HANCOCK GALILEE PTY LTD

Kevin's Corner Project Environmental Impact Statement

05 Soils, Topography and Land Disturbance

Section 05 Soils, Topography and Land Disturbance

5.1 Introduction

This section of the Environmental Impact Statement (EIS) describes the environmental values identified within the Project site, in terms of soil resources. The description and distribution of topsoil resources are provided and their suitability for rehabilitation assessed. The potential impacts that the proposed mining activities may have upon these landscape environmental values are assessed and any mitigation measures that may be required are outlined.

The Study Area (the Project site) covers a total of 37,379 ha. The preparation of a soil and land suitability assessment for the Project was undertaken through the following phased process:

Phase 1: Desktop study using existing information and reconnaissance field survey

This involved background research, an initial field investigation and communications with the Department of Environment and Resource Management (DERM) to provide a suitable Phase 2 approach outside the DERM guidelines. In December 2010 DERM responded with an agreement for a suitable scope for Phase 2.

Phase 2: Action DERM approved survey

This involved a targeted survey at a 1:100,000 scale assessing 73 test pits, and was undertaken in May 2011, following significant delays due to wet weather and inaccessible conditions.

The Soils and Land Suitability Report (Volume 2, Appendix I of this EIS) presents the full soils and land suitability assessment for the Project.

Study Area

The Study Area consists of four domains, which are based on the proposed level of disturbance and as shown in Figure 5-1. The four domains are:

(i) Nil Disturbance (Buffer Land; 36.5%),

(ii) Subsidence Disturbance (Subsided land from underground mining; 53.2%),

(iii) Infrastructure Disturbance (Rail loop, airfield, accommodation village, dams and detention basins, conveyors, workshop, etc; 2.1%),

(iv) Open Cut & Tailings Dam Disturbance (8.2%).

The disturbance level for these activities includes a range of impacts on the soil profile and potential stripping of topsoil for re-use in rehabilitation post mining.

Study Objectives

The major objectives of this assessment were:

- Classify and determine the soil types for the Study Area at a 1:100,000 survey scale;
- Assess the pre-mining and post-mining Land Suitability classes within the Study Area;
- Assess the pre-mining and post-mining Agricultural Land Classes including highlighting any Good Quality Agricultural Land within the Study Area;
- Assess the pre-mining Strategic Cropping Land within the Study Area;

- Calculate and discuss potential erosion rates of all soils within a variety of disturbance levels;
- Assess the suitability of the current topsoil for future rehabilitation including the identification of unfavourable materials in the Study Area; and
- Provide soil management recommendations for the topsoil management.

5.2 Soil Survey

5.2.1 Phase 1 Methodology

Desktop Study

An initial broad scale reconnaissance soil map for the study area was developed using the following background information, resources and techniques:

- Aerial photographs and topographic maps; Aerial photo and topographic map interpretation was used as a remote sensing technique allowing detailed analysis of the landscape, and mapping of features expected to be related to the distribution of soils within the Study Area.
- Reference information; Source materials were used to obtain correlations between pattern elements and soil properties that may be observable in the field. These materials included cadastral data, prior and current physiographic, geological, vegetation and water resources studies.

The key source used for reference, which details previous soil and landscape mapping for the Study Area and its surrounds was the Desert Uplands Strategic Land Resource Assessment (Lorimer, 2005), as outlined below:

- Desert Upland Land Resource Assessment: This study was undertaken within the Desert Uplands Bioregion which included the Kevin's Corner Study Area. Information obtained in this report includes landscapes and land systems which detail specific soil types and management implications for these soil types.

Reconnaissance Field Survey

An initial reconnaissance field survey was undertaken in late 2010. This survey collected information on the site's complexity and degree of uniformity such that a detailed survey methodology for DERM approval could be developed.

The reconnaissance field survey involved traversing the site and obtaining approximately 60 mapping observations. These observations included cuttings, vegetation, 0.30 m deep auger holes, exposed profiles from erosion as well as rock outcrops.

5.2.2 Phase 2 Methodology

Survey Details

To assess the Study Area the soil and land assessment survey was undertaken at a medium intensity survey scale of 1:100,000, as confirmed in consultation with DERM in December 2010. The survey was an integrated free survey undertaken at a high intensity scale.

To satisfy the 1:100,000 scale, in accordance with the *Guidelines for Surveying Soil and Land Resources* (NCST, 2009) and as per the ToR, 374 observations were required (i.e. 1 observation per 100 ha). Of these, 86 detailed full profile descriptions (to a depth of 1.2 m) were made in the field with the remainder composed of mapping observations. These mapping observations include, but not be limited to, exposed cuttings, 0.30 m auger holes and rock outcrops. Detailed profile descriptions were assessed in accordance with the Australian *Soil and Land Survey Field Handbook* soil classification procedures (NCST, 2009).

The soil taxonomic classification system implemented for the project soil and land suitability assessment is the Australian Soil Classification (ASC) system (Isbell, 1996). This is compatible with the TOR.

Laboratory Sampling

Soil samples from 41 sites were subject to analytical laboratory testing at a NATA accredited laboratory. The laboratory analyses covers both physical and chemical parameters including tests for soil colour, texture, aggregate stability, soil fertility and potential metal toxicity. These analyses are in accordance with *Land Suitability Assessment Techniques* (DME, 1995).

5.2.1 Soil Survey Results

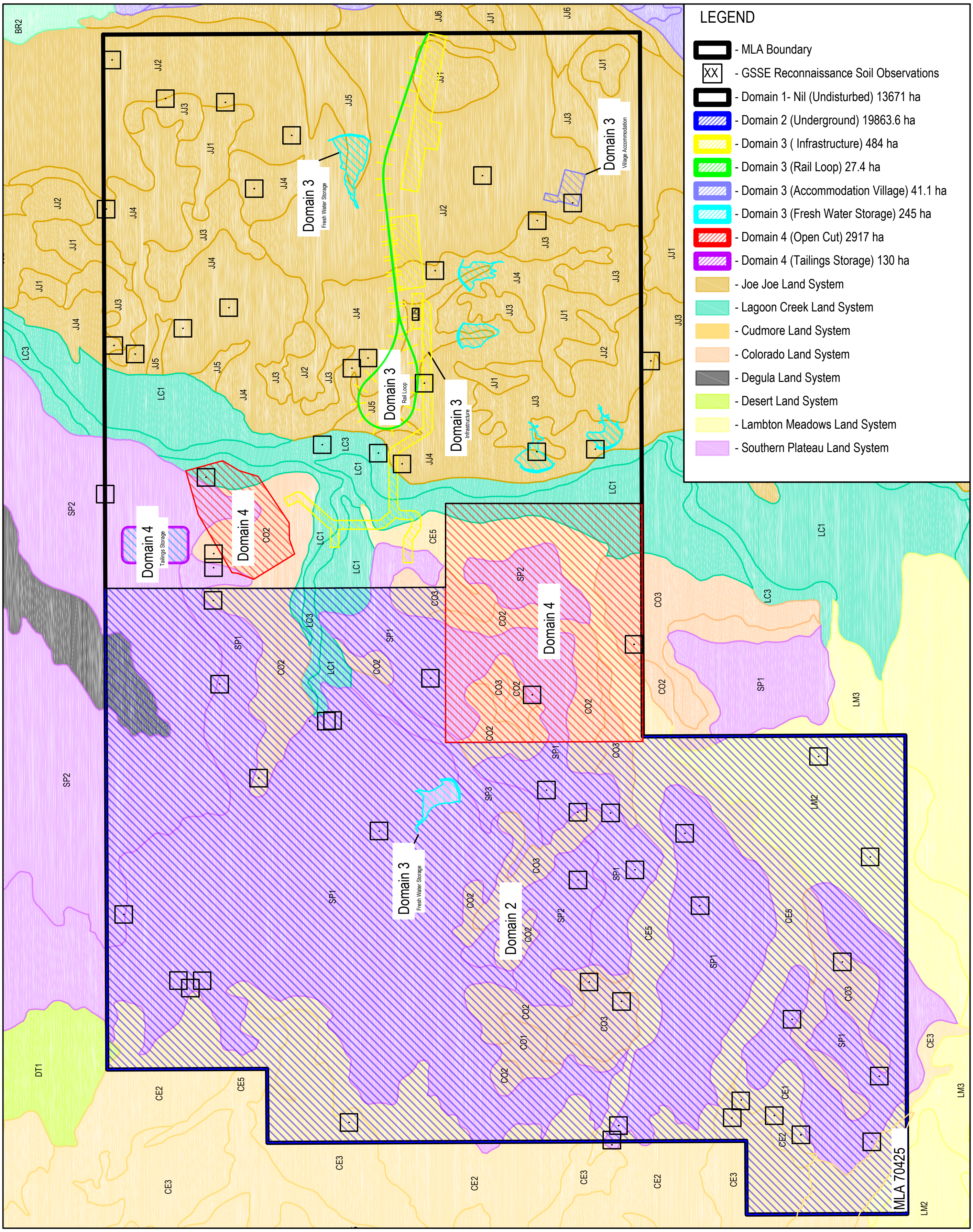
An initial broad scale reconnaissance soil map for the Study Area was developed using the Desert Upland Land Resource Assessment (Lorimer 2005) and a reconnaissance level field investigation undertaken in late 2010. The Study Area consisted of 5 Landscapes,8 Land Systems and 23 Land units as described on Lorimer (2005) (Figure 5-1). The Phase 2 investigations distinguished 26 representative soil types for the land units previously mapped, using field and laboratory analysis.

The project area is dominated by Sodosols (26%) and Kandosols (23%), with Rudosols (16%), Chromosols (15%) and Dermosols (15%). Small areas of Tenosols (4%) are located along creek lines, and very small pockets of Vertosols (1%) are also present.

Land Systems and Land Units

The Study Area contains five landscapes, eight land systems and 22 land units (Lorimer 2005).

Land systems are defined as being an area or group of areas that have a re-occurring pattern of topography, soils and vegetation that can be recognised. Within the Project area there are 8 land systems comprised of 23 land units and 26 soil types (Table 5.1). Brief descriptions of the land systems follow, and specific land unit and soil type descriptions are contained in the Soil and Land Suitability Report (Volume 2, Appendix I).



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Environmental Impact Statement

Kevins Corner Land Systems

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Figure: 5-1

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Table 5-1 Land Systems and Land units within the Study Area

Landscapes	Land System	Land Unit Number	Land Unit Number	Representative Soil Type	Study Area %
Lateritic	**Cudmore**	1	CE1	Brown Sodosol	0.5
		2	CE2	Petroferic Rudosol	2.9
		3	CE3	Brown Sodosol	1.9
		4	CE4	Brown Vertosol	0.6
		5	CE5	Stratic Rudosol	5.2
Lateritic	**Colorado**	6	CO1	Red Kandosol	0.3
		7	CO2	Red Kandosol	5.9
		8	CO3	Lithic Rudosol	4.2
Sandstone	**Southern Plateau**	9	SP1a	Red Dermosol	28.2
		9	SP1b	Yellow Kandosol	
		9	SP1c	Yellow Sodosol	
		10	SP2a	Red Sodosol	7.7
		10	SP2b	Brown Dermosol	
		11	SP3	Red Sodic Dermosol	0.9
Sandstone	**Joe Joe**	12	JJ1	Red Kandosol	2.3
		13	JJ2	Grey Sodosol	11.9
		14	JJ3	Grey Chromosol	4.9
		15	JJ4	Brown Chromosol	9.7
		16	JJ5	Tenosol	1.9
		17	JJ6	Stratic Rudosol	0.3
Alluvial Fans	**Lambton Meadows**	18	LM2	Stratic Rudosol	3.3
		19	LM3	Stratic Tenosol	0.7
Alluvial Fans	**Degula**	20	DA2	Red Chromosol	0.5
Alluvial Plains	**Lagoon Creek**	21	LC1	Yellow Kandosol	4.5
		22	LC3	Stratic Tenosol	1.7
Sand Plain	**Desert**	23	DT1	Red Kandosol	0.1

Land System 1: Cudmore Land System

The Cudmore land system contains some of the most rugged, inaccessible country in the Desert Uplands bioregion (Plate 1). The soil-vegetation associations are quite diverse with dense heathlands of slender wattle, fringe myrtle and desert tea-tree on shallow uniform sands over an ironstone hardpan (CE1), dense woodlands of lancewood on steep scarps with exposed ferricrete and gradational soils of variable depth (CE2), and complex woodlands of lancewood, narrow-leaved ironbark and bloodwood on moderate - steep slopes derived from sandstone with texture contrast soils with shallow topsoils covered with a mantle of silcrete (CE3). On the gentle lower slopes a complex of reddish-brown gradational and texture-contrast profiles plus some brown uniform clay soils support tall woodlands of silver-leaved ironbark and poplar box with some lemon-scented gum and Gympie messmate, and mid-high woodlands of brigalow, respectively (CE4). A tall woodland of river red gum predominates on the alluvial silty loam profiles of the stream banks and adjacent alluvial areas (CE5).

This Land System is represented by Brown Sodosols, Petroferic and Stratic Rudosols, and Brown Vertosols.

Land System 2: Colorado

The Colorado land system represents an extensive area of steeply dissected country in the western half of the study area. The plateau margin (CO1) with sandy gradational soils overlying an ironstone hardpan, sometimes exposed at the surface, supports a shrubland with isolated Normanton box, ghost gum and bloodwood. The scarp (CO2) of exposed ferricrete has variable steepness and soil depth, but lancewood and bendee dominate the vegetation. The footslopes (CO3) have open woodlands of silver-leaved ironbark, poplar box and ghost gum with diverse shrub and ground cover layers on deep texture-contrast soil profiles.

This Land System is represented by Red Kandosols and Lithic Rudosols.

Land System 3: Southern Plateau

The Southern Plateau land system represents an extensive landscape of undulating rises to the east of the lateritic Cudmore LS. An ironstone hardpan underlies most of the area and has a profound influence on the vegetation of the crests and upper slopes (SP1), where sparse woodlands of silver-leaved ironbark and ghost gum, together with occasional applejack and bush-house paperbark exist on shallow uniform sands and sandy loams. White cypress pine and poplar box are not uncommon, but represent small areas with deeper soil profiles. On the lower slopes (SP2) deep texture-contrast soil profiles predominate with thick sandy loam topsoils and reddish brown clay subsoils. Tall sparse woodlands consist of silver-leaved ironbark and ghost gum with a mid stratum of ironwood, false sandalwood, prickly pine, quinine tree and dead finish. Gummy spinifex dominates the ground layer. The drainage depressions with young sandy soils of variable depth and river red gum have been combined with closed depressions, which have grey uniform clay soils and coolabah-gidgee vegetation, to form land unit SP3. These areas are minor in extent but have important conservation values as riparian corridors and ephemeral wetlands.

This Land System is represented by Red and Brown Dermosols, Yellow Kandosols and Yellow and Red Sodosols.

Land System 4: Joe Joe

The Joe Joe land system represents a prominent ridge of sandstones on the eastern side of the lease. The crests and upper slopes have open woodlands dominated by silver-leaved ironbark on moderately deep, reddish-yellow, texture-contrast soils, which overlie a hardpan (JJ2). Also on the upper slopes, small areas of deep, red gradational sandy soils supporting low woodlands of yellow jacket-applejack (JJ1) occur at random. Exposures of the underlying ironstone hardpan appear as steep scarps with shallow rocky, gradational soils with mid-tall forests of lancewood (JJ3), whereas the lower slopes have deep texture-contrast profiles with yellowish brown clayey subsoils and tall woodlands of poplar box, bloodwood, and silver-leaved ironbark (JJ4). The drainage depressions have soil types ranging from young sandy alluvial deposits of variable depths supporting tall woodlands of poplar box, to silty loams on incised stream-banks with river red gum, to heavy clay soils on the lower reaches with brigalow (JJ5). Alluvial outwash fans adjacent to the lower drainage depressions are mostly cleared, but once supported woodlands of poplar box, silver-leaved ironbark and ghost gum on deep uniform sandy loam soils (JJ6).

This Land System is represented by Red Kandosols, Grey and Brown Chromosols, Grey Sodosols and Tenosols.

Land System 5: Lambton Meadows

The Lambton Meadows land system represents an extensive alluvial fan, extending in from the south east into Lagoon Creek which runs north through the centre of the lease. The soils on the upper slopes (LM1) overlie a hardpan, and consist of Yellow Chromosols texture-contrast profiles with sodic, reddish yellow, clay loam subsoils, which support tall open woodlands of silver-leaved ironbark, with occasional ghost gum and poplar box. The lower slopes (LM2) also have Sodosols which are texture-contrast soils but the mottled sandy clay subsoil is sodic.

This Land System is represented by Stratic Tenosols and Stratic Rudosols.

Land System 6: Degulla

The Degulla land system represents a large alluvial fan in the central north. The upper slopes (DA1) have Brown Chromosols which are yellowish-brown texture-contrast soils supporting open woodlands of silver-leaved ironbark and poplar box. The lower slopes (DA2) generally have deeper topsoils, resulting from accumulations of sandy wash material. Additional plant species such as bloodwood, white cypress pine and ironwood are common. Land unit DA3 is a complex unit comprising mostly of poplar box on deep soils in the drainage depressions but interspersed with areas of land unit DA2, which vary in size and shape.

This Land System is represented by a Red Chromosols.

Land System 7: Lagoon Creek

The Lagoon Creek land system represents the extended alluvial floodplain of Lagoon Creek. Land unit LC1 is most common with a typical soil-vegetation association of Red Kandosols deep sandy loam gradational profiles with tall sparse woodlands of bloodwood-ghost gum. Numerous small depressions and drainage lines with Chromosols with clayey subsoils cut through this unit. The backplains (LC2) are easily recognised by the Vertosols with heavy clay soils and a characteristic gilgai micro-relief with tall sparse woodlands of blackbutt and a lower tree layer of brigalow. The drainage depressions and creeklines (LC3) have tall open woodlands of river red gum, usually on Tenosols with uniform sandy loam soils, however desert bloodwood and poplar box are common on the sandy levee banks and interfluves.

This Land System is Represented by Yellow Kandosols and Stratic Tenosols.

Land System 8: Desert Land System

This land system represents an extensive sand plain stretching through the Flinders and Aramac Shires, with large areas also occurring in Belyando and Jericho Shires. The typical "desert country" (DT1) consists of mid-tall woodlands of Queensland yellowjacket, Clarkson's bloodwood, applejack, the occasional rusty jacket and a pasture dominated by spinifex on bright red, deep sandy gradational and texture contrast soils.

This Land System is represented by Red Kandosols.

5.3 Agricultural Land Assessment

5.3.1 Land Suitability and Good Quality Agricultural Land

The agricultural land assessment was undertaken following Phase 2 of the soil field investigation program and consisted of land suitability, agricultural land class, good quality agricultural land (GQAL) and a preliminary strategic cropping land (SCL) assessment.

Land was assessed for its suitability for agricultural activities and its relative agricultural importance for the region. This is comprised of a two part process.

Firstly, the Survey Area's overall suitability ranking for each soil type is determined in accordance with the DERM land suitability classification system using the *Guidelines for agricultural land evaluation in Queensland* (Queensland Department of Primary Industries, Land Resources Branch, 1990).

Secondly, these suitability rankings are interpreted using the *Planning Guidelines: The Identification of Good Quality Agricultural Land* (DPI, 1993) and translated into Agricultural Land Classes (ALC). These land classes are subsequently compared against the local shire planning document to determine which classes are considered to be GQAL for the specific region.

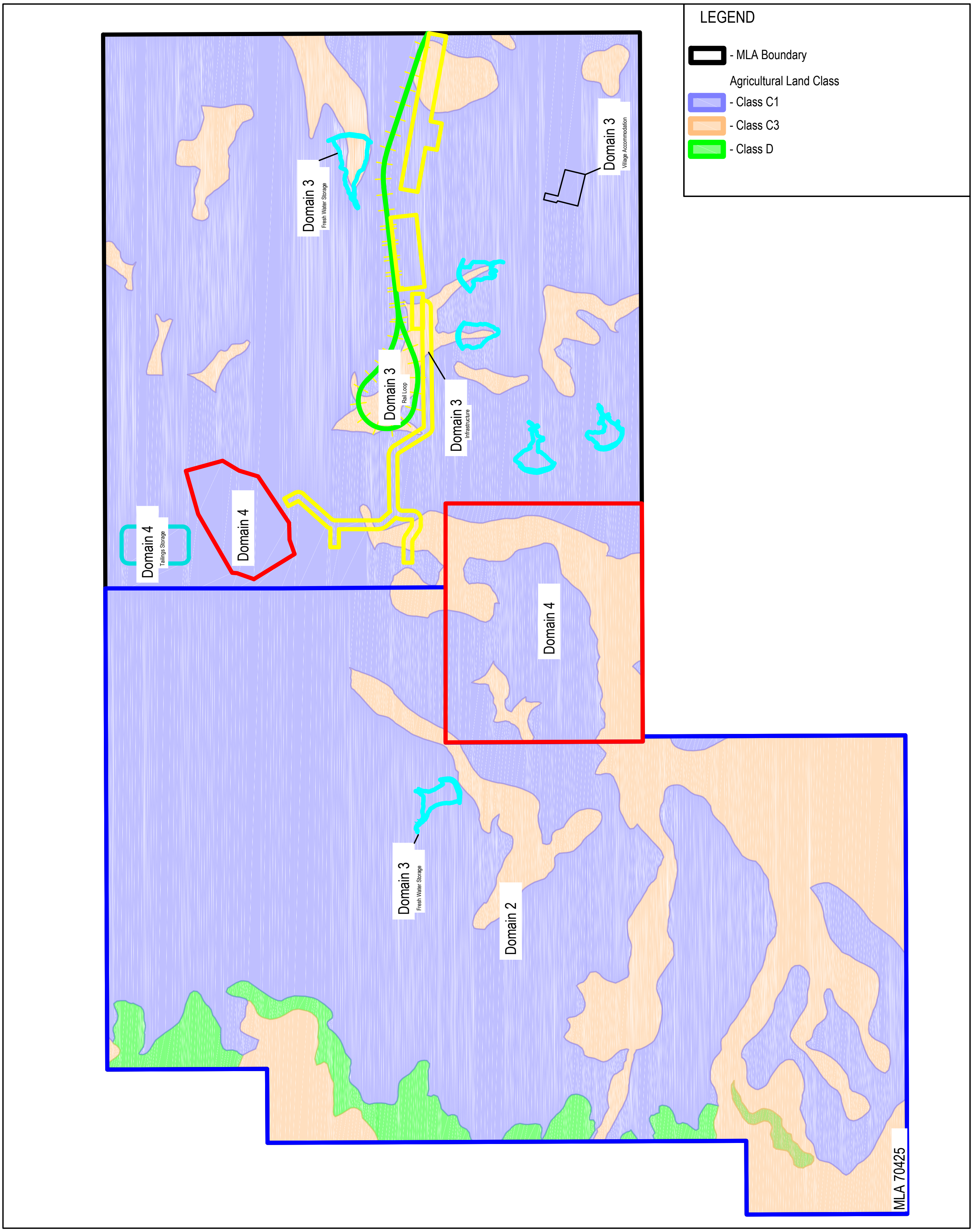
Agricultural land assessment is to be carried out for both the pre and post- mining circumstances.

Pre-mining

Preliminary results using the *Classification of Agricultural Class Land* mapping as published by DERM (2010-A; Figure 5-2), show that the Study Area is largely covered by Class C1 land with some areas of Class C3, and minor patches of Class D.

These classifications are generally associated with land that is suitable for Beef Cattle Grazing and not Rainfed Cropping (as described in the *Land Suitability Assessment Techniques*; DME, 1995). Land suitability can be tentatively inferred from ALC. The Study Areas, based on this inference, is composed largely of Land Suitability (LS) Class 3 for Beef Cattle Grazing (which is associated with ALC C1), contains anarea of LS 4 for Beef Cattle Grazing (which is associated with ALC C3) as well as a minor area of Land Suitability (LS) 5 for Beef Cattle Grazing (which is associated with ALC D) (See Figures 3 and 5 of the Soil and Land Suitability Report (Volume 2, Appendix I)).

The Jericho Shire Council Planning Scheme (2005) details that ALC's A, B & C1 are considered as GQAL and as such preliminary analysis indicates that only a minor portion of the Study Area is currently classified as GQAL. This scheme also provides a Land Characteristics Map which concurs with the more recent 2010 GQAL mapping by DERM. Within Phase 2, full land suitability and ALC analysis was conducted to confirm the preliminary ALC and GQAL mapping.



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Environmental Impact Statement

Kevins Corner
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Post- mining

The post mining land suitability continues to be dominated by Class C1 land, however the overburden emplacement slopes will be Class C3 land and final voids, tailings dam, fresh water dams and detention basins, and the rail loop are expected to be Class D (Figure 5-3).

The post mining land surface topography of the Study Area will further vary according to the impacts of subsidence from the longwall mining activities. In predicting post mining and post subsidence Land Suitability rankings, several factors need to be considered, such as predicted landform topography, risk of erosion and sedimentation and modifications to pre mining Land Suitability criteria. It is reasonable to predict that the modifications to pre mining Land Suitability criteria such as PAWC, ERD, pH, EC and rockiness will be negligible. However following subsidence, ponding and erosion hazards may become the limiting factors in areas where residual change in tilt has occurred as land that is evenly subsided will have no negative effect.

The current land surface of the Study Area includes low lying flat regions, which experience both intermittent and permanent ponding of water. Permanent ponding of water is defined as over 1.25 m, which indicates the water may not dry up over the dryer months and therefore may be permanently wet. Subsidence impact predictions may show a slight increase in the area to permanently pond water post mining. This will modify the land suitability to Class 5 (ponded water).

The areas that will be disturbed as a result of the project are as follows:

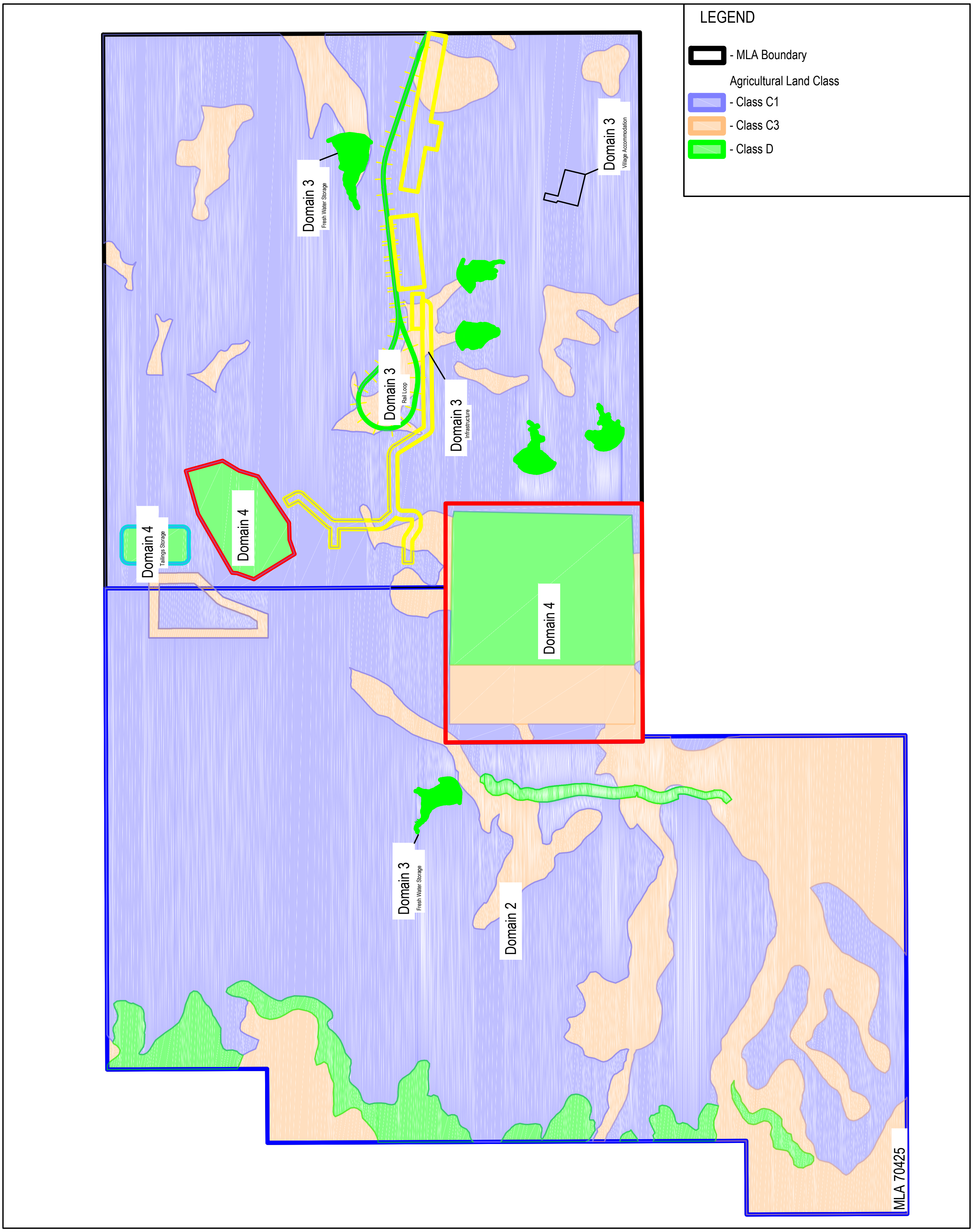
- *Areas subsided by underground mining.* These areas will not be subject to any major earthworks, but will be prone to surface subsidence effects resulting from underground mining operations. The surface subsidence effects will result in the development of an undulating land surface with gentle slopes (refer Provisional Assessment of Subsidence Behaviour (SCT 2010) for further detail). Most subsidence will not alter the land suitability and the area can continue to be used for grazing. Furthermore conservation works will be implemented to ensure a free draining landscape is maintained.
- *Open Cut Pits and Stockpile areas.* These areas will undergo major earthworks and will not return be returned to original condition. The post mining land use for stockpile areas is intended to be grazing, however the Land Suitability of this are will be reduced to Class 4, or ALC C3, while the void of the pits will remain as permanent features incapable of supporting grazing activity, resulting in an a land suitability Class 5 with ALC of D
- *Surface infrastructure.* Surface infrastructure will be constructed within the Project area. As described in the rehabilitation section of the main volume of the EIS, these areas will be rehabilitated and restored to grazing land post-mining. Their post-mining land suitability will therefore not be changed by the Project.
- *Water Dams and related infrastructure*. Water dams and related infrastructure will be constructed within the Project area. These dams will likely remain as depressions in the landscape with a ponding capacity, and may have possible uses associated with the post mining landuse of grazing.
- *Out of Pit Tailings Dam.* The tailings dam will be used for the disposal of tailings. Given the sensitive nature of the capping and rehabilitation endeavours, and the consequences of impacting on the integrity and stability of the capping layer, the post mining landuse will be

limited to vegetative cover for erosion protection. No grazing is recommended for this area and therefore will have a land suitability Class 5 for cropping and grazing with ALC of D.

- *Construction of railway*. A 20 m wide strip of land will be required for the construction of the railway line. The railway will be a permanent feature and therefore not suitable for any other use. The post mining land suitability class will therefore be Class 5, an ALC of D, for both cropping and grazing assessments.

5.3.2 Strategic Cropping Land

Strategic cropping land is a scarce natural resource defined by soil, climatic and landscape characteristics which result in an area highly suitable for crop production. An assessment of the potential for the Project to impact upon SCL was undertaken using the Protecting Queensland's strategic cropping land: A policy framework as guidance. Consultation with SCL Draft Trigger Maps C3 and C5 indicates that the Study Area does not lie within a potential SCL area. No further assessment is therefore required under SCL policy.



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Kevins Corner
Post Agricultural Land Class

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5.4 SOIL MANAGMENT

This section provides a summary on environmental impact mitigation and management recommendations with regards to:

1 ASS potential;

2 recommended stripping depths for salvage and re-use as topdressing in rehabilitation;

3 management of stored topdressing resources; and

4 erosion and sediment control measures including estimated erosion loss.

5.4.1 Acid Sulphate Soil

Acid Sulphate Soils are commonly found less than 5 m above sea level. The project site is located within the Desert Uplands Bioregion (which is located approximately 400 km from the coast) and there are no particularly low-lying coastal areas such as mangroves, salt marshes, floodplains, swamps, wetlands, estuaries, and brackish or tidal lakes. In addition, there has been little history of acid generation from regolith material with this region.

The potential for acid generation from regolith material (topsoil and subsoil) within the project site is low (this does not include acid generation potential within the overburden material, i.e. consolidated bedrock below 2-3 m depth.

Therefore, no additional investigation in accordance with the *Guidelines for Sampling and Analysis of Lowland Acid Sulfate Soils (ASS) in Queensland 1998* (Ahern CR, Ahern MR and Powell B, 1998) is required for the Study Area.

5.4.2 Soil Stripping Assessment

The soil suitability assessment aims to provide recommendations on how suitable the project site's soil is for rehabilitation works. This includes the provision of suitable topsoil and subsoil stripping depths as well as topsoil handling, stockpiling and amelioration recommendations.

The assessment uses the Australian *Guide for Selection of Topdressing Material for Rehabilitation of Disturbed Areas* (Elliot & Veness, 1981). This guide outlines the procedure for assessing soil based on grading, texture, structure, consistence, mottling, and root presence and this guideline remains the benchmark for land resource assessment in the Australian mining industry.

Investigations show a range of usable topsoils to varying depths, within the proposed disturbance areas. The soil types likely to undergo surface disturbance and be stripped of topsoil detailed in the Soil and Land Suitability Report (Volume 2, Appendix I) where volumes have been calculated and classified per disturbance area. There is a high presence of sandy soil throughout Project site, and therefore many soil types are not recommended for stripping, without treatment. However, a total of 16,871,000m^3 of soil recommended to be stripped for re-use.

5.4.3 Soil Erosion Potential/Rates

All soil samples collected during Phase 2 were laboratory tested for sodicity, using the Exchangeable Sodium Percentage (ESP). These tests indicate the susceptibility of a soil to losing its structure and binding capacity when wet, and therefore the erosion potential of the soil. Field assessments were made on site as to erosion observations which have been considered in the potential erosion rates outlined below.

Soil Erosion Rates analysis was undertaken using the Revised Universal Soil Loss Equation (RUSLE) to estimate the long term average soil loss rates that may result from sheet and rill flow during various levels of disturbance. RUSLE was used to estimate soil loss on the following Study Area surfaces:

- Undisturbed Surface;
- Pre Mining Surface cleared of vegetation and topsoil;
- Unshaped Overburden Dumps;
- Shaped Overburden Dumps with Graded Banks;
- Newly Rehabilitated Shaped Overburden Dumps; and
- Established Rehabilitated Shaped Overburden Dumps.

Erosion calculations show the disturbance level during mining with the highest risk of severe erosion rates will be the unshaped overburden scenario. The key factor to observe in this result is the topographic factor where the overburden is free dumped and left at the angle of repose albeit benched in some cases. This practice is unlikely to be modified due to cost effectiveness and practicalities of dumping activities. However it is recommended that these areas and times of highest risk should have adequate sedimentation controls in place downstream to capture any material eroded from these slopes. The shaped overburden dumps with graded banks (but without topsoil or vegetation) was the second highest predicted rate of erosion which indicates the need for the reshaping, grading, topdressing and seeding of overburden dumps to be undertaken in the quickest possible timeframe in order to minimise the risk of severe rainfall events impacting on these exposed slopes over a long period of time.

5.4.4 Landform Design & Erosion Control Measures

Provision of landform design and erosion controls aim to mitigate the impacts of land disturbance on soils, landforms and receiving waters. The full technical report summarises the key principles and design considerations to be included in this plan. In brief, the key principles include minimising erosion, segregating water, managing surface flows and monitoring activities

Best practice principles and recommendations for the construction of post-mining landforms focus on designing slope angles, lengths and shapes that are compatible with the proposed land use and not prone to an unacceptable rate of erosion. The report also provides recommendations on suitable engineering considerations such as drains and dams as well as the use of suitable erosion and sediment control strategies throughout the life of the project, and outlines the main objective of regrading is to produce slope angles, lengths and shapes that are compatible with the proposed land use and not prone to an unacceptable rate of erosion. Integrated with this is a drainage pattern that is capable of conveying runoff from the newly created catchments whilst minimising the risk of erosion and sedimentation. Final slope gradient should not exceed 17%, or approximately 10^0.

Appropriate provision of these controls for the project site used the Australian guideline *Managing Urban Stormwater: Soils and Construction–Volume 2E Mines and Quarries* (Department of Environment and Climate Change, 2008). This guide, also referred to as 'the blue book', is the industry approved erosion and sediment control guideline for Australia.

5.4.5 Topsoil Respreading and Seedbed Preparation

The report details best practice principles and recommendations for the preparation of shaped land for seed applications, re-spreading depths and techniques and weed management practices.

Where possible, suitable topsoil should be re-spread directly onto reshaped areas. Where topsoil resources allow, topsoil should be spread to a nominal depth of 0.1m on all re-graded spoil or disturbance areas. Topsoil should be spread, treated with fertiliser and seeded in one consecutive operation, to reduce the potential for topsoil loss to wind and water erosion.

5.5 Conclusion

The preparation of a soil and land suitability assessment for the Project was undertaken using a two phased process, which involved a reconnaissance level investigation followed by a targeted survey at a 1:100,000 scale assessing 86 test pits.

The initial broad scale reconnaissance soil map for the Study Area consisted of 5 Landscapes, 8 Land Systems and 23 Land units. The Phase 2 investigations distinguished 26 representative soil types for these land units, using field and laboratory analysis. These included Sodosols (26%) and Kandosols (23%), with Rudosols (16%), Chromosols (15%) and Dermosols (15%) also present throughout the project area. Small areas of Tenosols (4%) are located along creeklines, and very small pockets of Vertosols (1%) were also present.

The agricultural land assessment was undertaken following Phase 2. Initial consultation with Agricultural Land Class Maps and SCL Draft Trigger Maps C3 and C5, indicated that the Study Area does not contain cropping land or lie within a potential SCL area. Field observations and laboratory analysis confirmed the unlikely existence of potential cropping land. Given these results the land suitability assessment focussed on beef cattle grazing and ranked each land unit and soil type for this use. The majority of the pre mining land consists of land suitability for beef cattle grazing Class 3 with areas along creek lines and small patches in the east of the project site being Class 4, and minor steep rocky country in the far west being Class 5. The post mining land suitability continues to be dominated by Class 3 land, however the overburden emplacement slopes will be Class 4 land and final voids, tailings dam, freshwater dams and the rail loop are expected to be Class 5.

Soil management recommendations were made in this report including soil stripping and handling techniques for the open cut and other high disturbance areas, erosion and sediment control strategies, and topsoil respreading and seedbed preparation methods.