed to be reestablished.

The species will encourage the re-establishment of the pre-agricultural vegetation communities and, in the medium to longer term, create habitat and corridors for native fauna. Tubestock will generally be propagated from locally-collected seed through a seed collection program. Tubestock will be used in strategic landscape planting around the site for visual mitigation. Large areas will be seeded by direct seeding methods if site conditions allow, and will require the purchase of bulk seed mixes.

All areas identified for bushland and pasture re-establishment will have stock excluded until it can be demonstrated that the vegetation is stable and self-sustaining, and that agriculture will not impact upon its establishment.

5.6 Rehabilitation Maintenance

Rehabilitated areas will be assessed against the rehabilitation objectives in **Section 4.2** and regularly inspected for the following key aspects:

- Evidence of any erosion or sedimentation;
- Success of initial establishment of crop or grass cover and tree and shrub seeding / plantings;
- Natural regeneration of native species;
- Weed infestation (primarily noxious weeds, but also where rehabilitation areas are dominated by other weeds);
- Integrity of graded banks, diversion drains, waterways and sediment control structures; and
- General stability of the rehabilitation areas.

Where rehabilitation success criteria have not been met within the required timeframes, maintenance works will be undertaken. This may include the following:

- Re-seeding and, where necessary, re-topsoiling and/or the application of specialised treatments such as composted mulch or biosolids to areas with poor vegetation establishment;
- Installation of tree guards around planted seedlings or construction of temporary fencing suitable for excluding native and feral fauna species should grazing and browsing by animals be excessive;
- Replacement of drainage controls if they are found to be inadequate for their intended purpose, or compromised by vegetation or wildlife;
- De-silting or repair of sediment control structures; and
- Where monitoring indicates the presence of excessive weeds or the potential for noxious weed infestation, necessary precautions to prevent the development of weeds within the rehabilitated areas will be undertaken.

The Annual Review will detail monitoring results, any required maintenance activities and refinements of rehabilitation techniques.

5.6.1 Weed Management

The presence of weed species has the potential to have a major impact on revegetation and regeneration outcomes. Additionally, any presence of weed species within the surrounding land has the potential to significantly impact on the biodiversity value of the rehabilitated areas. Weed management will be a critical component of rehabilitation activities.

Weeds will be managed across the site through a series of control measures, including:

- Hosing down equipment in an approved wash down area before entry to the Project Boundary;
- Herbicide spraying or scalping weeds from topsoil stockpiles prior to re-spreading topsoil;
- Rehabilitation inspections to identify potential weed infestations; and
- Identifying and spraying existing weed populations together with ongoing weed spraying over the life of the mine.

The spread of declared noxious weeds will be managed by using the measures above. The monitoring and control of weed populations using herbicides will significantly reduce weed infestations. Weed control, if required, will be undertaken in a manner that will minimise soil disturbance. Any use of herbicides will be carried out in accordance with the regulatory requirements. Records will be maintained of weed infestations and control programs will be implemented according to industry best management practice for the weed species concerned.

5.6.2 Feral Animal Control

A feral animal control strategy will be implemented to contain the spread of weeds and other detrimental impacts on rehabilitation areas by feral animals. Goats, foxes, cats, rabbits, pigs and wild dogs will be controlled in accordance with Livestock Health and Pest Authority procedures.

5.6.3 Public Safety

Environmental management controls will be implemented in the Study Area to minimise the potential for impacts on public safety by the maintenance of fencing around those sections of the perimeter of the final void or any graded areas that have the potential to cause harm, that are accessible to the public.

6.0 REHABILITATION MONITORING

Regular monitoring of the rehabilitated areas will be required during the initial vegetation establishment period and beyond to demonstrate whether the objectives of the rehabilitation strategy are being achieved and whether a sustainable and stable landform has been provided. **Table 6** presents the recommended monitoring program, including the specific aspects and elements to be monitored and monitoring frequencies for those various aspects.

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 of monitoring data to assess trends and monitoring program effectiveness will be conducted. The outcome of these reviews will be included in the Annual Review.

In addition to the rehabilitated areas, at least two reference sites will be monitored to allow a comparison of the development and success of the rehabilitation against a target control site. Reference sites indicate the condition of surrounding un-disturbed areas for forest and woodland rehabilitation and nearby land capability Class III land currently utilised for agricultural production.

In developing the rehabilitation monitoring program, the following aspects will be taken into consideration:

- Replicated monitoring sites are needed in representative rehabilitation areas of different ages. One monitoring site per 100 ha is recommended for each major age class of the rehabilitation areas;
- Sites should be monitored in accordance with Table 5; and
- A standard monitoring plot design for areas rehabilitated with trees includes:
  - 2 m x 2 m quadrats – these will provide some estimate of statistical variance, so that if required, statistical analyses can be undertaken to objectively compare different rehabilitation treatments and changes over time;
  - a 20 m x 10 m plot overlying the 2 m quadrats and located 5 m either side of the centerline, for ease of monitoring; and
  - a 50 m erosion monitoring transect on contour, running through the centre of the plot.

Figure 17 shows the monitoring plot design that is to be adopted for the monitoring of an area revegetated with trees.

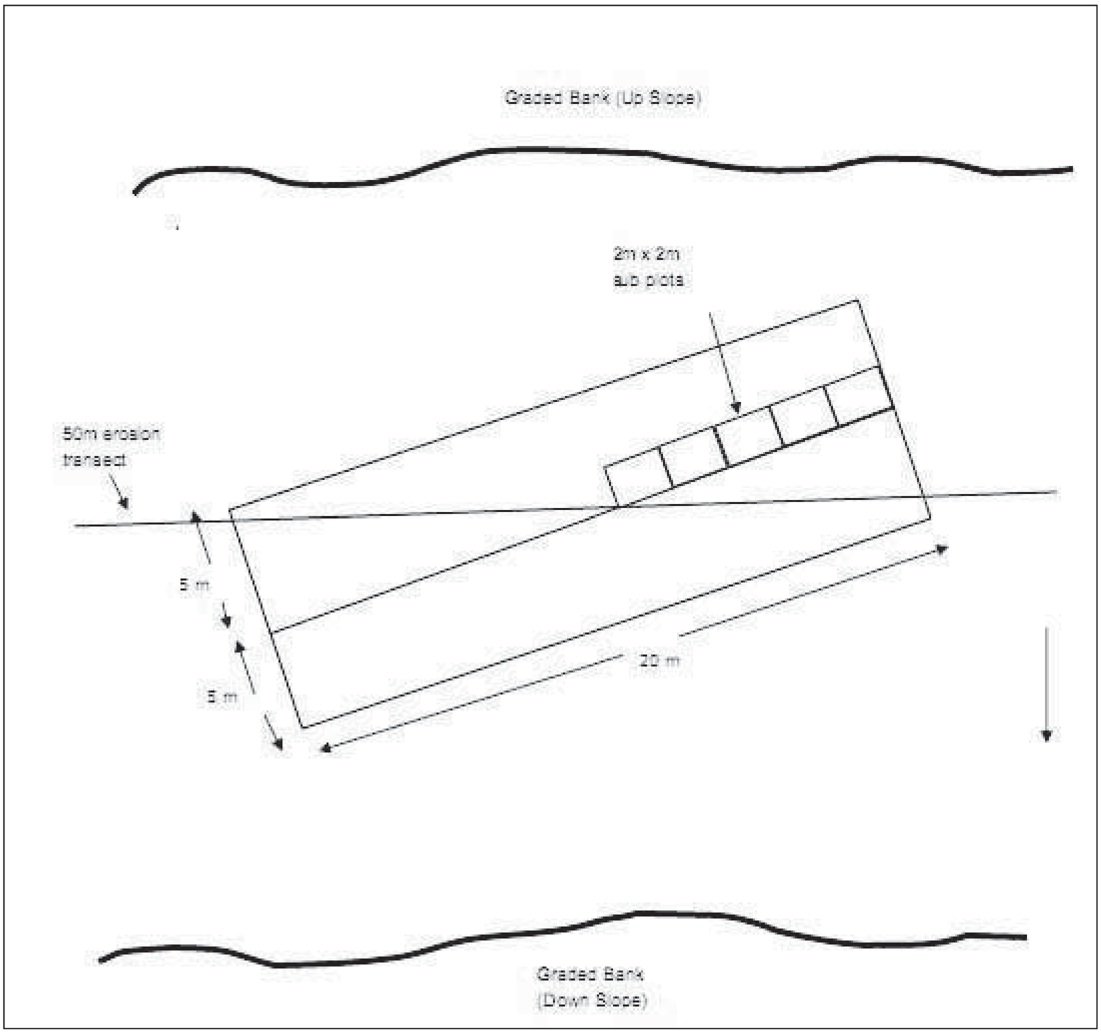


Figure 17 : Typical Monitoring Plot Design

For the areas rehabilitated with grass, it is proposed that transects be established across 'typical' sections of rehabilitation and monitored for grass cover, pasture species diversity, weed occurrence, percentage of bare ground, extent and type of erosion, rock presence, topsoil presence/absence and other factors likely to influence rehabilitation development. Rehabilitation methods will be improved as additional knowledge develops from monitoring data collected through these programs. More specifically, monitoring of the elements in **Table 6** will be undertaken to determine the level of achievement of success criteria.

Table 6
Proposed Rehabilitation Monitoring Program

Aspect of Rehabilitation	Elements to be Monitored	Monitoring Frequency
Ecosystem Establishment		
General Description	• Describe the vegetation in general terms, e.g. mixed eucalypt woodland with grass understorey and scattered shrubs, dense Acacia scrub, etc.	Six Monthly for the first 12 months after establishment and then every 12 months
2m x 2m quadrats	• Count the number of plants of all species, excluding grass. • Measure live vegetation cover for understorey and grasses (separately) using a line intercept method. • Record details of ground cover (litter, logs, rocks etc.).	Six Monthly for the first 12 months after establishment and then every 12 months
20m x 10m plots	• Count, by species, all trees >1.6m tall • Tag and measure DBH of trees >1.6m tall, to a maximum of 10 for any one species. • Record canopy cover over the whole 20m centreline when trees are tall enough. • Subjectively describe tree health, by species if relevant, noting signs of drought stress, nutrient deficiencies, disease and severe insect attack. Where health problems are noted, record the percentage of unhealthy trees. • Record any new plant species not present in the smaller plots, including any problem and declared noxious weeds. • Take five surface soil samples (e.g. at approx. 5m intervals along the centreline) and bulk these for analyses of: pH, EC, chloride and sulfate; exchangeable Ca/Mg/K/Na; cation exchange capacity; particle size analysis and R1 dispersion index; 15 bar and field capacity moisture content; organic carbon; total and nitrate nitrogen; total and extractable phosphorus; Cu, Mn and Zn.	Six Monthly for the first 12 months after establishment and then every 12 months
50m transect	• Along the 50m erosion monitoring transect, record the location, number and dimension of all gullies >30cm wide and/or 30cm deep. • Erosion pins should be established in plots located in newer rehabilitation to record sheet erosion if present.	1 year after establishment and then every 2 years
Rehabilitation in general	• When traversing between monitoring plots, note the presence of species of interest not previously recorded (e.g. key functional or structural species, protected species, noxious weeds), as well as obvious problems including any extensive bare areas (e.g. those greater than 0.1ha). • Observations such as this can provide useful, broad scale information on rehabilitation success and problems.	Six Monthly for the first 12 months after establishment and then every 12 months
Photographic record	• For each 20m x 10m plot, a photograph should be taken at each end of the plot, along the centreline looking in.	Six Monthly for the first 12 months after establishment and then every 12 months
Habitat	• General observations relating to the availability and variety of food sources (e.g. flowering/fruiting trees,	Six Monthly for the first 12 months after establishment and then every 12 months

Aspect of Rehabilitation	Elements to be Monitored	Monitoring Frequency
	presence of invertebrates etc). • Availability and variety of shelter (e.g. depth of leaf litter, presence of logs, hollows etc.). • Presence/absence of free water in the rehabilitated areas.	
Fauna	• General observations of vertebrate species (including species of conservation significance). • Detailed fauna surveys including presence and approximate abundance and distribution of vertebrate species (focussing on species of conservation significance).	After rehabilitation is 3 years old undertake monitoring annually
Invertebrate	• Diversity and abundance of present species.	Annually
Weeds and pests	• Species identity. • Approximate numbers/level of infestation. • Observations of impact on rehabilitation (if any).	Six Monthly during the first two years and biennially after that. Inspections should be opportunistic after significant rainfall events.
Geotechnical Stability		
	• Assessment of the stability of batters and also looking at surface settlements (sink holes). In particular where these features could impact on the performance of any surface water management system. • Surface integrity of landform cover/capping (measurement of extent of integrity failure). • Presence / absence of landform slumping.	Annually
Surface and Groundwater		
	• Groundwater quality and depth. • Efficiency of landform surface water drainage systems (integrity of banks and drains). • Water quality including pH, EC and total suspended solids of water in water storages, and open cut mining areas, sedimentation dams.	Quarterly or following significant rainfall events
Soils		
	• Profile development (Chemical analysis, structure, biotic evidence). • Land Capability Classification based on criteria to be agreed with NSW Government. • For Land capability Class III agricultural land, productivity outcomes comparable to control sites nearby.	1 year after establishment and then every 2 years

7.0 REHABILITATION SUCCESS CRITERIA

The preliminary success criteria (or completion criteria) for the rehabilitation areas are included in **Table 7**. The success criteria are performance objectives or standards against which rehabilitation success 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 could be handed back to stakeholders in a productive and sustainable condition.

The success criteria will be reviewed every five years with stakeholder participation to ensure the nominated success criteria remain realistic and achievable.

The success criteria comprise indicators that reflect the nominated post-mine land uses, being native woodland and land capability Class III agricultural land. Indicators have been developed for the rehabilitation elements in **Table 7**. For each element, standards that define rehabilitation success at mine closure are provided. Each criterion will be further developed to be specific, measurable, achievable, realistic and outcome based, and to reflect the principle of sustainable development. Throughout the life of the Project, success criteria will be refined based on results of ongoing rehabilitation monitoring and may be amended as future research advances industry best practices.

Table 7
Preliminary Rehabilitation Success Criteria

Phases of Strategic Rehabilitation	Relevant Domains	Rehabilitation Element	Indicator	Criteria
1. Decommissioning Phase	Domain 1 & 4	Services & Structures	Site Services	All services including power, water, data and telephone communication for the entire site will be isolated, disconnected, terminated and or removed/buried to make them safe.
			Infrastructure & Buildings	Equipment and buildings will be removed from the site unless these can be reused in situ to support nearby communities.
			Roadways Carparks and Hardstands	The unwanted bitumen roadways, car parks and hardstand areas will be ripped up and disposed of appropriately.
			Surface Water Management Structures	All surface water structures will be removed, unless valuable to post mining landuse.
2. Landform Establishment	Domain 1, 2, 3 & 4	Landform stability	Slope gradient	No less than 75% of the area has slopes <10°. Where the slopes are steeper, additional water management structures will be utilised (as required).
				Where reject layers are present and exposed, the landform is capped with a minimum of 3m of inert material and be free-draining.
			Erosion control	Erosion control structures are installed at intervals commensurate with the slope of the landform.
				Dimensions and frequency of occurrence of erosion rills and gullies are generally no greater than that in reference sites that exhibit similar landform characteristics.
			Surface Water Drainage	Use of contour banks and diversion drains to direct water into stable areas or sediment control basins.
				All landforms will be free draining except where specific structures have been constructed for the storage of water as required for sediment and erosion control or some post mining land use.

Phases of Strategic Rehabilitation	Relevant Domains	Rehabilitation Element	Indicator	Criteria
3. Growth Media Development	Domain 1, 2, 3 & 4	Water quality	EC, pH, TSS and oil and grease	Ensure receiving waters affected by surface water runoff have contaminant limits of the Environment Protection Licence (EPL)
		Topsoil	Salinity (electrical conductivity)	Soil salinity content is within the limits of the targeted land capability.
			pH	Soil pH is within the limits of the targeted land capability.
			Sodium content	Soil Exchange Sodium Percentage (ESP) is within the limits of the targeted land capability.
			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.
		Land and Soil Capability	Soil Survey	Soil survey and land capability assessment to be undertaken in accordance with relevant guidelines and Australian Standards to ensure post disturbance land meets the nominated land capability classes for the mining area, and pre-mining land capability classes for infrastructure area.
4. Ecosystem Establishment	All	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.
			Species composition	Subject to proposed land use, comprise a mixture of native trees, shrubs and grasses representative of regionally occurring woodland.
5. Ecosystem Development	All	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 native woodland.
			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.
			Sustainability	Species are capable of setting viable seed, flowering or otherwise reproducing. Evidence of second generation of shrub and understorey 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 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 closure.
				The number of vertebrate species does not show a decrease over a number of successive seasons prior to mine closure.
			Invertebrate species	Presence of representatives of a broad range of functional indicator groups involved in different ecological processes.

Phases of Strategic Rehabilitation	Relevant Domains	Rehabilitation Element	Indicator	Criteria
			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, and logs; and · signs of natural generation of shelter sources including leaf litter.

8.0 REHABILITATION TRIALS AND RESEARCH

A key component of successful rehabilitation is to regularly review performance and to identify areas for continuous improvement. In this regard, it is recommended that Shenhua Watermark contribute to and actively participate in trials and research to improve mine site rehabilitation techniques and enhance performance outcomes. This may include trials and research into the re-establishment of native woodland, native grasses, Box Gum Woodland CEEC, riparian corridors and preferred Koala habitat. Consideration should also be applied to any trials and research into agricultural activities and performance indicators post-mining.

9.0 DEMONSTRATED CAPACITY TO ACHIEVE REHABILITATION OUTCOMES

9.1 Rehabilitation of Land Capability Class III

The targeted 3,233 ha of post mining land capability Class III, of which 2,106 ha will be constructed in the rehabilitation program within Domain 2 – Open Cut Areas, and Domain 3 – Overburden Emplacements, is achievable due to the creation of relatively gentle topography, excess topsoil and subsoil resources available and previous examples of high quality mine rehabilitation of agricultural land (see Figure 16). Below is a brief summary of a comparable case study carried out in the Hunter Valley since 1994. The case study shows the reinstatement of Class II land, so similar principles and standard engineering techniques will be applied to reinstate Class III land on the Watermark site.

Case Study: Alluvial Lands Project (Nelson and Stewart 2007)

The following case study has been presented to demonstrate proven ability to reinstate high value 'Agricultural Land' on post mining landforms.

The Alluvial Lands Project is located within the Hunter Valley North development consent boundary. In 1993, consent was granted to mine a 165 ha parcel of land adjacent to the Hunter River at the Alluvial Lands Project. The consent required the relocation and reinstatement of 63 ha of Agricultural Suitability Class 1 and 2 land that were able to achieve a lucerne hay productivity yield of 'at least equivalent to the average crop productivity yields for the Upper Hunter Region for three consecutive years'. The remaining land, 102 ha, was required to be rehabilitated to Class 4 land such that it was suitable for grazing.

The Alluvial Lands Project commenced in 1994 and its objective was to reinstate land Classes 1 and 2 in the mining disturbance footprint area. To measure the success of this objective, (i) productivity yield monitoring and soil chemical attribute analysis was conducted throughout 2003-2007, and (ii) soil structure and fertility monitoring was conducted throughout 2003-2006.

Yield Monitoring

The production of lucerne hay (and silage) from the rehabilitated land was been monitored since initial lucerne sowing in spring 2003. This monitoring occurred in close association with the former Department of Infrastructure, Planning and Natural Resources (DIPNR), former DPI NSW Agriculture, and former DPI NSW Minerals regarding lucerne species, productivity measurement, agronomic practices, reinstatement techniques and outcomes.

The monitoring years were 2003/4, 2004/5, 2005/6 and 2006/7. The recorded variables were hay yield, hay quality, and management practices. In addition, in 2004/5 a parallel monitoring program of district farmers' lucerne paddocks was initiated to provide production comparisons due to the lack of available existing data on local production levels. These district measurements continued for 2005/06 and 2006/07.

During 2007 it was successfully demonstrated that the production of hay yields on the rehabilitated land were above the district comparison yield for three years of lucerne growth.

Soil Fertility Monitoring

Chemical soil attributes of the rehabilitated land were also been monitored since the initial lucerne sowing in spring 2003. This monitoring included pH, electrical conductivity, phosphorus, potassium, calcium, sulphur and zinc.

The soil chemical analyses provided insight into the comparability of the nutrient levels between the rehabilitated and control sites. The soil fertility levels on the rehabilitated site have generally been optimal for lucerne growing. The topsoils were assessed as being neutral to alkaline (pH range of 6.2 -7.3) with an initial low amount of the trace element zinc. An application of 5 kg/ha of zinc was applied in a fertiliser blend when the lucerne was sown and no additional zinc has since been required. Fertiliser has been applied to the rehabilitated land with each crop and additional annual topdressing's have been conducted on established lucerne stands.

Soil Profile Structure and Fertility Assessment

To assess whether the reinstated soils had suffered any deleterious effects due to handling practices, the structural characteristics of the reinstated land were compared to a control site (adjoining unmined alluvial soils). This involved the assessment of soil physical and chemical properties over a four year period (2002 to 2006). The assessment targeted three separate areas: the Reinstated area, Trial area, and Control land. The Reinstated Area and Trial Area were both located on the reinstated soils of the Alluvial Lands Project, and the Control Land was located on adjoining unmined alluvial land.

In each area, a backhoe was utilised to excavate test pits to approximately 1.7m. Soil samples were collected from the topsoil and subsoil horizons of each test pit. These samples were then sent to the government laboratory at Scone, NSW, for analysis of physical and chemical soil properties. The following soil parameters were analysed: Particle Size Analysis, Dispersion Percentage, Emerson Aggregate Test, Bulk Density, Saturated Hydraulic Conductivity, Available Water Content, Electrical Conductivity, pH, Cation Exchange Capacity, Exchangeable Cations (Na, K, Mg, Al), Organic Carbon, Phosphate and Total Nitrogen.

Physical

GSSE (2011) concluded that there was no appreciable difference in soil structure between the control land and the rehabilitated area. Surface horizons in both control and rehabilitated sites exhibited moderate pedality. The primary peds had similar shape and were approximately the same size. Porosity and cracking was evident in both areas. Significantly, roots occurred to a depth of 0.9 m in the rehabilitated pits and there was no obvious pans or compacted layers which suggest there was no structural deterioration.

Chemical

The soil chemical analyses provided insight into the comparability of the nutrient levels between the rehabilitated and control sites. The pH was less alkaline than the controlled soil. Nutrient levels were nearly identical to a depth of 1.2 m and this included the major nutrients. Nitrogen and phosphorus were found to be adequate in rehabilitated land, however, measurements showed variability. Exchangeable cations such as potassium were found to be more abundant in the rehabilitated land. It is likely that the exhibited higher cation exchange capacity was a result of the increased cation availability in the rehabilitated soil.

Organic carbon was found to be slightly lower in the rehabilitated soil but this is attributable to the lack of pasture management on the rehabilitated land and can be directly corrected with agricultural management techniques, crop rotation, and lucerne cover. In addition, organic carbon will be naturally corrected as soil organisms and plant root material reach a typical level for cropped land.

Soil Permeability

Due to the strong positive correlation between level of permeability and soil organic matter, it was also concluded that as the rehabilitated lands experience nutrient enrichment, increased number of soil organisms, and increased plant root material then the soil will become increasingly permeable relative to the control site. Given that the rehabilitated site had not experienced continual pasture management, it will take a period of time for important soil properties such as organic matter to reach equilibrium. Increasing soil organic carbon will in turn enhance the soil structure and pedality, which will directly improve permeability and naturally correct consolidation measures.

Furthermore, due to the sandy nature of the rehabilitated land at a depth of 1.2-1.4 m, it was concluded that permeability exists to some degree throughout the entire horizon. This factor combined with the increased Available Water Content of the rehabilitated soil will prevent excessive consolidation and compaction that could occur at a depth greater than that of the critical root zone.

This dedicated study demonstrated that successful rehabilitation of agricultural land is achievable when following recommended soil rehabilitation techniques. Further information is available for this case study upon request.

10.0 DECOMMISSIONING AND MINE CLOSURE

10.1 Mine Closure Objectives

The principal objectives of mine closure planning for the Project are to:

- Develop an overall framework for mine closure including rehabilitation and decommissioning strategies that are consistent with Department of Trade and Investment, Regional Infrastructure and Services (DTIRIS) expectations;
- Establish clear and agreed criteria, which can be used to provide the standard against which the final mine rehabilitation and post mining land use can be assessed;
- Reduce or eliminate adverse environmental effects once the Project ceases operation;
- Ensure mine closure is completed in accordance with industry best practice; and
- Ensure the closed mine does not pose an unacceptable risk to public health and safety.

10.2 Closure Strategy – Decommissioning of Infrastructure, Plant and Buildings

The following sections summarise the key aspects related to the decommissioning and closure of the Project.

It assumes that all buildings and other infrastructure are demolished and removed from the Study Area despite the potential for them being used after mining (subject to the landholder's requirements). It is considered likely that at least some aspects of the existing infrastructure will be used post mining; however they are not able to be identified at this time. These options will be considered in greater detail during stakeholder engagement, which will be undertaken closer to final mine closure.

10.2.1 Site Services

All services including power, water, data and telephone on the site will be isolated, disconnected and terminated to make them safe. Generally all underground services will be made safe and left buried in the ground. Overhead power lines should be removed and the materials (i.e. poles and wire) recovered for potential re-sale or recycling as applicable.

10.2.2 Infrastructure and Buildings

All sumps will be de-watered and de-silted prior to the commencement of demolition. In addition all items of equipment will be de-oiled, degassed, depressurised and isolated and all hazardous materials removed from the site. All buildings, including the administration building, workshop and CHPP will 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 Study Area 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 areas being backfilled if available at the time of closure. Prior to disposal, all wastes should be assessed and classified in accordance with the *Waste Classification Guidelines* (DECC, 2008).

All concrete footings and pads should be broken up to at least 1.5 metres below the surface. The waste concrete will be crushed to produce an aggregate that can either be re-used or sold for some other beneficial use beyond mine closure. All areas will then be reshaped, deep ripped, topsoiled and seeded in accordance with **Section 5.0**.

10.2.3 Roadways, Car Parks and Hardstands

The bitumen roadways, car parks and hardstand areas around the workshop and administration areas should be ripped up and the inert waste material placed in the open cut mining area and buried. All areas will then be reshaped, deep ripped, topsoiled and seeded in accordance with **Section 5.0**.

10.2.4 Fuel Farms and Chemical Storage Areas

Leading up to closure, a preliminary sampling and analysis program will be implemented to determine whether a more detailed contamination assessment is required. This will assist to quantify the amount of contaminated material requiring bio-remediation on-site or sent off-site for disposal at a licensed facility.

10.2.5 Storages and Surface Water Management

All sedimentation dams which assist in the water flow from the final rehabilitated surface will be retained following mine closure. All dams will be assessed for structural integrity and upgrade works completed if the dam is to be retained. Any of the remaining dams that are not required will be removed and the original drainage paths re-established wherever possible.

In general, drainage lines will be restored with adequate controls to minimise the erosion within the channel, along with controls to prevent the migration of any erosion upstream or downstream.

10.2.6 Surrounding Lands

This land includes all unmined lands owned or managed by Shenhua Watermark that are not used for purposes related to mining. It includes a significant proportion of the land immediately around the Study Area.

The surrounding land primarily comprises agricultural land that provides a buffer between the Study Area and surrounding residences. The key aspects include:

- Access roads/tracks that are not included within the Study Area;
- Dams around the Study Area; and
- Biodiversity offset areas.

These areas will be assessed in accordance with the proposed post-mining land use to ensure that they are free of weeds and the fences are sound. An assessment of the road network should be made and those required for the on-going management of these areas retained. All other roads should be ripped and rehabilitated.

The management of the biodiversity offset areas will be undertaken by Shenhua Watermark whilst ever the company owns the land. Should Shenhua Watermark sell the land (and subject to the nature of the long term security afforded to the areas), the new owner(s) will be required to manage the biodiversity areas in accordance with the requirements of the approvals.

10.3 Closure Management of Salinity and pH

A geochemical impact assessment of representative overburden/interburden, potential coal reject, coarse reject and tailings materials has been undertaken for the project as detailed in the Watermark Coal Project: Geochemical Impact Assessment of Overburden/Interburden and Coal Reject (RGS 2012). The following conclusions related to Salinity and pH were made from the assessment:

- The majority of overburden/interburden and coal reject materials are expected to have low sulfur content, excess Acid Neutralising Capacity, and be classified as Non Acid Forming;

- The majority of overburden/interburden and coal reject materials are likely to have a high factor of safety with respect to potential acid generation;

- A very small proportion of Potential Acid Forming overburden/interburden and coal reject materials are likely to occur at the Project. The Potential Acid Forming overburden/interburden appears to be restricted to isolated parts of the fresh Permian interburden located near the Lower Hoskissons coal seam. The Potential Acid Forming potential coal rejects appear to be limited to roof and floor strata associated with the Lower Hoskissons seam.

- Most overburden/interburden and coal reject materials reporting to overburden emplacement areas should generate pH neutral to slightly alkaline run-off/seepage with low and moderate salinity values, respectively, following surface exposure. The salinity of run-off/seepage from these materials is expected to decrease with time;

- Overall, the risk of potentially significant water quality impacts from overburden/interburden and coal reject materials is low;

11.0 FINAL VOID MANAGEMENT

As evident on the final landform shown on **Figure 9**, coal extraction will leave a final void in the Western Mining Area at mine closure, covering an area of around 100 hectares in the western extents of the mining area. It will have a maximum depth of around 80 metres below the natural surface.

The eastern slope of the final void will be shaped to achieve 10 degree batter angles (1V:6H) depending on the location of the slope within the extent of the final void. The highwall on the western side of the final void will be retained or battered depending on the final land use.

There are several key environmental issues that have been considered for the long term management of the final void following closure of the Project. The issues are outlined below.

11.1 Objectives

The primary objectives of the final void management are to:

- Propose mitigation measures to minimise potential off-site impacts associated with the final void;
- Propose measures to be incorporated in the final landform which aim to minimise potential safety hazards to the general public; and
- Present options for the final land use of the final void following the completion of mining.

11.2 Final Land Use Options (Final Void)

The options available for post-mining land use(s) of the final void are generally determined by the location and nature of the final void, and although the options presented at this time are considered appropriate, there may be more appropriate options at mine closure. These will be considered further through on-going stakeholder consultation undertaken closer to the end of the economic life of the mine.

In terms of post-mining land use(s), the following preliminary potential options have been considered:

11.2.1 Backfilling with Overburden or Other Waste Material

Emplacement of overburden and coal rejects will, to the extent practicable, be undertaken and seek to minimise the overall size of the final void.

11.2.2 Highwall for future Underground Mining

Significant coal resources suitable for underground mining methods have been identified to the north west of the Study Area. The highwall which remains in the final void may be a suitable entry point for future underground mining activities. Any future underground mining activities would be subject to separate environmental assessments and approvals.

11.2.3 Post Closure Water Storage Area

This scenario assumes the final void is managed as a water storage area by collecting groundwater and surface water inflows. AGE Consultants (2013) and WRM Water & Environment (2013) have assessed the potential groundwater and surface water inflows and quality and quantity. Further detail is provided in the Surface Water Impact Assessment (WRM Water & Environment (2013)) and Groundwater Impact Assessment (AGE Consultants, 2013) prepared as part of the EIS.

Leaving the final void as a stable landform with the possible additional use of long-term water storage is, at this point in time, the preferred option. There may be additional appropriate land use options at mine closure and in consultation with stakeholders at that time, any such options will need to be assessed as appropriate.

11.3 Final Void Rehabilitation

11.3.1 Void Slope Stability

Low Walls

For the purposes of this document, the low wall is assumed to comprise mixed, disturbed and fragmented material. Stability of the low wall should be achieved in the following manner:

- The low wall will be battered back from the angle of repose to ensure the long term geotechnical stability of the face, with the determination of geotechnical stability and recommendations as to the final slope undertaken by a qualified geotechnical engineer on the basis of an assessment of the overburden material, the likely degree of settlement, and the degree of weathering expected in the long term. However it is expected that the low wall sides of the final void will be battered back to a maximum of 10 degrees;

- Surface water drainage on and over the low wall will be minimised through the construction of drainage control structures and the aim of diverting as much of the catchment as possible away from the final void and back into the surface water system; and

- Erosion of the low wall will be controlled by limiting the length of slope through the use of contour and graded drains, minimising the slope, and by the establishment of suitable vegetation.

Highwall

For the purposes of this document, the highwall is assumed to comprise undisturbed, solid material generally occurring above the economically lower-most limits of the mineable seam in the final void.

Depending on the geology of the deposit, the highwall material may comprise a range of natural occurring soil or rock materials of varying strengths or states of weathering.

To ensure the safety of the final void, the surrounding final slopes should be left in a condition where the risk of slope failure is minimised. The highwall of the final void will be left at a suitable slope to ensure long term geotechnical stability. This will be assessed by a suitably qualified geotechnical engineer.

11.3.2 Spontaneous Combustion

While spontaneous combustion is not identified to occur in the Study Area, it has been included in this document for reference as it has occurred with some final voids, particularly where coal seams (and other carbonaceous materials) are left exposed (i.e. not capped or covered). There is also the possibility that a bushfire post closure could ignite any exposed seams if they are in close proximity to the surface.

The following should be undertaken to reduce the potential for spontaneous combustion:

- Accumulations of coal, coarse rejects and other carbonaceous material, particularly if it is known to contain pyritic material, will be buried under a minimum of 3 metres of inert overburden material;

- Should any outbreaks of spontaneous combustion occur during mining operation, the details on the materials involved, presence of pyrites, location, date, time and climatic conditions should be recorded on surveyed plans; and

- These areas will be assessed at closure to ensure appropriate mitigation measures are in place to minimise the likelihood of spontaneous combustion occurring post mine closure. These areas should also be included as part of the ongoing inspection and monitoring that will be required following closure of the mine and before final lease relinquishment.

11.3.3 Control of Surface Water Inflow

The control of surface water inflow into the final void is essential for the long term management of water quality within the final void and will also aid in the control of erosion to low walls and highwalls. Surface water is a possible cause of slope deterioration and ultimate failure. Drainage has been directed away from the highwall face (where ever possible) 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.

Drainage over the low wall will be minimised through constructing surface water diversions. The drainage on the low wall will be limited and controlled to reduce the erosion potential. The catchment area of the final void will be minimised by the installation of diversion drains.

11.3.4 Public Safety Considerations

At mine closure, one of the main priorities for the final void will be to render it safe in terms of access by humans, livestock and wildlife. In order to achieve this, the following key activities should be considered:

- Instability of the low wall can induce failures or mass movement. To ensure the stability of the low walls, they will be battered back;

- Instability of the highwall can also induce failures and mass movement. To ensure the stability of the highwall to be retained post closure, an appropriately qualified geotechnical engineer will be consulted on final highwall design;

- Where possible, the exposed coal seams will be covered with inert material to prevent ignition either from spontaneous combustion, bushfires or human interference;

- Suitable signs, clearly stating the risk to public safety and prohibiting public access, will be erected at 50 metre intervals along the entire length of the fence;

- A physical barrier will be constructed at a safe distance from the perimeter of the final void to prevent human access. The highwall areas should be secured by the construction of a trench and a 2 metre safety berm. Additional security measures will be installed as required by DTIRIS. This is to provide an engineered barrier between the final void and the surrounding area. The trench and berm should be constructed in such a way that will physically stop most vehicles;

- Surface runoff from land surrounding the final void will be diverted so as to prevent any potential development of instability of the final void walls; and

- Where practicable, grasses and shrubs / trees selected to conform to the agreed post-mining rehabilitation criteria and land use will be planted along the outside edge of the bund wall to lessen any visual impact of the final void wall.

12.0 SUMMARY

Rehabilitation techniques and strategies proposed for the Study Area include several key approaches to ensure an effective rehabilitation process that complies with rehabilitation objectives and results in the final land use. The final land use of the Study Area will be established for ecological conservation and agricultural purposes and will increase areas of Class III rural land capability throughout the Study Area.

The rehabilitation management process involves the following phases:

- Setting Targets;
- Risk Identification;
- Landform Establishment;
- Topsoil Management;
- Revegetation;
- Rehabilitation Maintenance; and
- Monitoring.

Regular monitoring of the rehabilitated areas will be required during the initial vegetation establishment period and beyond to demonstrate whether the objectives of the rehabilitation strategy are being achieved and whether a sustainable and stable landform has been provided.

The success criteria are performance objectives or standards against which rehabilitation efforts to achieve a sustainable system for the proposed post-mine land use is demonstrated. By satisfying the success criteria (as indicated by monitoring results), Shenhua Watermark will demonstrate that the rehabilitated landscape is ready to be relinquished from the mine's financial assurance and could be handed back to stakeholders in a productive and sustainable condition.

It is further recommended that Shenhua Watermark prepare a Rehabilitation Management Plan and Mine Closure and Final Void Management Plan for the Project, which are reviewed and updated every five years.

13.0 REFERENCES

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