

# Meteor Downs South

Revised Strategic Cropping Land Restoration Plan

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### Overview

#### 1. Introduction

The *Regional Planning Interests Act, 2014* (RPI Act) identifies and protects areas of regional interest from inappropriate resource or regulated activities. A strategic cropping area (SCA) is an area of regional interest under the RPI Act and consists of the areas shown in the strategic cropping land (SCL) trigger map as SCL (Department of Infrastructure, Local Government and Planning (DILGP), 2014).

A resource activity or regulated activity located within an SCA will be required to obtain a regional interests development approval (RIDA) under the RPI Act, unless exempt under section 22, 23, 24 or 25 of the Act (DILGP, 2014).

Endocoal Ltd previously received an approved RIDA (RPI17/008) in relation to proposed disturbance to SCL within the Meteor Downs South Project. Due to site requirements, an additional area of 1.095 ha is required to provide adequate infrastructure to support the Meteor Downs South project activities. This Restoration Plan is provided in support of a SCA RIDA to demonstrate how permanent impacts to proposed by additional disturbance to SCL shall be avoided.

#### 2. Project description

The Meteor Downs South (MDS) project is a single open cut coal operation to be developed over nine years. The coal strike length is up to 1.5km long and will result in a final void depth of 80m below ground level. The project has 13 million tonnes in reserves with a projected production rate of 500ktpa during the first two years of export grade thermal coal. The MDS project plans to ramp up to production of 1.5mtpa by Year 4. Standard open pit mining is proposed using truck and shovel methods (with dozer assist) to target an average seam depth of 6m and an average strip ratio of 6:1 during the life of mine.

#### 3. Project location

The MDS project is located along the Dawson Highway, approximately 25km west of Rolleston and 45km south east of Springsure in Central Queensland as shown in Figure 1. There will be a main access road from the highway leading southwest to the mining workshop and offices. A haul road linking the pit and ROM will be constructed on the south-eastern boundary of the Mining Lease (ML). The pit is in the southern corner of the ML with out-of-pit overburden stockpiling to the north and west.



Figure 1: Location of the MDS project.

#### 3.1 Tenement and property description

The MDS project is located on mining lease (ML) 70452, granted 27 September 2015 and expires 30 November 2030. The ML is located on several freehold parcels detailed in Table 1. Figure 7 provides an overview of infrastructure associated with the MDS project.

#### 3.2 Current land uses

#### Lot 1 SP 164068

The current land use for Lot 1 SP 164068 is grazing of cattle. Proposed activities by the Meteor Downs South project on Lot 1 SP 164068 include the following:

- haul road and site access
- tank farm
- Dirty Water Dam

- Mine Infrastructure Area (MIA)
- borefield maintenance track and access to groundwater bore
- AB Triple contractor compound.

Figure 2 demonstrates land use for the Lot and Plan as detailed in GSS Environmental, 2013.



Figure 2: Land use for Lot 1 SP 164068 as demonstrated in GSS Environmental, 2013.

Lot 4 SP 170740

The current land use for Lot 4 SP 170740 is grazing of cattle. Proposed activities by the Meteor Downs South project on Lot 4 SP 170740 include the following:

- haul road and site access.

Figure 3 demonstrates land use for the Lot and Plan as detailed in GSS Environmental, 2013.



Figure 3: Land use for Lot 4 SP 170740 as demonstrated in GSS Environmental, 2013.

Lot 2 RP 616045

The current land use for Lot 2 SP 616045 is grazing of cattle. Proposed activities by the Meteor Downs South project on Lot 2 SP 616045 include the following:

- haul road and site access.

Figure 4 demonstrates land use for the Lot and Plan as detailed in GSS Environmental, 2013.



Figure 4: Land use for Lot 2 RP 616045 as demonstrated in GSS Environmental, 2013.

#### Lot 4 RP 617701

The current land use for Lot 4 RP 617701 is cropping and grazing of cattle. Proposed activities by the Meteor Downs South project on Lot 4 SP 617701 include the following:

- haul road and site access
- tank farm
- Dirty Water Dam
- borefield maintenance tracks and access to groundwater bores
- topsoil stockpile
- active pit operations (including high wall and low wall)
- mine water dam
- overburden dump plateau (including external batters)
- Run of Mine (ROM) pad
- borefield pipe.

Endocoal Ltd previously received an approved RIDA for Priority Agricultural Areas (PAAs) in November 2014 for Lot 4 RP 617701 (Appendix C). The approved RIDA is RPI14/002

UDMeteor – Meteor Downs South Coal Mine Project (MDS). Figure 5 demonstrates land use for the Lot and Plan as detailed in GSS Environmental, 2013. Figure 6 demonstrates land use as of September 2017 (provided by U & D Mining Pty Ltd).



Figure 5: Land use for Lot 4 RP 617701 as demonstrated in GSS Environmental, 2013.



Figure 6: Land use for Lot 4 RP 617701 as provided by U & D Mining Pty Ltd October 2017.

Lot 1 SP 174071

The current land use for Lot 1 SP 174071 is extractive industries (coal mining) as conducted by CRA Rolleston Pty Ltd, Sumisho Coal Australia Pty Ltd and Xstrata Coal Queensland Pty Ltd.

There are no proposed activities by the Meteor Downs South project on Lot 1 SP 174701.

#### 3.3 Current approvals

Endocoal Ltd previously received an approved RIDA for Priority Agricultural Areas (PAAs) in November 2014 for Lot 4 RP 617701 (Appendix C). The approved RIDA is RPI14/002 UDMeteor – Meteor Downs South Coal Mine Project (MDS).

Approval was also received for RIDA application RPI17/008 U & D Mining – Meteor Downs South Project (Appendix D).

Areas already approved under RPI14/002 and RPI17/008 are included for the purpose of determining proposed impact to trigger mapped SCL on currently unapproved property with common ownership (as defined under the RPI Act).



Figure 7: Infrastructure layout for the MDS project.

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Table 1: Tenure of lands existing under ML70452.

LOT	PLAN	PREDOMINATE LANDUSE	TENURE TYPE	OWNER
Lot 1	SP 164068	Grazing	Freehold	Xstrata Coal Queensland Pty Ltd (as trustee)
Lot 4	SP 170740	Grazing	Freehold	Xstrata Coal Queensland Pty Ltd (as trustee)
Lot 2	RP 616045	Grazing	Freehold	Xstrata Coal Queensland Pty Ltd (as trustee)
Lot 4	RP 617701	Grazing/cropping	Freehold	Xstrata Coal Queensland Pty Ltd (as trustee)
Lot 1	SP 174071	Extractive	Freehold	CRA Rolleston Pty Ltd, Sumisho Coal Australia Pty Ltd and Xstrata Coal Queensland Pty Ltd

## Legislative context

#### 1. Overview

The RPI Act identifies and protects areas of Queensland that are of regional interest. The intent of the RPI Act is to manage the impact and support coexistence of resource activities and other regulated activities in areas of regional interest. The RPI Act is supported by the *Regional Planning Interests Regulation 2014* (RPI Regulation).

The RPI Act and RPI Regulation seek to establish an appropriate balance between protecting priority land uses and delivering economic projects for Queensland regions.

The RPI Act protects:

- living areas in regional communities
- high-quality agricultural areas from dislocation
- strategic cropping land
- regionally important environmental areas.
- Areas of Regional Interest are defined under the RPI Act as follows:
  - a priority agricultural area
  - a priority living area
  - the strategic cropping area
  - a strategic environmental area.

The RPI Act restricts the carrying out of resource or regulated activities where the activity is not exempt from the provisions of the RPI Act, or a regional interests development approval (RIDA) has not been granted.

A resource activity (as applicable to the MDS project) is defined under the section 12 (2) of the RPI Act as follows:

- an activity for which a resource authority is required to lawfully carry out
- for a provision of a resource authority or proposed resource authority an authorised activity for the authority or proposed authority (if granted) under the relevant resource act.

#### 2. Strategic Cropping Land requirements

A resource activity or regulated activity located within an SCA will be required to obtain a regional interests development approval (RIDA) under the RPI Act, unless exempt under section 22, 23, 24 or 25 of the Act (DILGP, 2014). It is considered on this basis that the MDS project is not exempt from the requirement for a RIDA for SCL.

#### 2.1 Strategic cropping areas

The SCA covers the area mapped as SCL on the DNRM SCL trigger map and is updated by DNRM periodically to indicate 'potential strategic cropping land.' There are three required outcomes for the SCA when applying for a RIDA:

- no impact on SCL in the SCA
- no material impact on SCL on the property
- no material impact on SCL in an area in the SCA.

A number of prescribed solutions are encouraged when assessing outcomes of RIDA applications in relation to SCL and include:

- voluntary agreement with land owners
- locating the resource activity on land not used for SCL
- minimising the construction and operation footprint of a resource activity
- no permanent impact on more than two (2) percent of the SCL on the 'property'.

#### Definition – property

As defined under the RPI Regulation, a *property* in the SCL area is considered to be:

- a single lot, or
- otherwise all the lots that are owned by the same person or have one (1) or more common owners and:
  - are managed as a single agricultural enterprise, or
  - form a single discrete area because 1 lot is adjacent, in whole or part, to another lot in that single discrete area (other than for any road or watercourse between any of the lots).

#### Definition - permanent impact

As defined under the RPI Regulation, a resource activity or regulated activity has a *permanent impact* on SCL if because of carrying out the activity, the land can not be restored to its preactivity condition.

### Site Environment

#### 1. Climate

The MDS project is located in a sub-tropical region of Queensland with moderately dry winters and wetter summers (Bureau of Meteorology (BOM), 2017). Annual average rainfall is 635.8mm with the majority of this rainfall occurring in the months of December to February (Rolleston BOM station 035059, 2017) as shown in Figure 8. Mean maximum temperatures range from 22.9°C in July to 34.8°C in January as shown in Figure 9.



Figure 8: Average monthly rainfall at Rolleston (BOM station 035059).



Figure 9: Average monthly temperature at Rolleston BOM station 035059.

#### 2. Hydrology and topography

GSS Environmental (GSSE) (2013) provides the following detail regarding hydrology and topography for the MDS project site.

The Fitzroy Basin is a major Queensland catchment incorporating 9.1% of the area of the state, including major towns Biloela, Blackwater, Clermont, Dysart, Emerald, Gladstone, Injune, Moranbah, Mount Morgan, Moura and Rockhampton. The MDS project is located in one of eleven sub-basins, the Comet sub-basin.

Spring Creek is situated to the southeast of MDS and Alderbaran Creek to the northeast. Spring Creek and Alderbaran Creek are tributaries of Comet River and drain into the Mackenzie River. The Mackenzie River is the dominant river along with the Nogoa River within the Fitzroy Basin. Tributaries and drainage lines within the MDS project area predominantly flow in a southeasterly direction draining to Spring Creek in the south. Drainage from the northern part of the ML is to tributaries of Alderbaran Creek.

The topography of the MDS project area comprises undulating plains, lowlands and low hills at the base of the Carnarvon National Park. The Carnarvon National Park (a mountain range with a height of 770m above sea level) is approximately 30km to the south-west of MDS. The Carnarvon National Park is a part of the Great Dividing Range, with underlying Upper and Lower Permian shale, sandstone and volcanics.

#### 3. Geology and geomorphology

GSSE (2013) provides the following detail regarding geology and geomorphology for MDS.

Geological descriptions for MDS were made from were made from 1:100,000 web-based mapping (https://webgis.dme.qld.gov.au/webgis/webqmin/viewer.htm). The local landscape comprises Tertiary Basalts (Tb) that overly Permian Rangal Coal Measures, Bandanna Formation, Baralaba Coal Measures (Pwj, sandstone, siltstone, mudstone, coal, tuff, conglomerate), late Permian age Black Alley Shale (Pbs, mudstone, siltstone, tuff, sandstone), Peawaddy Formation (Pbp, mudstone, siltstone, sandstone, coquinite), Cattle Creek Formation (Pbk, quartzose to sub-labile sandstone and mudstone) sloping gently (1–3%) to the floodplain of Spring Creek (Qa, comprising quaternary clay, silt and gravels). Remnants of formerly more widespread basalt flows occur extensively around Rolleston.

Geomorphic domains described refer to land system mapping (Story *et al.*, 1967). The geomorphology is associated with erosional surfaces on fresh rock below the Tertiary weathered zone. The MDS ML traverses undulating hills and plain sequences of two land systems: (i) Oxford Undulating Lowlands, and (ii) Waterford Low Hills.

#### 4. Land units

Land units identified from regional land system mapping (Gunn, R.H, 1974) have been confirmed as present by GSSE (2013). Land units which have been identified to include trigger mapped SCL (revised since GSSE, 2013) are detailed below.

#### 4.1 Land unit 105

Crests and steep slopes and benches, (slopes < 40% to 100%), eucalypt woodland and softwood thicket, skeletal soils very shallow loams, Rugby soil family (Um1.4, Uf1.4), Rudosols, generally stony with extensive basalt outcrop.

#### 4.2 Land unit 107

Crests and upper slopes on mesas and slope benches (slopes 2% - 60%), mountain coolabah and grassy woodland, skeletal soils and very shallow loams. Rugby soil family (Um1.4, Uf1.4), Rudosols, generally gravelly or stony with extensive basalt outcrop.

#### 4.3 Land unit 108

Crests and upper slopes on ridges (slopes 2% - 10%), mountain coolabah and grassy woodland, cracking clay soils, shallow, Bruce soil family (Ug5.12, 5.13, 5.14, 5.32, 5.37). Vertisols, generally stony with extensive basalt outcrop.

#### 4.4 Land unit 10

Middle and lower slopes (slopes o% - 2%), tussock grassland, cracking, self-mulching clay soils, deep, May Downs soil family (Ug5.12, 5.15, 5.16, 5.18), Vertisols, stony in places with linear gilgai microrelief on steeper slopes.

#### 5. Strategic cropping land

#### 5.1 Meteor Downs South trigger map

SCL is identified to occur within the MDS ML and immediate surrounds as detailed in Figure 10. Table 2 also details the extent of mapped SCL in relation to the MDS project (including immediate surrounds).

Table 2: Extent of mapped SCL i	in relation to the MDS project.
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LOT AND PLAN	SCL MAPPED (ha)	OWNER
Lot 1 SP 164068	616.52	Xstrata Coal Queensland Pty Ltd (as trustee)
Lot 4 SP 170740	343.51	Xstrata Coal Queensland Pty Ltd (as trustee)
Lot 2 RP 616045	192.25	Xstrata Coal Queensland Pty Ltd (as trustee)
Lot 4 RP 617701	635.67	Xstrata Coal Queensland Pty Ltd (as trustee)
Lot 1 SP 174071	269.62	CRA Rolleston Pty Ltd, Sumisho Coal Australia Pty Ltd and Limited and Xstrata Coal Queensland Pty Ltd
Total	2057.57	

#### 5.2 Meteor Downs South infrastructure

SCL is identified to be disturbed as a result of infrastructure establishment within the MDS ML. Table 3 provides definitions of resource activities proposed and the associated disturbance area to SCL. Figure 11 provides an overview of SCL proposed to be disturbed by MDS project infrastructure and includes additional proposed disturbances to SCL.

MINE INFRASTRUCTURE DESCRIPTION		APPROVED UNDER RPI17/008		PROPOSED ADDITIONAL DISTURBANCE
Infrastructure type	Description	Infrastructure area (ha)	SCL proposed to be disturbed (ha)	Additional SCL proposed to be disturbed (ha)
Contractor compound	Compound and laydown area for contractor use.	2.077	2.046	-
Open cut pit	Open cut mining location and area of primary extractive activities.	2.836	0.000	-
Borefield maintenance track	Borefield maintenance track to facilitate access to bores.	0.945	0.127	0.045
Borefield (MW18)	Dewatering bore location.	0.008	0.000	-
Borefield pipe	Pipeline for access to dewatering bore.	0.051	0.000	-
Borefield test	Borefield testing area (associated with MW18 and Borefield pipe).	0.024	0.000	-
Dirty water dam	Mine dam for managing sediment laden water.	0.534	0.000	-
Dump plateau	Overburden and waste rock dump plateau and storage.	17.096	0.000	-
External batters	Batters associated with Dump plateau.	14.293	0.000	0.012
Groundwater monitoring bores	Compliance monitoring bores for groundwater.	0.031	0.000	-

Table 3: Definitions of resource activities proposed and associated disturbance to SCL.

MINE INFRASTRUCTURE DESCRIPTION		APPROVED UNDER RPI17/008		PROPOSED ADDITIONAL DISTURBANCE
Haul road	Haul road providing access to and from site and movement of extracted material from Run of Mine (ROM) pad.	72.645	23.942	1.037
High wall	Open cut pit infrastructure.	7.402	0.000	-
Low wall	Open cut pit infrastructure.	13.166	0.000	-
Mine Infrastructure Area (MIA) Pad	MIA pad includes associated administration buildings, workshop facilities and storage areas.	3.450	3.450	-
Mine water dam	Mine dam for managing mine affected water.	2.891	0.000	-
Run of Mine (ROM) Pad	Pad for storage of coal product prior to transport off site.	5.580	0.000	-
Tank farm	Hydrocarbon storage area.	0.100	0.000	-
Topsoil stockpile	Stockpile of topsoil resource for use in restoration and rehabilitation.	6.385	0.000	-
Water Infrastructure Area	Location of infrastructure for managing site water.	0.237	0.000	-
Total		149.751	29.573	1.095



Figure 10: Strategic Cropping Land proposed to be disturbed by the MDS project.

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Figure 11: Strategic Cropping Land proposed to be disturbed by MDS project infrastructure.

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### **Restoration Plan**

#### 1. Overview

A Restoration Plan is required to demonstrate how permanent impacts to SCL as a result of a resource activity will be avoided. The Restoration Plan is required to demonstrate the capacity for SCL disturbed by the resource activity to be returned to pre-activity status.

#### 2. Proposed disturbance

As required under the RPI Act, no more than 2% of SCL may be permanently impacted. The total area of the mapped SCL is calculated as the area of a polygon that covers one or more lot and plans under the ownership of a single landholder. Disturbance to that mapped SCL under the ownership of that single landholder cannot exceed 2% of that mapped area.

The area of impact is considered to be the area of that mapped SCL which will potentially be impacted by the activity, whether or not the land can be restored to its pre-activity condition after the activity ceases.

The proposed disturbance to SCL as a result of the MDS project is presented in Figure 10 and Appendix A. Table 4 details areas of impacted SCL and associated Lot and Plans. The total proposed disturbance to the mapped SCL in possession of Xstrata Coal Queensland Pty Ltd, CRA Rolleston Pty Ltd and Sumisho Coal Australia Pty Ltd currently approved is 29.57ha. An additional 1.095 ha is proposed to be disturbed as outlined in Table 4.

LOT AND PLAN	IMPACTED SCL (ha)	IMPACTED SCL (%)	OWNER	PROPOSED ADDITIONAL IMPACTED SCL (ha)
Lot 1 SP 164068	19.771	3.207	Xstrata Coal Queensland Pty Ltd (as trustee)	0.972
Lot 4 SP 170740	0.000	0.000	Xstrata Coal Queensland Pty Ltd (as trustee)	-
Lot 2 RP 616045	9.801	5.098	Xstrata Coal Queensland Pty Ltd (as trustee)	-

Table 4: Areas of impacted SCL in relation to the MDS project mine infrastructure.

LOT AND PLAN	IMPACTED SCL (ha)	IMPACTED SCL (%)	OWNER	PROPOSED ADDITIONAL IMPACTED SCL (ha)
Lot 4 RP 617701	0.001	0.000	Xstrata Coal Queensland Pty Ltd (as trustee)	0.124
Lot 1 SP 174071	0.000	0.000	CRA Rolleston Pty Ltd, Sumisho Coal Australia Pty Ltd and Limited and Xstrata Coal Queensland Pty Ltd	-
Total	29.573	1.437		1.095

As the proposed percentage of impacted SCL is below 2 percent, it is considered that the prescribed outcome that no permanent impact on more than two (2) percent of the SCL on the property is able to be met.

#### 3. Activities to restore SCL to pre-disturbance condition

#### 3.1 Land suitability assessment

GSSE (2013) conducted an assessment of land units, land suitability and SCL (as defined by SCL trigger mapping at the time of study). Since this study, the SCL trigger map has been amended at government level, resulting in a net increase in mapped SCL for the MDS project. In order to establish restoration criteria to return proposed disturbed SCL areas to predisturbance activities, comparison to land suitability criteria determined by GSSE (2013) is recommended.

Land suitability has been previously assessed for the MDS project according to the Queensland Technical Guidelines for Mining (DME, 1995). The method accounts for climate, soils, geology, geomorphology, soil erosion, topography and past land uses. The classification may not reflect the existing land use, rather it indicates the potential of the land for crop production, pasture improvement and grazing. Table 5 provides an overview of the land suitability classification scheme as reproduced from GSSE (2013).

Table 5: Land suitability classification scheme.

ORDERS	CLASS	CLASS DESCRIPTOR	DESCRIPTION
S (Suitable)	1	S1 None/Minor limitations (Highly suitable)	Land with negligible limitations, which is highly productive requiring only simple management practices to maintain economic production.
	2	S2 Minor limitations (Moderately suitable)	Land with minor limitations which either reduce production or require more than the simple management practices of Class 1 land to maintain economic production.
	3	S3 Moderate limitations (Marginally suitable)	Land with moderate limitations which either further lower production or require more than those management practices of Class 2 land to maintain economic production.
N (Not suitable)	4	N1 (or S4) Marginal land (Presently unsuitable)	Marginal lands with severe limitations which make it doubtful whether the inputs required to achieving and maintaining production outweigh the benefits in the long term (presently considered unsuitable due to the uncertainty of the land to achieve sustained economic production).
	5	N2 (or S5) Unsuitable	Unsuitable land with extreme limitations that preclude its use for the proposed purpose.

Soil type characteristics (e.g. Plant Available Water Capacity and pH) of land units identified within the MDS project have been cross-referenced against DME, 1995 for 'rainfed broadacre cropping' and 'beef cattle grazing'.

The most severe limitations as defined under Attachment 2 of DME, 1995 have been identified by GSSE (2013) for land units within the MDS project, with a land suitability ranking applied to each limitation. The overall land suitability for a land unit is defined based on the most severe limitation for the identified land unit.

Table 6 provides an overview of land units, associated soil type and limitations to rainfed cropping for SCL trigger mapped areas within the MDS project.

LAND UNIT	SOIL TYPE	MAIN LIMITATIONS TO RAINFED CROPPING (DME, 1995) <sup>1,2,3,4</sup>	LAND SUITABILITY FOR RAINFED CROPPING
105	Haplic, self-mulching, Black Veritsol, non-gravelly, fine, fine, moderate	P <sub>3</sub> N <sub>3</sub> E <sub>3</sub>	3
107	Haplic, self-mulching, Brown Vertisol, slightly gravelly, fine, fine, moderate	P <sub>2</sub> N <sub>3</sub> E <sub>3</sub>	3
108	Haplic, self-mulching, Brown Vertisol, non-gravelly, fine, fine, moderate	P <sub>5</sub> N <sub>3</sub> E <sub>3</sub>	5
110	Haplic, self-mulching, Brown Vertisol, non-gravelly, fine, fine, deep	P <sub>2</sub> N <sub>3</sub> E <sub>3</sub>	3

Table 6: Land units and limitations of SCL trigger mapped areas within the MDS project.

<sup>1</sup>Limitation class ranked from 1 (most suitable) to 5 (least suitable) in accordance with DME (1995) and Table 5.

<sup>2</sup>P – Plant available water capacity.

<sup>3</sup>N – Soil nutrient levels.

<sup>4</sup>E – Water erosion (water erosion susceptibility).

#### 3.2 Defining restoration criteria

As there has been a net increase in mapped SCL since GSSE (2013), restoration criteria proposed to return land to a pre-activity condition are based on rainfed cropping land suitability classes for land units identified to be associated with disturbance of SCL for the MDS project. Specific physical and chemical characteristics of representative land unit soil types are detailed in GSSE (2013) provided in Appendix B. Table 7 provides restoration criteria for relevant land units and associated tenures.

Table 7: Restoration criteria for mapped SCL proposed to be disturbed by MDS.

LAND UNIT	LOT AND PLAN	LAND SUITABILITY CLASS FOR RAINFED CROPPING	LIMITATIONS TO RAINFED CROPPING (DME, 1995)	PREVIOUSLY CONFIRMED SCL (GSSE, 2013)
105	Lot 4 RP617701	3	P <sub>3</sub> N <sub>3</sub> E <sub>3</sub>	Not SCL

LAND UNIT	LOT AND PLAN	LAND SUITABILITY CLASS FOR RAINFED CROPPING	LIMITATIONS TO RAINFED CROPPING (DME, 1995)	PREVIOUSLY CONFIRMED SCL (GSSE, 2013)
107	Lot 1 SP164068 Lot 2 RP616045	3	P <sub>2</sub> N <sub>3</sub> E <sub>3</sub>	SCL
108	Lot 1 SP164068 Lot 2 RP616045	5	P <sub>5</sub> N <sub>3</sub> E <sub>3</sub>	Not SCL
110	Lot 1 SP164068	3	P <sub>2</sub> N <sub>3</sub> E <sub>3</sub>	Not SCL

#### 4. Restoration methods – Mitigation of impacts to SCL

Trigger mapped SCL has been identified for the MDS project on the following tenures:

- Lot 4 RP 617701
- Lot 1 SP 164068
- Lot 2 RP 616045.

Associated land units for each tenure are detailed in Table 7 and include restoration criteria (outlined as land suitability criteria for rainfed cropping) that will be required to be met in order to establish pre-activity land uses. Pre-activity land suitability's to be achieved are:

- Rainfed Cropping Class 3 (Land unit 105, 107, 110)
- Rainfed Cropping Class 5 (Land unit 108).

Methodologies for restoration are contained herein and include previous studies undertaken in the MDS project region. Methodologies for restoration are considered to be appropriate to mitigate impacts to mapped SCL.

Additionally, Appendix 2 of GSSE (2013) includes a Topsoil Management Plan for MDS. Implementation of restoration methods should be undertaken with reference to GSSE (2013) and in accordance with the Topsoil Management Plan. A synopsis of soil management methodologies detailed in GSSE (2013) is provided in this restoration plan.

#### 4.1 Previous studies

A number of studies have been conducted previously to describe and assess soils encountered within the MDS project region and include:

- Meteor Downs South Soils, Land, Overburden and Process Waste study (GSS Environmental (GSSE), 2013)
- Lands of the Isaac Comet Area, Queensland, (Story, R et al. 1967)
- Land units of the Fitzroy Region, Queensland (Gunn, R.H. and Nix, H.A, 1977)
- A soil catena of weathered basalt in Queensland (Gunn, R.H, 1974)

- Characterisation of basaltic clay soils (Vertisols) from the Oxford Land System (Department of Primary Industries, 1990).

Studies detailed above have been utilised as the basis for developing restoration plan methodologies.

#### 4.2 Soil stripping

Charman and Murphy (2010) describes activities to promote and preserve soil materials during stripping and handling with machinery. As a general rule, the handling of soil materials by machinery should be undertaken in slightly moist conditions (e.g. soil moisture content between shrinkage limit and plastic limit) so as to minimise both brittle failure that may occur in dry soil and compressive failure that may occur in soils that are too wet.

Mine machinery and equipment is designed to move large volumes of material at low unit costs and is inappropriate in many instances for removal and emplacement of topsoil materials because of the high potential for structural damage, compaction and inadequate precision or high wastage while excluding non-desirable materials.

Grading or pushing soil into windrows with light graders or track-driven bulldozers are examples of less aggressive soil handling systems that will be implemented. Tracking over stripped areas and stockpiled soils following stripping should be avoided to minimise degradation of the soil resource.

Soil stripping activities shall be undertaken with particular regard to mapped SCL within the following areas:

- Mine Infrastructure Area (MIA) Pad
- groundwater monitors
- borefield maintenance track
- haul road.

Figure 11 provides an overview of SCL areas impacted by infrastructure that will require soil stripping prior to construction.

#### 4.3 Soil management

As a general rule, a maximum soil stockpile height of 2m will be maintained. Clay soils should be stored in lower stockpiles for shorter periods of time compared to sandy soils (GSSE, 2013).

Impacted SCL, which has been stripped, will be stockpiled and batters should be constructed with a 3:1 slope to prevent slumping and allow the establishment of protective cover crop vegetation. Where stockpiles are to be maintained for extensive periods (six months or longer), seed and fertiliser will be applied on establishment. An annual cover crop species that produces sterile florets or seed will be sown (e.g. Japanese millet or Rye grass).

A soil management register will be developed and include details of impact SCL soils that have been stripped and stockpiled, including the date of stripping, location of storage, volume stripped, soils type and source location.

Soil stripped for the preservation of pre-activity condition for mapped SCL will be stored in a position removed from the area of operation, away from concentrated overland flow with exclusion of access and adequate signage maintained.

Regular monitoring of stockpiles shall be undertaken to ensure that nutrient status of soil types is maintained and degradation of soil does not occur under stockpiled conditions.

#### 4.4 Re-establishment of disturbed areas mapped as SCL

Replacement of soil over stripped areas will be undertaken in a similar manner to original stripping activities. Sampling of the stockpiled resource should be undertaken prior to respread of materials to understand the nutrient status and amelioration requirements (e.g. application of gypsum, NPK fertilisers, etc.) if required.

Additionally, any foreign material brought in (e.g. gravel, road stabilisers, etc.) should be removed from the area to be restored and ripping of sub-soils should be undertaken to alleviate compaction and allow for the "keying in" of topsoil resources into subsoil.

Replacement of stripped SCL materials over the restoration area should result in an area "left rough" to promote infiltration of water and aeration. SCL soils stripped will be returned to be same general location that SCL soils were initially stripped from. Consultation with the land holder will be undertaken to determine required activities to facilitate a return to agricultural activities (e.g. ploughing and target crop requirements).

### 4.5 Monitoring activities – demonstration that impacted SCL has been restored

Table 8 details monitoring procedures to be applied to disturbed SCL areas and should be read in conjunction with the MDS project Topsoil Management Plan to ensure the condition of stockpiled resources is maintained.

Monitoring activities proposed will be undertaken to demonstrate that disturbed areas are returned to designated land-uses identified in Section 4 and that impacts to mapped SCL have been successfully mitigated.

Table 8: Topsoil management procedures to be applied to disturbed SCL areas of the MDS project.

PARAMETER	ACTION	MONITORING	FREQUENCY
Approvals and clearances	Updated and relevant to activity.	Checking validity of approvals and clearance permits as per protocol.	Prior to clearance activities
Hostile soils	Identification of dispersive, sodic, saline, highly acidic or highly alkaline soils.	Use soil survey information and continued observations to avoid any stripping of hostile material.	Prior to and during clearance activities
Stripping depths	Strip to depths advised.	Clearance operators to constantly ensure stripping depths are as per recommendations in GSSE (2013).	Prior to and during clearance activities
Topsoil condition	Ensure prior to stripping that soil has appropriate moisture content. Must be slightly moist during stripping.	Visually inspect soil to be stripped to ensure that soil is in a slightly moist condition.	Prior to and during clearance activities
Stripped material placement	*Place directly in a position away from operations and concentrated flow paths.	Investigate influential parameters including mining sequencing, equipment scheduling and weather when determining placement of soil, ensuring that stripped soil is placed in such a way as to avoid ongoing operations and concentrated water flow paths.	Prior to clearance activities
Stockpile surface condition	Keep surface condition as coarse as possible.	Visually monitor activity to ensure no unnecessary handling or smoothing occurs. Avoid unnecessary shaping and compaction of stockpile.	During and following stripping activities
Waterway contamination	Prevent sediments from stockpiles reaching waterways.	Ensure stockpiles are designed and protected as per the practical standards detailed in Section 2.2 (of GSSE, 2013) and established in appropriate locations.	Prior to, during and following stripping activities
Stockpile height	Stockpiles to be a maximum of 2m in height.	Machinery operators to visually gauge height of stockpiles upon establishment, to be confirmed by appropriately qualified person (e.g. surveyor).	During stripping activities
Soil stockpile treatment	Seed and fertilise stockpiles intended for extended duration.	The duration of the stockpile will be predicted upon establishment and seeding and fertiliser will be applied where necessary.	Following stripping activities

PARAMETER	ACTION	MONITORING	FREQUENCY
Soil fertility	Soil sampling and analysis to monitor soil fertility and quality.	Representative soil samples to be collected from stockpiled soils by an appropriately qualified person (e.g. Environmental Advisor) and analysed by a NATA accredited laboratory for soil fertility and quality. Parameters to be analysed to include:	Annually
		- pH	
		- Electrical conductivity (EC)	
		- Chloride	
		- Cation exchange capacity	
		- Total nitrogen	
		- Colwell potassium	
		- Colwell phosphorous	
		- Total organic carbon.	
		Laboratory results should be compared to representative land unit soils types and Hazelton and Murphy (2016) and ameliorants to be applied (e.g. gypsum) to maintain stripped soil quality (if required).	

\*Differs from Table 2.2.3 of the MDS Topsoil Management Plan.

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# Appendix summary

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Appendix B	Meteor Downs South Soil, Land, Overburden and Process Waste
Appendix C	Study
Appendix D	Approved RIDA RPI14/002
11	Approved RIDA RPI17/008
## Appendix A

Maps



ENDOCOAL METEOR DOWNS SITE LOCATION							
Legend							
Dual Carriageway  Principal Road							
Secondary Road							
Proposed project area							
Credits: Cadastre and Strategic Cropping Land © State of Queensland (Department of Natural Resources and Mines) 2016.							
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# Appendix B

Meteor Downs South Soil, Land, Overburden and Process Waste Study



## **APPENDIX C**

Soils and Overburden Assessment Report

**Endocoal Limited** 

## Meteor Downs South Coal Project, EPC 1517, Dawson Highway, Rolleston

Soils, Land, Overburden and Process Waste Study



March 2013

MEM08-001



#### Prepared on behalf of McCollum Environmental Management Services Pty Ltd for Endocoal Limited



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Date of Issue:March 2013GSSE Reference:MEM08-001

#### ISSUE AND AMENDMENT CONTROL HISTORY

Issue	Date	Description	Author	QA/QC
1	19.09.2012	Report Draft 1	SHS/MB	IH
	24.01.2013	Client Review	SHS	ME
2	19.02.2013	Report Draft 2	SHS	IH
3	06.03.2013	Final	SHS	MB

#### EXECUTIVE SUMMARY

McCollum Environmental Management Services Pty Ltd (MEMS) engaged GSS Environmental (GSSE) on behalf of Endocoal Limited (Endocoal) to conduct a soil, land, overburden and process waste study for the proposed Meteor Downs South Coal Project, EPC1517 (the MDS Project), which is located adjacent to the Dawson Highway approximately 25 kilometres west of Rolleston, Central Queensland. The MDS Project covering an area of 1606 hectares is wholly contained within EPC1517 and involves the development of an open cut coal mine and associated infrastructure to produce 1.5 Mtpa of thermal coal for export. Production is expected to commence in 2013, with the mine life expected to be 10-15 years at the proposed mining rate. Endocoal require a soil, land, overburden and process waste study to support a mining lease application for assessment as an Environmental Management Plan (EMP).

Soil survey and assessment methods were designed to address Queensland technical guidelines for assessing land suitability, strategic cropping land and good quality agricultural land. Field survey work was conducted between the 22<sup>nd</sup> and the 23<sup>rd</sup> May 2012 by Scott Hayes-Stanley (GSSE Environmental Scientist) and Malvin Manueli (GSSE Senior Environmental Scientist).

A geochemical assessment program for coal and mining waste materials was developed with reference to technical guidelines applicable in Queensland (DME, 1995d), Australia (DITR, 2007) and internationally (INAP, 2009). Malvin Manueli (GSSE Senior Environmental Scientist) proposed a geochemical sampling and testing program undertaken by Endocoal that used representative samples of overburden and interburden (potential reject material) from the surface up to the roof of the lowest target coal seam. Cost limitations and relative size of the area (below 1,000 ha) prevented the DME sampling guideline for specific rock types being observed for the mass-balance calculations. However, samples were collected according to specific intervals and horizons encountered.

The GSSE soil, land, overburden and process waste study provides:

- A description of the soil types across the MDS Project area using the Australian Soil Classification system nomenclature;
- A description of the land suitability classes, agricultural land classes and good quality agricultural land classes across the MDS Project;
- Identification of unfavourable soil materials, including potentially acid forming soils, that require specific management and handling practices;
- A description of the overburden characteristics, including concentrations of sulfides, metals, pH, electrical conductivity, NAPP and NAGG;
- Discussion of potential for the assessed overburden materials to generate acidic, alkaline, saline and/or metalliferous leachate;
- Discussion of the potential for leachate to occur from waste dumps and potential quality of any leachate;
- Discussion of the erosion potential of overburden and the long term sustainability of the proposed landforms relative to the material characteristics;
- An impact assessment on Soils, Land Suitability and Good Quality Agricultural Land as a result of the proposed Project;
- An assessment and recommendations of Strategic Cropping Land as a result of the proposed project;
- Recommendations on soil-stripping depths for proposed disturbance areas; and.
- A description of necessary erosion and sediment-control measures to manage in-situ and stockpiled soil resources.

The soil and land suitability field survey was undertaken at a medium intensity scale of 1:30,000. Soil samples were analysed for various physical and chemical soil attributes by accredited laboratories. These

analyses included tests for nutrient content, dispersion, and erodibility attributes, and potentially acidforming characteristics.

Soil types ranged from shallow to deep uniform and gradational cracking clay soils on gently undulating to undulating plains. Soils have developed from Tertiary age basalt.

Provisions of the *Strategic Cropping Land Act* (SCL Act) and the local government plan currently constrain development on parts of the MDS Project area. However, this Strategic Cropping Land (SCL) assessment would support an SCL validation application that would revise down the mapped SCL in the MDS Project area.

According to the Bauhinia Shire Planning Scheme, the MDS Project area was identified as Class A and Class C2 land. Assessment of the Agricultural Land Classes for the MDS Project area by GSSE identified the MDS Project area as Class B, Class C1 (GQAL) and Class C2 (not GQAL). Mining development of approximately 227 ha of good quality agricultural land (GQAL) would need consideration according to the local government plan.

Land suitability was assessed for the MDS Project area as being Class 2 to Class 5 for rainfed cropping or Class 2 to Class 3 beef cattle grazing. The MDS Project area is constrained primarily by plant available water due to soil depth. Post-development plans are committed to restoring the disturbance footprint (outside of the pit, final void and overburden stockpile) to its pre-development Agricultural Land Classes. The proposed post-development rehabilitation objective for the pit, final void and overburden stockpile will be the establishment of a native ecosystem, consistent with Class D Agricultural Land Class.

Most soil types were found to be suitable for salvage and re-use in rehabilitation works. Recommended maximum soil stripping depths generally ranged from 0.0 to 0.2 m for primary media (683,000 m<sup>3</sup>), and 0.1 to 0.6 m for secondary media (2,469,000 m<sup>3</sup>). Approximately 80% of the disturbance footprint was assessed as having a moderate erosion hazard rating with the major factor influencing the severity of this hazard being soil erodibility. Appropriate erosion and sediment controls have been recommended to minimise potential adverse erosion effects on the surrounding environment.

The overburden assessment determined that overburden material will generate a neutral to slightly alkaline runoff and seepage. All overburden samples were identified as very low sulfur (< 0.1% content). Three overburden samples were identified as Unconfirmed – Non Acid Forming, one sample was identified as Unconfirmed Potentially Acid Forming and all other overburden samples were identified as Not Acid Forming. Interburden (rejects) material was determined as not expected to be generally acidic or metalliferous with NAPP results ranging from < 0.5 to 6.9 kg H<sub>2</sub>SO<sub>4</sub>/t. Based on limited testing, overburden material is suitable for use in landform construction and coarse rejects (interburden) needs to be placed in the final void.

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#### 1.0 INTRODUCTION

McCollum Environmental Management Services Pty Ltd (MEMS) engaged GSS Environmental (GSSE) on behalf of Endocoal Limited (Endocoal) to conduct a soil, land, overburden and process waste study for the proposed Meteor Downs South Coal Project, EPC1517 (MDS Project), which is located adjacent to the Dawson Highway approximately 25 kilometres west of Rolleston, within the Central Highlands Regional Council area of Central Queensland. Endocoal require a soil, land, overburden and process waste study to support a mining lease application for the MDS Project.

#### 1.1 Project Description and MDS Project area

The MDS Project is located along the Dawson Highway, approximately 25km west of Rolleston and 35km south east of Springsure in Central Queensland, shown in **Figure 1-1**. The nearest regional town to the MDS Project is Emerald, approximately 165km to the north. The MDS Project involves the development of an open cut coal mine and associated infrastructure to produce 1.5 Mtpa of thermal coal for export. Production is expected to commence in 2013, with the mine life expected to be 10-15 years at the proposed mining rate.

The town of Rolleston is located approximately 25km east of the MDS Project area. Rolleston services both mining and agriculture and resides within the Central Highlands Regional Council with a population of approximately 25,296 people (ABS, 2011). The relevant planning scheme across the MDS Project is the Bauhinia Shire Council Planning Scheme, which the Central Highlands Regional Council has administered since the restructuring of local government in Queensland during 2012.

The MDS Project is wholly contained within EPC1517, with disturbed and undisturbed areas covering 1606 ha (refer **Figure 1-2**). The mine plan approximates the total disturbed area at 521 ha, comprising mine infrastructure (83 ha); mine pit and out of pit spoil dump (337 ha), haul road (5 ha), sediment dams (11 ha), quarry (47 ha) and access roads and tracks (38 ha).

#### 1.2 Assessment Objectives

The soils and land assessment objectives were to:

- 1. Identify existing environmental values for topography, landscape, land use including land suitability, and Good Quality Agricultural Land (GQAL), geology and soils in terms of physical and economic properties;
- 2. Identify changes to the landscape and topography of the area since European settlement;
- 3. Identify presence of Strategic Cropping Land (SCL) within and surrounding the MDS project area;
- 4. Classify and determine soil types for the surface and sub-surface material according to observed and analysed physical and chemical characteristics;
- 5. Assess values for each identified soil type for recovery ahead of disturbance and reuse as a topsoil on rehabilitation areas;
- 6. Assess the proposed final landform feature stability in terms of erosion potential;
- 7. Assess erosion potential (including sheet, rill, gully and tunnel) of materials relative to varying disturbance categories;

- 8. Assess erosion sources and calculate likely impacts and rates of erosion on the various facets of the operation including cleared land, topsoil stripped, pits/voids, overburden dumps (at various stages of development and rehabilitation), topsoil stockpiles, infrastructure areas, creek banks, roads, etc.; and
- 9. Assess the characteristics of overburden relative to seed germination and plant establishment and growth.

The overburden analysis objectives were to:

- 1. Identify characteristics of overburden and crushing reject/oversize material, which includes concentrations of salts, sulfides, metals, pH, Electrical Conductivity (EC), Net Acid Producing Potential (NAPP), Net Acid Generation (NAG), Acid Neutralisation Capacity (NAC), nutrients, Cation Exchange Capacity (CEC) and Exchangeable Sodium Percentage (ESP);
- 2. Assess materials relative to their Potential Acid Forming and Non Acid Forming characteristics;
- 3. Assess the potential for poor quality drainage (leachate) from overburden and oversize dumps (i.e. acidic, alkaline, saline and metalliferous);
- 4. Assess material characteristics relative to landform stability, sustainability and their use as a growth medium used in rehabilitation;
- 5. Assess erosion potential (including sheet, rill, gully and tunnel) of materials relative to varying disturbance categories;
- 6. Discuss expected overburden quantities and dump locations within the MDS project area;
- 7. Discuss expected void locations and final landform stability within the MDS project area; and
- 8. Discuss expected reject quantities and disposal locations within the MDS project area where applicable.

#### 1.3 Scope of Work

#### 1.3.1 Soils and Land Assessment

The scope of the soil and land assessment analysis refers to the assessment objectives in Section 1.2. To satisfy Objective 1 and 2 of the Assessment, the existing environmental values for topography, landscape, land use, including land suitability and GQAL, geology, soils and changes to landscape and topography since European settlement was undertaken in accordance with:

- National Committee on Soil and Terrain, 2009, Australian Soil and Land Survey Field Handbook;
- Isbell, 2002, Australian Soil Classification;
- Mckenzie et al, 2nd Ed., 2008 Guidelines for Survey Soil and Land Resources;
- Department of Primary Industries and Department of Local Government and Housing, 1993, Planning Guidelines The Identification of Good Quality Agricultural Land;
- Department of Primary Industries and Department of Local Government and Housing, 1992, State Planning Policy 1/92 (Development and the Conservation of Agricultural Land);
- Department of Minerals and Energy, 1995, Technical Guidelines for the Environmental Management of Exploration and Mining in Queensland: Land Suitability Assessment Techniques;

To satisfy Objective 3, the identification of Strategic Cropping Land was undertaken in accordance with:

- Strategic Cropping Land Act 2011;
- Department of Environment and Resource Management, Protecting Queensland's Strategic Cropping Land: A policy framework (2011);
- Protecting Queensland's strategic cropping land: Proposed criteria for identifying strategic cropping land (2011); and
- Protecting Queensland's strategic cropping land: Guidelines for applying the proposed strategic cropping land criteria (2011).

To satisfy Objective 4, classification and determination of soil types for the surface and sub-surface material observed and analysed was in accordance with:

- National Committee on Soil and Terrain, 2009, Australian Soil and Land Survey Field Handbook; and
- Isbell, 2002, Australian Soil Classification.

To satisfy Objective 5, the assessment of values for identified soil types for recovery ahead of disturbance and reuse as a topsoil on rehabilitated areas was undertaken in accordance with:

- Environmental Protection Agency, 2004, A Policy Framework to Encourage Progressive Rehabilitation of Large Mines; and
- Department of Minerals and Energy, 1995, Technical Guidelines for the Environmental Management of Exploration and Mining in Queensland: Growth Media Management.

To satisfy Objective 6, the proposed final landform feature stability in terms of erosion potential was assessed in accordance with the Australian guideline *Best Practice Erosion and Sediment Control* (International Erosion Control Association (IECA), 2008).

To satisfy Objective 7, erosion potential of materials relative to varying disturbance categories was assessed in accordance with Department of Minerals and Energy, 1995, Technical Guidelines for the Environmental Management of Exploration and Mining in Queensland: *Erosion Control.* 

To satisfy Objective 8, the erosion sources and calculation of likely impacts and rates of erosion on various facets of operations shall be assessed in accordance with Department of Minerals and Energy, 1995, Technical Guidelines for the Environmental Management of Exploration and Mining in Queensland: *Erosion Control.* 

#### 1.3.2 Overburden Analysis

The overburden analysis refers to the assessment objectives that were given in Section 1.2. To satisfy Objective 1, identify characteristics of overburden and crushing reject/oversize material (including concentrations of salts, sulfides, metals, pH, Electrical Conductivity, EC, Net Acid Producing Potential, NAPP, Net Acid Generation, NAG, Acid Neutralisation Capacity, ANC, nutrients, Cation Exchange Capacity, CEC and Exchangeable Sodium Percentage, ESP) assessments were made according to:

- Guidelines on the Investigation Levels for Soil and Groundwater Schedule B (1), National Environment Protection Council (NEPC) Measure (Assessment of Site Contamination), 1999; and
- Guidelines on Health-Based Investigation Levels, National Environment Protection Council (NEPC) Measure (Assessment of Site Contamination), 1999; and Leading Practice Sustainable

Development Program for the Mining Industry (LPSDPMI), 2007, Managing Acid and Metalliferous Drainage.

To satisfy Objective 2 and Objective 3, assess materials relative to their Potential Acid Forming and Non Acid forming characteristics and assess the potential for poor quality drainage (leachate), according to:

- Department of Minerals and Energy, 1995, Technical Guidelines for the Environmental Management of Exploration and Mining in Queensland: Assessment and Management of Acid Drainage; and
- Global Acid Rock Drainage Guide (GARD) Guidelines published by the International Network for Acid Prevention (INAP).

To satisfy Objective 4 and Objective 5, assess material characteristics relative to landform stability, sustainability and their use as a growth medium used in rehabilitation and assess erosion potential of materials relative to varying disturbance categories according to:

- Manual for Assessing Hazard Categories and Hydraulic Performance of Dams, Queensland Government Environmental Protection Agency (1999);
- Technical Guidelines for the Environmental Management of Exploration and Mining in Queensland, Department of Minerals and Energy (1995).

To satisfy Objective 6, Objective 7 and Objective 8, discuss expected overburden quantities and dump locations, expected void locations and final landform stability and expected reject quantities and disposal locations within the MDS Project area, was undertaken in accordance with:

- Department of Minerals and Energy, 1995 Technical Guidelines for the Environmental Management of Exploration and Mining in Queensland;
- Department of Minerals and Energy, 1995, Technical Guidelines for the Environmental Management of Exploration and Mining in Queensland: Assessment and Management of Acid Drainage;
- Department of Minerals and Energy, 1995, Technical Guidelines for the Environmental Management of Exploration and Mining in Queensland: *Erosion Control;*
- Global Acid Rock Drainage Guide (GARD) Guidelines published by the International Network for Acid Prevention (INAP);
- Leading Practice Sustainable Development Program for the Mining Industry (LPSDPMI), 2007, Managing Acid and Metalliferous Drainage;
- Guidelines on the Investigation Levels for Soil and Groundwater Schedule B (1), National Environment Protection Council (NEPC) Measure (Assessment of Site Contamination), 1999;
- Guidelines on Health-Based Investigation Levels, National Environment Protection Council (NEPC) Measure (Assessment of Site Contamination), 1999; and
- And where applicable, the Manual for Assessing Hazard Categories and Hydraulic Performance of Dams, Queensland Government Environmental Protection Agency (1999).



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PMF Levee Bese Plan Data Source: Gode	le Earth Pro
LEGEND FIGURE 1.2 Project: Meteor Downs South Soils,	Land,
Project Boundary Area    Overburden and Process W      Proposed Infrastructure    Proposed Out of Pit Spoil Dump and Mining Area      Proposed Quary    Project Layout      Client:    Endocoal Limited      Proposed Trimmed Dumps    File:	Vaste Study
0  1km  2km    Scale 1:45 000  Scale 1:45 000    Version  Date:  Author:  Checked:  Approved:    0  06/03/2013  BS  SHS  MB	ıt_130306

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### 2.0 EXISTING ENVIRONMENT

#### 2.1 Hydrology and Topography

The Fitzroy Basin is a major Queensland catchment incorporating 9.1% of the area of the state, including major towns including Biloela, Blackwater, Clermont, Dysart, Emerald, Gladstone, Injune, Moranbah, Mount Morgan, Moura and Rockhampton. The MDS Project is located in one of eleven sub-basins — the Comet sub-basin.

Spring Creek is situated to the south-east of the MDS Project Area and Aldebaran Creek to the northeast. Spring Creek and Aldebaran Creek are tributaries of Comet River and draining into the Mackenzie River. The Mackenzie River is the dominant river along with the Nogoa River within the Fitzroy Basin. Tributaries and drainage lines within the MDS Project area predominantly flow in a south-easterly direction draining to Spring Creek in the south. Drainage from the northern part of the MLA is to tributaries of Alderbaran Creek.

The topography of the MDS Project area comprises undulating plains, lowlands and low hills at the base of the Carnarvon National Park. The Carnarvon National Park (a mountain range with a height of 770 m above sea level) is approximately 30 km to the south west of MDS Project area. The Carnarvon National Park is a part of the Great Dividing Range, with underlying Upper and Lower Permian shale, sandstone, and volcanics.

#### 2.2 Climate

The MDS Project area has a subtropical climate with moderately dry winters and wetter summers (Bureau of Meteorology (BOM), 2012). Annual average rainfall is 638 millimetres with the majority of this rainfall falling in the summer months of December to February (Rolleston BOM station No. 035059, 2012). Mean maximum temperatures range from 22 degrees Celsius in July to 34.4 degrees in January (Rolleston BOM station No. 035059, 2012 and Springsure BOM station No. 035065). The seasonal cycle can be divided into two equal segments. (a) A hot summer period during which the major part of the annual rainfall occurs; the period taken is from November to April, which coincides with the crop cycle for summer crops such as sorghum, maize, cotton and peanuts and also roughly with the normal period of bare fallow between successive winter crops. (b) A cool, marginally wet to dry winter period from May to October, which coincides with the crop cycle for cool-season crops such as wheat, barley, oats and oil seeds and also roughly with the normal period of bare fallow between successive summer crops.

#### 2.3 Geology and Geomorphology

Geological descriptions for the MDS Project area (1:100 000 scale) were made from web-based mapping (https://webgis.dme.qld.gov.au/webgis/webqmin/viewer.htm). The local landscape comprises Tertiary Basalts (**Tb**) that overly Permian Rangal Coal Measures, Bandanna Formation, Baralaba coal measures (**Pwj**, Sandstone, siltstone, mudstone, coal, tuff, conglomerate), late Permian age Black Alley Shale (**Pbs**, mudstone, siltstone, tuff, sandstone), Peawaddy Formation (**Pbp**, mudstone, siltstone, sandstone, coquinite), Cattle Creek Formation (**Pbk**, Quartzose to sub-labile sandstone and mudstone) sloping gently (1-3 %) to the floodplain of Spring creek (**Qa**, comprising quaternary clay, silt and gravels). Remnants of formerly more widespread basalt flows occur extensively around Rolleston.

Geomorphic domains described in this report refer to land system mapping (Story et al., 1967). The geomorphology is associated with erosional surfaces on fresh rock below the Tertiary weathered zone. The MDS Project traverses undulating hills and plain sequences of two land systems (i) Oxford Undulating Lowlands and Plains, and (ii) Waterford Low Hills. The location of these geomorphic domains is depicted in **Figure 2-1**.

#### Domain 1: Oxford Land System Undulating Lowlands and Plains

The Oxford Undulating Lowlands are the most extensive land system in the MDS Project area, characterised as slightly weathered or unweathered Tertiary basalt (Tb) flows in erosional, low relief terrain extending to the valley floor. Elevation ranges between 245 and 282 metres above sea level.

The Oxford land system represents typical downs country of black soils and grassland developed on basalt. The soils are generally deep but thin out on the low rises where outcrops occur (Oxford land system, Story et al., 1967). It commonly supports open savannah woodland vegetation.

#### Domain 2: Waterford Low Hills

The Waterford land system occurs in the southern part of the MDS Project area and is characterised as fresh or little-weathered basalt comprising low rocky hills and undulating colluvial foot slopes underlain by Tertiary Basalt Unit (Tb). Elevation ranges between 241 and 273 metres above sea level and slopes are mainly gently inclined. It is characterised by mesas and hills, which are slightly weathered.

The land system in many places shows traces of a former deep weathered zone and the soils can be correspondingly reddish rather than black and secondary silica, carbonate and gypsum are common (Waterford land system; Story, 1967). The common vegetation community is silver-leaved ironbark.

#### 2.4 Soils

The MDS Project area was mapped at 1:250 000 scale in the Fitzroy region land resources survey (Story et al. 1967) and land unit descriptions were correlated with geomorphic surfaces and land systems in Gunn and Nix (1977). The lithology of underlying rocks and slope control the distribution of soils on erosional landscapes below the Tertiary weathered zone. The soils in the MDS Project area are formed in basalt parent material according to Gunn and Nix (1977).

The general pattern is dominance of skeletal soils on steep slopes underlain by quartz sandstones, mixed sediments, metamorphic and acid volcanic rocks; texture contrast soils on gentle slopes underlain by mixed sediments, granite and old alluvial materials, and cracking clay soils on lithic sandstones, shales, mudstones, basalt and fine textured alluvium. Soils with varying textural properties and minimal profile development occur in some recent alluvial landscapes.

#### 2.5 Land Units

The following soil and land units were identified from regional land unit mapping (Gunn and Nix 1977) in the MDS Project area.

#### 2.5.1 Waterford Low Hills,

**Land unit 105:** crests and steep slopes and benches (slope < 40 - 100%); eucalypt woodland and softwood thicket; skeletal soils very shallow loams, Rugby soil family (Um1.4, Uf1.4), Rudosols, generally stony with extensive basalt outcrop.

#### 2.5.2 Oxford Undulating Lowlands and Plains,

Land unit 107: crests and upper slopes of mesas and slope benches (slope 2 - 60%); mountain coolabah grassy woodland; skeletal soils, very shallow loams, Rugby soil family (Um1.4, Uf1.4), Rudosols, generally gravelly or stony with extensive basalt outcrop;

**Land unit 108:** crests and upper slopes of low ridges (slope 2 – 10%); mountain coolabah grassy woodland; cracking clay soils, shallow, Bruce soil family (Ug5.12, 5.13, 5.14, 5.32, 5.37), Vertosols, generally stony with extensive basalt outcrop;

**Land unit 109:** upper and middle slopes (slope 2 - 5%); tussock grassland; cracking, self-mulching clay soils, moderately deep, Arcturus soil family (Ug5.12, 5.32, 5.37), Vertosols, gravelly or stony in places, commonly with linear gilgai microrelief;

**Land unit 110:** middle and lower slopes (slope 0 - 2%); tussock grassland; cracking, self-mulching clay soils, deep, May Downs soil family (Ug5.12, 5.15, 5.16, 5.18), Vertosols, stony in places, commonly with linear gilgai microrelief on steeper slopes;

**Land unit 111:** upper, middle and lower slopes (slope 3 – 5%); silver-leaved ironbark grassy open woodland; cracking, self-mulching clay soils, deep, Arcturus soil family (Ug5.12, 5.15, 5.16, 5.18), Vertosols, stony in places, commonly with linear gilgai microrelief on steeper slopes.

#### 2.5.3 Potentially Acid Forming Soils

Excluding acid generation potential within the overburden material (consolidated bedrock below two to three metres depth) the potential for acid generation from regolith material (topsoil and subsoil) within the MDS Project area is very low. Potential Acid Sulfate Soils (PASS) have formed in recent geological time below five metres (AHD), particularly in low-lying coastal areas such as mangroves, salt marshes, floodplains, swamps, wetlands, estuaries, and brackish or tidal lakes. The MDS Project in the Central Highlands region 350 kilometres from the coast and above 220 metres AHD is free from coastal PASS risk. However, inland acid sulfate soils may develop under reducing conditions when saline groundwater tables rise after land clearing or where parent materials that contain sulfate. There is no recorded PASS risk from regolith material within this region.

#### 2.6 Vegetation

The MDS Project area is defined as open savannah woodland predominantly covered with grasses, used for beef cattle grazing and cropping activities. Most of the native vegetation has been cleared for agriculture and pasture grasses such as *Dichanthium sericeum* (Queensland Blue Grass) and *Heteropogon contortus* (Black Spear Grass) predominate.

#### 2.7 Land use

The primary agricultural land use was identified as grazing native vegetation with relatively minor areas of secondary cropping land use from State land use mapping (Queensland Land Use Baseline 1999).

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#### 3.0 SOIL SURVEY

The distribution of main soil types within the MDS Project area was identified from the field survey, which was conducted according to land resource assessment guidelines (NCST 2009). The methods and results for the field and laboratory assessment are described below.

#### 3.1 Methodology

#### 3.1.1 Background Information

Descriptions of soil types and their distribution with landform and parent material in the MDS Project area refer to regional land systems mapping (Story et al. 1967) and land unit descriptions (Gunn and Nix 1977). Preliminary soil map boundaries were developed from:

Aerial photographs and topographic maps -

Aerial photo and topographic map interpretation was used as a remote sensing technique to analyse the landscape and map features expected to be related to the distribution of soils within the MDS Project area;

• GQAL digital map data derived from regional soil surveys -

Source materials were used to obtain correlations between the landscape features (identified from aerial and map analysis) and soil properties that may be observable in the field. These materials include cadastral data, prior and current physiographic, geological, vegetation and water resources studies. Relevant reports cross-referenced include the *Lands of the Isaac-Comet Area, Queensland* (Story, 1967), *Land Units of the Fitzroy Region, QLD* (Gunn and Nix, 1977), Springsure 1:250 000 Geological Sheet (GSQ, 2012), *Characterisation of Basaltic Clay Soils* (*Vertosols*) from the Oxford Land System in Central Queensland (A. A. Webb, A. J. Dowling, 1990) and A Soil Catena on Weathered Basalt in Queensland (R. H. Gunn, 1974).

#### 3.1.2 Field Survey Methodology

A 'free survey' design was used that complied with GQAL and SCL assessment guidelines. Soil boundaries range from abrupt to gradual where trends can be associated with variations along toposequences. The survey team used their judgment to locate reference and detailed soil survey sites within unique map areas defined by landform and geology and check sites to delineate soil boundaries and SCL exclusion areas.

#### 3.1.3 Mapping Sampling and Classification

Map scale, survey density and assessment detail for the MDS Project area (1606 ha) are presented in **Table 3-1** with SCL (DERM, 2011c), GQAL (QDPI, 1993) and land suitability assessment (DME 1995b) survey guidelines. The field survey made 46 site observations, with 17 full profile descriptions collected, 12 of which were submitted for laboratory analysis and 17 check and/or exclusion sites. The number of full profile descriptions and sites with laboratory data exceeded the survey guidelines, while there were fewer check sites than generally recommended. On this basis the field survey design was sufficiently detailed to assess soil properties and their distribution across the MDS Project area. The locations of the sampled soil survey sites are shown on **Figure 3-1**.

Soil profile cores were collected with a vehicle mounted hydraulic push corer to 1.5 m or refusal in rock substrate. Core holes were backfilled. Soil profile morphology was described from cores collected at detailed sites (Class I and II in **Table 3-1)** in accordance with standard practice (NCST, 2009). Check site observations were made to confirm map boundaries and SCL exclusion areas. These observations were made from exposures in cuttings (such as cut slopes), excavations using a spade to the top of the subsoil (B horizon) or 0.4 m, vegetation associations and rock outcrops.

Class Observations		Land Suitability		GQAL	SCL	Actual for Project
		Undisturbed area (1085 ha)	Disturbed area (521 ha)			
	Minimum map scale	1:50,000	1:25,000	1:10,000	1:30,000	1:30,000
	Site density	1 site/sq.cm. mapped	1 site/sq.cm. mapped	1 site/25ha	1 site/50ha	1 site/35ha
	Total number	43	83	64	32	46
I	Full profile descriptions	10	20	3	10	17
II	Reference profiles with laboratory data <sup>1</sup>		10	3	5	12
III	Check sites	33	63	12	36	17
	Exclusion sites				10	

	Table 3-1	Field	Survey	Observations
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<sup>1</sup> One reference site was described in detail and sampled for laboratory analysis for each soil type described in Section 2.5.

In total, 148 soil samples were sent to the Scone Research Centre in New South Wales and Australian Laboratory Services (ALS) in Brisbane, Queensland for analysis. These laboratories are accredited by the National Association of Testing Authorities (NATA). Full results for these analyses are contained in **Appendix 1**.

Soil physical and chemical parameters were selected in the laboratory testing program (**Table 3-2**) to meet data requirements for GQAL, SCL and Land Suitability Assessment (DME 1995b; DERM 2011b; DPI 1993).

Property	Application	Testing Program
Physical:		
Particle-size Analysis (PSA) (<2mm)	Nutrient retention; exchange properties; erodibility; workability; permeability; sealing; drainage; interpretation of most other physical and chemical properties and soil qualities	A, B and C horizons
Coarse fragments (>2mm)	Soil workability; root development.	Every sample
Colour	Soil colour based on Munsell Colour chart.	Selected representative samples
K-Factor (Erodibility)	Aid in the prediction of erosion rates for soil layers.	Selected representative samples
Plant Available Water Content	Determine usable soil water for cropping or grazing pastures, calculation for gravimetric water content.	Selected representative samples
Chemical:		
Phosphorous	Nutrient availability	A, B and C horizons
Potassium	Nutrient availability	A, B and C horizons
Sulfur	Nutrient availability	A, B and C horizons
Total Nitrogen	Nutrient availability      A horizon	

#### **Table 3-2 Laboratory Analysis Parameters**

Property	Application	Testing Program
Chloride	Nutrient availability, trace elements	Every sample
Sulfate	Nutrient availability	A horizon
Replaceable Potassium	Nutrient availability	A horizon
Total Organic Carbon	Nutrient availability	A horizon
Metals	Nutrient availability, trace elements	A, B and C horizons
Aluminium	Nutrient availability, trace elements	A horizon
Micronutrients	Nutrient availability	A horizon
Free and Total Iron	Nutrient availability	A horizon
Exchange Acidity	Nutrient availability; nutrient fixation; toxicities (especially Aluminium, Manganese); liming; sodicity; correlation with other physical, chemical and biological properties.	A, B and C horizons
Soil reaction (pH) (1:5, soil: water suspension)	Nutrient availability; nutrient fixation; toxicities (especially Aluminium, Manganese); liming; sodicity; correlation with other physical, chemical and biological properties.	Every sample
Electrical conductivity (EC) (1:5, soil: water suspension)	Appraisal of salinity hazard in soil substrates or groundwater, total soluble salts.	Every sample
Cation Exchange Capacity (CEC) and Exchangeable Cations	Nutrient status; calculation of exchangeable sodium percentage (ESP); assessment of other physical and chemical properties, especially dispersivity, shrink – swell, water movement, aeration.	A, B and C horizons

Soils were classified from profile morphology and laboratory analyses according to the Australian Soil Classification (ASC) system (Isbell 2002). Less confidence was expressed in check site descriptions than reference and detailed survey site descriptions.

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#### 3.2 SOIL SURVEY RESULTS

#### 3.2.1 Soil Map Units

Five soil map units were identified in the MDS Project area. Each representative soil type was cross referenced with relevant land systems as identified in *Lands of the Isaac-Comet Area, Queensland* (Story, 1967) and the land unit descriptions in Gunn and Nix (1997). Moderate to deep, Haplic, Self-mulching, Brown Vertosols occurring over 84% of the MDS Project area are identified in the soil map legend, **Table 3-3**. Soil types are mapped in **Figure 3.2**. 10 Reference sites have been presented in the following section. Additional analysis has been conducted to meet the requirements for SCL assessment and is represented in **Section 5.2.2**.

Map unit/soil family	Soil survey	Australian Soil Classification	MDS Proj	ect area
	reference site #		ha	%
Oxford undulatin	g lowlands ar	nd plains		
107, Rugby	1, 3	Haplic, Self-Mulching, Brown Vertosol; Slightly Gravelly, Fine, Fine, Shallow – Moderate	491	30
108, Bruce	12	Haplic, Self-Mulching, Brown Vertosol; Non-Gravelly, Fine, Fine, Moderate	835	52
109, Arcturus	10, 11, 14	Haplic, Self-Mulching, Grey Vertosol; Non-Gravelly, Fine, Fine, Moderate	126	8
110, May Downs	8	Haplic, Self-Mulching, Brown Vertosol; Non-Gravelly, Fine, Fine, Deep	30	2
Waterford Low H	ills			
105, Rugby	2, 7, 9	Haplic, Self-Mulching, Black Vertosol; Slightly-Gravelly, Fine, Fine, Shallow-Moderate,	124	8
		Minor Haplic, Eutrophic Brown Dermosol; Slightly Gravelly, Fine, Fine, Shallow		
	Total		1606	100

Table 3-3 Soli Map Leyenu	Table	3-3	Soil	Мар	Legend
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## 3.2.3 Soil Properties

### 3.2.3.1 Oxford – Rugby Land Unit 107 (Rugby 107) – Haplic, Self-Mulching, Brown Vertosols; Slightly Gravelly, Fine, Fine, Shallow - Moderate

Rugby 107 soils are brown heavy clay topsoils grading to dark brown heavy clay subsoil. Profiles are neutral becoming moderately alkaline with depth, have very low salinity and are non sodic throughout. High cation exchange capacity is present throughout the profile and comprise primarily of exchangeable calcium and magnesium. The topsoil has high phosphorus and organic matter contents and low nitrogen content.

The Rugby 107 soils are recommended for use in rehabilitation and are suitable for stripping and stockpiling. This soil should be managed according to the *Meteor Downs South Topsoil Management Plan*.



#### Landscape (Site 1)

ASC Soil Type	Haplic, Self-Mulching, Brown Vertosol; Slightly Gravelly, Fine, Fine, Shallow					
Representative Pit	Site 1	Site 1				
Dominant Geology Association	Tertiary Basalt					
Dominant Slope Association	Gently undulating plains					
Land Use and Vegetation	Native pastures and grazing					
Land Suitability Class	Beef Cattle Grazing Class 3					
Erosion Risk Class	Moderate					
Soil Stripping Pecommendation	Primary Media Depth (m)	Secondary Media Depth (m)				
	0.0 m - 0.1 m – nil limitations	0.1 m – 0.35 m – nil limitations				



Analytical Description <sup>1</sup>											
Analyte	Units		A1	I	B2		С				
Depth	m	0.00	- 0.10	0.10	- 0.35	0.35 – 0.55					
Colour <sup>2</sup>	-	Bı	rown	Dark	Brown	Dark Yello	wish Brown				
рН	-	7.0	Neutral	7.4 Mildly Alkaline		8.3	Moderately Alkaline				
Electrical Conductivity	dS/cm	0.014	Very Low	0.017	Very Low	0.091	Low				
Cation Exchange Capacity	meq/100g	42.8	Very High	47.9	Very High	50.7	Very High				
Exchangeable Sodium Percent	%	0.2	Non Sodic	0.4 Non Sodic		0.8	Non Sodic				
Total Phosphorus	mg/kg	369	-	302	-	1010	-				
Total Kieldebl Nitregen	mg/kg	1100	Law	-		-					
rotal Kjeldani Nitrogen	%	0.11	LOW		-	-					
Total Organic Carbon	%	1.7	Moderate		-		-				
Emerson Aggregate Test	-	5	Slight	5	Slight	5	Slight				
	%	15.5	N/A	51.4	N/A	33.1	N/A				
Available Water Capacity	mm/cm	1.6	N/A	2.1	N/A	1.7	N/A				
	mm/layer	16	N/A	53	N/A	34	N/A				

2 Colour analysed on moist sample unless was a bleached layer

Site Description									
	Landscape (Site 3)								
ASC Soil Type	Haplic, Self-mulching, Brown Vertosol; Moderate	Slightly Gravelly, Fine, Fine,							
Representative Pit	Site 3								
Dominant Geology Association	Tertiary Basalt								
Dominant Slope Association	Gently undulating plains								
Land Use and Vegetation	Native pastures and grazing								
Land Suitability Class	Beef Cattle Grazing Class 3								
Erosion Risk Class	Moderate								
Soil Stripping Documendation	Primary Media Depth (m)	Secondary Media Depth (m)							
Soli Stripping Recommendation	0.0 m - 0.2 m – nil limitations	0.2 m – 0.6 m – nil limitations							



Analyte	Units	A1			B2		С	
Depth	m	0.0 - 0	.20	0.20 - 0.60		0.60 - 0.70		
Colour <sup>2</sup>	-	Very Dark	Brown	Dark Red	dish Brown	Brown		
рН	-	6.8	Neutral	7.1	Neutral	7.7	Mildly Alkaline	
Electrical Conductivity	dS/cm	0.58	Very Low	0.011	Very Low	0.03	Very Low	
Cation Exchange Capacity	meq/100g	27	High	28.8 High		57.3	Very High	
Exchangeable Sodium Percent	%	0.37	Non Sodic	0.69 Non Sodic		1.57	Non Sodic	
Total Phosphorus	mg/kg	469	-	215	-	267	-	
Total Kieldebi Nitregen	mg/kg	1810	Law	-		-		
rotal Kjeldani Nitrogen	%	0.18	LOW	-		-		
Total Organic Carbon	%	1.85	High		-		-	
Emerson Aggregate Test	-	3(1)	Slight	5	Slight	5	Slight	
	%	33	N/A	47.6	N/A	19.4	N/A	
Available Water	mm/cm	2.56	N/A	0.92	N/A	1.5	N/A	
Capacity	mm/layer	25.6	N/A	36.9	N/A	15	N/A	

2 Colour analysed on moist sample unless was a bleached layer

### 3.2.3.2 Oxford – Bruce Land Unit 108 (Bruce 108) – Haplic, Self-Mulching, Brown Vertosols; Non-Gravelly, Fine, Fine, Moderate

Bruce 108 soils are very dark brown heavy clay topsoil and dark greyish brown subsoil. Profiles are mildly alkaline becoming strongly alkaline with depth, have very low to low salinity and are non sodic throughout. Very high cation exchange capacity is present throughout the profile and comprise primarily of exchangeable calcium and magnesium. Phosphorus and organic matter is moderate in the topsoil, however nitrogen content is low.

The Bruce 108 soils are recommended for use in rehabilitation and are suitable for stripping and stockpiling. This soil should be managed according to the *Meteor Downs South Topsoil Management Plan*.





Analyte	Units	A1			B2	I	B3	
Depth	m	0.00 - 0	0.10	0.10 - 0.50		0.50 - 0.60		
Colour <sup>2</sup>	-	Very Dark	Grey	Very Da	ark Brown	Dark	Brown	
рН	-	7.4	Mildly Alkaline	7.9	Moderatel y Alkaline	8.5	Moderatel y Alkaline	
Electrical Conductivity	dS/cm	0.078	Very Low	0.041	Very Low	0.118	Low	
Cation Exchange Capacity	meq/100g	68.7	Very High	71.4	Very High	62.2	Very High	
Exchangeable Sodium Percent	%	0.29	Non Sodic	0.28 Non Sodic		0.32	Non Sodic	
Total Phosphorus	mg/kg	317	-	279	-	580	-	
Total Kieldebi Nitregen	mg/kg	910	Law	-		-		
rotar Kjeldani Mitrogen	%	0.09	LOW		-	-		
Total Organic Carbon	%	1.21	Moderate		-		-	
Emerson Aggregate Test	-	5	Slight	5	Slight	4	Neg. <sup>3</sup>	
	%	16.4	N/A	57.2	N/A	26.4	N/A	
Available Water	mm/cm	1.94	N/A	1.68	N/A	3.12	N/A	
Capacity	mm/layer	19.4	N/A	67.5	N/A	31.2	N/A	

2 Colour analysed on moist sample unless was a bleached layer

3 Negligible

### 3.2.3.3 Oxford – Arcturus Land Unit 109 (Arcturus 109) – Haplic, Self-Mulching, Grey Vertosols; Non-Gravelly, Fine, Fine, Moderate

Arcturus 109 soils are very dark grey uniform heavy clays. Profiles are mildly alkaline becoming moderately alkaline with depth, have very low to low salinity and are non sodic throughout. Very high cation exchange capacity is present throughout and comprise primarily of exchangeable calcium and magnesium. Phosphorus and organic matter are high in the topsoil, however nitrogen content is low.

The Arcturus 109 soils are recommended for use in rehabilitation and are suitable for stripping and stockpiling. This soil should be managed according to the *Meteor Downs South Topsoil Management Plan*.





Analyte	Units	A1			B2	I	B3	
Depth	m	0.00 - 0	0.10	0.10 - 0.50		0.50 - 0.60		
Colour <sup>2</sup>	-	Very Dark	Grey	Very D	ark Grey	Br	own	
рН	-	7.7	Mildly Alkaline	7.8	Mildly Alkaline	8.2	Moderatel y Alkaline	
Electrical Conductivity	dS/cm	0.037	Very Low	0.027	Very Low	0.057	Very Low	
Cation Exchange Capacity	meq/100g	72.4	Very High	74.5	Very High	69.6	Very High	
Exchangeable Sodium Percent	%	0.14	Non Sodic	0.27 Non Sodic		0.43	Non Sodic	
Total Phosphorus	mg/kg	631	-	404	-	563	-	
Total Kieldebl Nitregen	mg/kg	1220	Low	-				
rotal Kjeldani Nitrogen	%	0.12	LOW		-	-		
Total Organic Carbon	%	1.72	Moderate		-		-	
Emerson Aggregate Test	-	5	Slight	5	Slight	4	Neg. <sup>3</sup>	
	%	18.3	N/A	49.3	N/A	32.4	N/A	
Available Water	mm/cm	2.36	N/A	2.12	N/A	2.09	N/A	
Capacity	mm/layer	23.6	N/A	63.6	N/A	41.8	N/A	

2 Colour analysed on moist sample unless was a bleached layer

3 Negligible

Site Description								
	Landscape (Site 11)							
ASC Soil Type	Self-Mulching, Grey Vertosol; Non-Gra	velly, Fine, Fine, Moderate						
Representative Pit	Site 11							
Dominant Geology Association	Tertiary Basalt							
Dominant Slope Association	Gently undulating plains							
Land Use and Vegetation	Native pastures and grazing							
Land Suitability Class	Beef Cattle Grazing Class 2							
Erosion Risk Class	Low							
Soil Stripping Recommendation	Primary Media Depth (m)	Secondary Media Depth (m)						
con stripping recommendation	0.0 m – 0.1 m – nil limitations	0.1 – 0.6 m – nil limitations						



Analyte	Units	A1		B2			B3	
Depth	m	0.00 - 0	0.00 - 0.10		0.10 - 0.50		0.50 - 0.60	
Colour <sup>2</sup>	-	Very Dark	Grey	Very D	ark Grey	Very D	ark Grey	
рН	-	7.7	Mildly Alkaline	7.9	Moderatel y Alkaline	8.1	Moderatel y Alkaline	
Electrical Conductivity	dS/cm	0.092	Very Low	0.028	Very Low	0.036	Low	
Cation Exchange Capacity	meq/100g	77.9	Very High	77.8	Very High	82.7	Very High	
Exchangeable Sodium Percent	%	0.38	Non Sodic	0.51 Non Sodic		0.61	Non Sodic	
Total Phosphorus	mg/kg	334	-	262	-	247	-	
Totol Kieldebl Nitregen	mg/kg	820	Law	-		-		
rotal Kjeldani Nitrogen	%	0.08	LOW	-		-		
Total Organic Carbon	%	1.20	Moderate		-		-	
Emerson Aggregate Test	-	5	Slight	5	Slight	4	Neg. <sup>3</sup>	
	%	23	N/A	60	N/A	17	N/A	
Available Water	mm/cm	2.64	N/A	1.73	N/A	1.95	N/A	
Capacity	mm/layer	26.4	N/A	69	N/A	19.5	N/A	

2 Colour analysed on moist sample unless was a bleached layer

3 Negligible

Site Description								
ASC Soil Type	Haplic, Self-Mulching, Grey Vertosol; N	Non-Gravelly, Fine, Fine, Moderate						
Representative Pit	Site 14							
Dominant Geology Association	Tertiary Basalt							
Dominant Slope Association	Gently undulating plains							
Land Use and Vegetation	Native pastures and cropping							
Land Suitability Class	Rainfed Broadacre Cropping Class 2							
Erosion Risk Class	Low							
Soil Stripping Recommendation	Primary Media Depth (m)	Secondary Media Depth (m)						
	0.0 m – 0.15 m – nil limitations	0.15 m – 0.80 m – nil limitations						



Analytical Description <sup>1</sup>											
Analyte	Units	A1			B2		B3				
Depth	m	0.00 - 0	).15	0.15 - 0.80		0.80 – 0.90					
Colour <sup>2</sup>	-	Very Dark	Grey	Very	Dark Grey	Very D	ark Grey				
рН	-	7.4	Mildly Alkaline	8 Moderately Alkaline		8.3	Moderately Alkaline				
Electrical Conductivity	dS/cm	0.046	Very Low	0.029	Very Low	0.128	Low				
Cation Exchange Capacity	meq/100g	72.6	Very High	76.8 Very High		86	Very High				
Exchangeable Sodium Percent	%	0.28	Non Sodic	0.52	Non Sodic	0.58	Non Sodic				
Total Phosphorus	mg/kg	483	-	335	-	324	-				
Totol Kieldebl Nitregen	mg/kg	1420	Law	-		-					
rotal Kjeldani Nitrogen	%	0.14	LOW		-		-				
Total Organic Carbon	%	2.02	High		-		-				
Emerson Aggregate Test	-	5	Slight	5	Slight	5	Slight				
	%	18.2	N/A	42.8	N/A	39	N/A				
Available Water	mm/cm	1.75	N/A	0.95	N/A	5.64	N/A				
Capacity	mm/layer	26.25	N/A	61.8	N/A	56.4	N/A				

2 Colour analysed on moist sample unless was a bleached layer

# 3.2.3.4 Oxford – May Downs Land Unit 110 (May Downs 110) – Haplic, Self-Mulching, Brown Vertosols; Non-Gravelly, Fine, Fine, Deep

May Downs 110 soils are brown medium clay topsoil grading to a dark brown sub soil. Profiles are moderately alkaline becoming strongly alkaline with depth, have very low salinity trending to moderate and are non sodic throughout. High cation exchange capacity is present throughout the profile and comprise primarily of exchangeable calcium and magnesium. Phosphorus and organic matter is moderate in the topsoil, however nitrogen content is low.

The May Downs 110 soils are recommended for use in rehabilitation and suitable for stripping and stockpiling. This soil should be managed according to the *Meteor Downs South Topsoil Management Plan*.



0.0 m - 0.1 m - nil limitations

0.1 - 0.6 m - nil limitations



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	1.4	0	stro Dar geo	ngly alka k Brown logy is Te	aline and salini mottling chara ertiary basalt.	alinity is rated low to medium. Drainage is considered poor with 10% naracteristics. 10% calcareous concretions were noted and underlying alt.						
					Anal	ytical De	scription <sup>1</sup>					
Analy	te	Uni	its A1 B21 B22					B3				
Depth		m	I	0.	0 - 0.10	0.1	0 - 0.50	0.5	50 – 0.90	0.90 – 1.40		
Colour <sup>2</sup>		-		E	Brown	Da	rk Brown	Da	rk Brown	В	rown	
рН		-		8.4	Moderately Alkaline	8.0	Moderately Alkaline	8.4	Moderately Alkaline	8.7	Strongly Alkaline	
Electrical Conductivi	ty	dS/o	cm	0.075	Very Low	0.045	Very Low	0.062	Very Low	0.211	Low	
Cation Exchange Capacity		meq 0į	/10 9	42.5	Very High	32.8	High	35.9	High	77.6	Very High	
Exchangea Sodium Pe	able ercent	%	þ	0.24	Non Sodic	0.61	Non Sodic	2.22	Non Sodic	2.57	Non Sodic	
Total Phosphoru	IS	mg/	′kg	291	-	207	-	160	-	265	-	
Total K	jeldahl	mg/	′kg	920	Low		-		-			
Nitrogen		%	) )	0.09	LOW		-		-			
Total O Carbon	rganic	%	þ	1.37	Moderate		-		-			
Emerson Aggregate	Test	-		5	Slight	5	5 Slight		Slight	4	Neg. <sup>3</sup>	
		%	þ	8.1	N/A	24.5	N/A	30.7	N/A	36.7	N/A	
Available	Water	mm/	′cm	1.14	N/A	0.86	N/A	1.08	N/A	1.03	N/A	
Capacity		mm/ ei	′lay r	11.4	N/A	34.5	N/A	43.2	N/A	51.6	N/A	

1 Interpretations from Hazelton & Murphy (2007) unless otherwise stated

2 Colour analysed on moist sample unless was a bleached layer

3 Negligible

# 3.2.3.5 Waterford – Rugby Land Unit 105 (Rugby 105) – Haplic, Self-Mulching, Black Vertosol; Slightly-Gravelly, Fine, Fine, Moderate

Rugby 105 soils are very dark brown topsoils and black heavy clay subsoils. The soil is neutral becoming strongly alkaline with depth, has very low salinity and is non sodic throughout. Very high cation exchange capacity is present throughout the profile and comprise primarily of exchangeable calcium and magnesium. Phosphorus and organic matter is moderate in the topsoil, however nitrogen content is low.

The Rugby 105 soils are recommended for use in rehabilitation and suitable for stripping and stockpiling. This soil should be managed according to the *Meteor Downs South Topsoil Management Plan*.



0.0 m - 0.1 m - nil limitations

0.1 m - 0.6 m - nil limitations



Analytical Description <sup>1</sup>											
Analyte	Units	A1		B21		B22					
Depth	m	0.00 - 0	).10	0.10	- 0.50	0.50 - 0.90					
Colour <sup>2</sup>	-	Very Dark	Brown	В	lack	В	ack				
рН	-	7.3	Neutral	8.1	Moderatel y Alkaline	8.6	Strongly Alkaline				
Electrical Conductivity	dS/cm	0.027	Very Low	0.039	Very Low	0.046	Very Low				
Cation Exchange Capacity	meq/100g	46.2	Very High	51.2 Very High		57.2	Very High				
Exchangeable Sodium Percent	%	0.22	Non Sodic	0.78 Non Sodi		1.92	Non Sodic				
Total Phosphorus	mg/kg	232	-	182	-	185	-				
Totol Kieldebl Nitregen	mg/kg	930	Law	-		-					
rotal Kjeldani Nitrogen	%	0.09	LOW		-	-					
Total Organic Carbon	%	1.6	Moderate		-		-				
Emerson Aggregate Test	-	5	Slight	4	Neg.	4	Neg. <sup>3</sup>				
	%	10	N/A	41	N/A	49	N/A				
Available Water	mm/cm	1.14	N/A	1.19	N/A	1.42	N/A				
Capacity	mm/layer	11.4	N/A	47.4	N/A	56.7	N/A				

2 Colour analysed on moist sample unless was a bleached layer

3 Negligible

Site Description							
	Landscape (Site 7)	h Clickthy Croyolly, Fina Fina					
ASC Soil Type	Shallow	r; Slightly Gravelly, Fine, Fine,					
Representative Pit	Site 7						
Dominant Geology Association	Tertiary Basalt						
Dominant Slope Association	Gently undulating plains						
Land Use and Vegetation	Native pastures and cropping						
Land Suitability Class	Beef Cattle Grazing Class 2						
Erosion Risk Class	Low						
Soil Stripping Recommendation	Primary Media Depth (m)	Secondary Media Depth (m)					
	0.0 – 0.1 m – nil limitations	0.1 – 0.6 m – nil limitations					



Analytical Description <sup>1</sup>									
Analyte	Units	A1		B2		С			
Depth	m	0.00	- 0.10	0.10	- 0.40	0.40 - 0.60			
Colour <sup>2</sup>	-	В	lack	В	lack	Black			
рН	-	7.3	Neutral	7.8 Mildly Alkaline		8.2	Moderately Alkaline		
Electrical Conductivity	dS/cm	0.033	Very Low	0.047	Very Low	0.104	Low		
Cation Exchange Capacity	meq/100g	63.3	Very High	68.7	Very High	63.6	Very High		
Exchangeable Sodium Percent	%	0.16	Non Sodic	0.44	Non Sodic	0.63	Non Sodic		
Total Phosphorus	mg/kg	590	-	452 -		537	-		
Tatal Kialdah Nitus yan	mg/kg	1310	1			-			
i otal Kjeldani Nitrogen	%	0.13	LOW			-			
Total Organic Carbon	%	1.62	Moderate	-		-			
Emerson Aggregate Test	-	5	Slight	5 Slight		5	Slight		
	%	18.6	N/A	53	N/A	28.4	N/A		
Available Water Capacity	mm/cm	2.38	N/A	2.26	N/A	1.82	N/A		
	mm/layer	23.8	N/A	67.8	N/A	36.4	N/A		

2 Colour analysed on moist sample unless was a bleached layer

Site Description						
ASC Soil Type	Haplic, Eutrophic, Brown Dermosol; \$	Slightly Gravelly, Fine, Fine, Shallow				
Representative Pit	Site 9	·				
Dominant Geology Association	Tertiary Basalt					
Dominant Slope Association	Gently undulating plains					
Land Use and Vegetation	Native pastures and cropping					
Land Suitability Class	Beef Cattle Grazing Class 3					
Erosion Risk Class	High					
Soil Stripping Recommendation	Primary Media Depth (m) 0.0 m – 0.1 m – nil limitations	Secondary Media Depth (m) 0.1 m – 0.55 m – nil limitations				



Analytical Description <sup>1</sup>									
Analyte	Units	A1		B21		B22			
Depth	m	0.00	- 0.10	0.10 - 0.35		0.35 – 0.55			
Colour <sup>2</sup>	-	Very Da	ark Brown	Br	rown	Dark Brown			
рН	-	6.9	Neutral	7.4	Mildly Alkaline	7.9	Moderately Alkaline		
Electrical Conductivity	dS/cm	0.035	Very Low	0.040 Very Low		0.038	Very Low		
Cation Exchange Capacity	meq/100g	32.2	High	46.4	Very High	30.2	Very High		
Exchangeable Sodium Percent	%	0.31	Non Sodic	0.22	Non Sodic	0.66	Non Sodic		
Total Phosphorus	mg/kg	1460	-	976 -		698	-		
Tatal Kialdah Nitus yan	mg/kg	2210	1	-		-			
i otal Kjeldani Nitrogen	%	0.22	LOW	-		-			
Total Organic Carbon	%	2.72	High	-		-			
Emerson Aggregate Test	-	3(1)	Slight	3(1) Slight		5	Slight		
	%	19	N/A	44	N/A	37	N/A		
Available Water Capacity	mm/cm	1.63	N/A	1.51	N/A	1.59	N/A		
	mm/layer	16.3	N/A	37.75	N/A	31.75	N/A		

2 Colour analysed on moist sample unless was a bleached layer

## 4.0 OVERBURDEN ASSESSMENT

## 4.1 Background

Project waste generated through mining (waste rock) and coal processing (coal reject) is defined as mining waste (i.e. materials of non-current marketable or useful value). The coal reject is the overburden and interseam waste rock and coal that are not suitable for product sale. Coarse reject is the course fraction of this waste stream. Fine rejects from coal washing and handling are not part of this assessment. Consequently, all of the coal rejects materials being considered are coarse rejects.

The expected volume of waste rock and coal rejects deposited in waste rock stockpiles adjacent to the pit is 74,512,883 BCM over the life of the mine from 2013 to 2023 (according to EDC001M Sep12 Reschedule Summary ROM Limit).

## 4.2 Overburden Assessment Methodology

A geochemical assessment program for coal and mining waste materials was developed with reference to advisory guidelines applicable in Queensland (DME, 1995d), Australia (DITR, 2007) and internationally (INAP, 2009). Cost limitations and the relatively small size of the mine area (below 1,000 ha) prevented the DME sampling guideline for each rock type being observed for the mass-balance calculations. Samples were however collected according to specific intervals and horizons encountered. GSS Environmental proposed a geochemical sampling and testing program undertaken by Endocoal on the MDS Project area that focussed on utilizing representative samples of overburden and interburden (potential reject material) from the surface up to the roof of the lowest target coal seam.

The Overburden Assessment was undertaken to provide a preliminary Acid Base Accounting (ABA) of the overburden and interburden (reject) materials that will be generated in the course of extraction of the coal resource. This will identify potential for acid generation from these materials in each of the stratigraphic horizons in the mine plan, as well as characterise sub-horizons that could be of value in the management of identified Potential Acid-Forming (PAF) material in the MDS Project area. Other properties such as conductivity, sodicity, cation exchange capacity, metal concentration and erosion potential across horizons are also assessed to provide background information for the development of overburden and reject material management measures.

A total of 87 overburden samples from two core drilling locations (**Figure 4-1**) with a drilling depth of 73.74 m and 83.58 m respectively, were selected program based on expected geological variability and complexity in rock types and sent to ALS Laboratories for testing. The sampling and analysis program for core ORD130HC1 is summarised in **Table 4-1** Overburden Samples Selected for Geochemical Testing (ORD130HC1) and for core ORD133HC1 in **Table 4-2**. Samples were collected in one metre interval across the strata from the surface to the lowest coal seam roof to characterise each of the lithologic horizons overlying the target coal seams. Samples collected from the same lithologic horizon were composited to a maximum interval of five meters to provide a representative sample for every five-meter section where applicable. Lithologic horizon thicknesses below the five-metre limit, were logged in the same fashion and composited according to the recorded horizon thickness.



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Sample ID	Sample Code	Depth from (m)	Depth to (m)	Stratum Lithology	Horizon	Analytes
1	9939	0	-1	Soil		Analytes assessed for all collected
2	9940	-1	-2	Soil	]	samples as follows:
3	9941	-2	-3	Soil	]	1) Soil nH
4	9942	-3	-5	Soil		
5	9943	-5	-6	Clay		2) Oxidizing pH
6	9944	-5	-6	Clay		
7	9945	-6	-7	Clay		3) Net Acid Production Potential
8	9946	-6	-7	Clay		4) EC
9	9947	-7	-8	Basalt	Basalt	
10	9948	-8	-9	Basalt	Dasan	5) Acid Neutralising Capacity (ANC as
11	9949	-11	-12	Basalt		H2SO4, ANC as CaCO3, Fizz Rating)
12	9950	-13	-14	Basalt		6) Moisture Content
13	9951	-13	-14	Basalt		
14	9952	-13	-14	Basalt		7) Exchangeable Cations (Ca, Mg, K,
15	9953	-14.02	-14.24	Basalt		Na, Cation Exchange Capacity)
16	9954	-14.02	-14.24	Basalt		8) Total Sulfur by LECO
17	9993	-14.02	-14.24	Basalt		9) Chloride (Discrete Analyser)
18	9955	-14.02	-14.24	Basalt		
19	9956	-27.7	-27.76	Claystone		
20	9957	-27.76	-27.82	Claystone		10) Soluble Major Cations (Ca, Mg,
21	9958	-27.82	-27.88	Claystone		
22	9959	-27.88	-28.73	Claystone		11) Total Metals by ICP-AES (Al, Sb, As, Ba, Be, Bo, Cd, Cr, Co, Cu, Fe, Pb, Mn, Mo, Ni, Se, Ag, Sr, Sn, V, Zn, Ti, Ta
23	9960	-28.73	-28.79	Siltstone		
24	9961	-28.79	-28.85	Siltstone		
25	9962	-28.85	-28.91	Siltstone	Tartian	12) Total Recoverable Mercury by FIMS
26	9963	-31.92	-31.98	Sandstone Medium Grained	Teruary	
27	9964	-31.98	-32.04	Sandstone Medium Grained		13) Nitrite as N by Discrete Analyser
28	9965	-32.04	-32.1	Sandstone Medium Grained		15) Nitrite + Nitrate as N (sol.)
29	9966	-36.7	-36.76	Conglomerate		
30	9967	-36.76	-36.82	Conglomerate		
31	9968	-36.82	-36.88	Conglomerate		
32	9969	-38.14	-38.2	Mudstone		
33	9970	-38.2	-38.26	Mudstone		
34	9971	-38.26	-38.32	Mudstone	Permian	
35	9972	-41.1	-41.16	Sandstone Medium Grained		
36	9973	-41.16	-41.22	Sandstone Medium Grained		

## Table 4-1 Overburden Samples Selected for Geochemical Testing (ORD130HC1)

Sample ID	Sample Code	Depth from (m)	Depth to (m)	Stratum Lithology	Horizon	Analytes
37	9974	-41.22	-41.28	Sandstone Medium Grained		
38	9975	-48.44	-48.5	Sandstone Medium Grained		
39	9976	-48.5	-48.56	Sandstone Medium Grained		
40	9977	-48.56	-48.62	Sandstone Medium Grained		
41	9978	-49.33	-49.39	Carbonaceous Mudstone		
42	9979	-49.39	-49.45	Carbonaceous Mudstone		
43	9980	-49.45	-49.57	Carbonaceous Mudstone		
44	9981	-64.84	-64.9	Siltstone		
45	9982	-64.9	-64.96	Siltstone		
46	9983	-64.96	-65.02	Siltstone		
47	9984	-65.02	-65.08	Siltstone		
48	9985	-68.94	-69	Siltstone		
49	9986	-69	-69.06	Siltstone		
50	9987	-69.06	-69.12	Siltstone		
51	9988	-69.12	-69.18	Siltstone		
52	9989	-73.5	-73.56	Sandstone Medium Grained		
53	9990	-73.56	-73.62	Sandstone Medium Grained		
54	9991	-73.62	-73.68	Sandstone Medium Grained		Similar Suite as above including the following Analytes:
55	9992	-73.68	-73.74	Sandstone Medium Grained	Coal Seam Interburden/ Reject Material	<ol> <li>Major Anions (S, Cl)</li> <li>Major Cations (Ca, Mg, Na, K)</li> <li>Calculated Components (Acid Component, Neutralising Component, NAG Acidity)</li> <li>Oxidizing pH (ext)</li> </ol>

Sample ID	Sample Code	Depth from (m)	Depth to (m)	Stratum Lithology	Horizon	Analytes
1	117332	0	-1.5	Soil		Analytes assessed for all collected
2	117333	-1.5	-3	Sandy Clay		samples as follows:
3	117334	-3	-5	Coarse Sandstone		1) Soil pH
4	117335	-5	-8	Very Coarse Sandstone		2) Oxidizing pH
5	117336	-8	-13	Basalt		3) Net Acid Production Potential
6	117337	-13	-18	Basalt		-,
7	117338	-18	-23	Basalt	Basalt	4) EC
8	117339	-23	-28	Basalt		
9	117340	-28	-33	Basalt		5) Acid Neutralising Capacity (ANC as H2SO4_ANC as CaCO3_Fizz Rating)
10	117341	-33	-38	Basalt		
11	117342	-38	-39	Basalt		6) Moisture Content
12	117343	-39	-42.24	Basalt		
13	117344	-42.24	-44.09	Igneous with Siderite	•	7) Exchangeable Cations (Ca, Mg, K, Na, Cation Exchange Capacity)
14	117345	-44.09	-46.33	Igneous		8) Total Sulfur by LECO
15	117346	-46.33	-46.76	Carbonaceous Mudstone		9) Chloride (Discrete Analyser)
16	117347	-46.76	-47.52	Mudstone		,
17	117348	-47.52	-49.6	Fine-Medium Grained Sandstone	Tertiary	10) Soluble Major Cations (Ca, Mg, Na, K)
18	117349	-49.6	-54.6	Coarse- grained Sandstone		11) Total Metals by ICP-AES (Al, Sb, As, Ba, Be, Bo, Cd, Cr,Co, Cu, Fe, Pb, Mn, Mo, Ni, Se, Ag, Sr, Sn, V, Zn, Ti, To
19	117350	-54.6	-55.77	Coarse Sandstone		
20	117351	-55.77	-55.95	Claystone		FIMS
21	117352	-55.95	-60.95	Coarse Sandstone		13) Nitrite as N by Discrete Analyser
22	117353	-60.95	-62.1	Coarse Sandstone		14) Nitrate as N by Discrete Analyser
23	117354	-62.1	-62.49	Claystone		
24	117355	-62.49	-66.45	Fine Sandstone		15) Nitrite + Nitrate as N (sol.)
25	117356	-66.45	-66.56	Siderite	]	
26	117357	-66.56	-66.81	Fine Sandstone	Permian	
27	117358	-66.81	-66.92	Siderite		
28	117359	-66.92	-69.44	Fine Sandstone		
29	117360	-69.44	-69.6	Medium Sandstone		
30	117361	-69.6	-74.6	Fine Sandstone		
31	117362	-74.6	-79.47	Siltstone	]	
32	117363	-83.12	-83.58	Carbonaceous	Coal Seam	Similar Suite as above including the

## Table 4-2 Overburden samples selected for geochemical testing (ORD133HC1)
Sample ID	Sample Code	Depth from (m)	Depth to (m)	Stratum Lithology	Horizon	Analytes
				Siltstone	Interburden/ Reject	following Analytes:
					Material	1) Major Anions (S, Cl)
						2) Major Cations (Ca, Mg, Na, K)
						3) Calculated Components (Acid Component, Neutralising Component, NAG Acidity)
						4) Oxidizing pH (ext)

Overburden and interburden material, which includes potential reject samples were screened from a series of standard static physical geochemical tests that included pH (soil and peroxide treated - OX), Electrical Conductivity (EC), Moisture Content, Total Sulfur by LECO, Exchangeable Cations, Acid Neutralising Capacity (ANC), Net Acid Generation (NAG, interburden samples only), Net Acid Producing Potential (NAPP), Total Metals suite by ICP-AES and Total recoverable Mercury.

The NAG test was used for interburden (coal reject) testing as previous research into the accuracy of the NAG test indicate that the presence of organic matter in samples can cause erroneous recording of results (Stewart et al., 2003). The potential for a sample to generate acid was derived from the Total Oxidisable Sulfur (TOS) content and the calculated NAPP value.

The Australian Laboratory Services (ALS) results are provided in **Appendix 3**. The test work results are presented in the sections below.

# 4.2.1 pH

All overburden and interburden samples taken in 2011 and 2012 were tested for pH using soil pH value and peroxide treated - OX pH values. In this assessment the OX pH values were used to approximate the pH in terms of their reactivity.

# 4.2.2 Electrical Conductivity

All overburden and interburden samples from the two sampling cores each taken in 2011 and 2012 were tested for Electrical Conductivity (EC) at  $25^{\circ}$ C as a measure of salinity.

# 4.2.3 Exchangeable Cations & Exchangeable Sodium Percentage (ESP)

Soil chemical and physical behaviour is governed by the nature of the surfaces of soil particles, particularly the surface area and charge. The Cation Exchange Capacity (CEC) provides a measure of the total capacity of a soil to hold exchangeable cations, therefore indicating the negative charge present per unit mass of soil, generally in cmol(+)/kg or meq/100g. The CEC provides a buffering effect to changes in pH, available nutrients, calcium levels and soil structural changes. As such CEC is a major controlling agent of soil structure, nutrient availability for plant growth, soil pH, and the soils reaction to fertilisers and other ameliorants. A low CEC generally means the soil has low fertility.

The Exchangeable Sodium Percentage (ESP) is a measure of sodicity calculated by dividing the exchangeable sodium value by the total cation exchange capacity and multiplying by 100. Sodic soils are dispersible under wet conditions and therefore susceptible to surface crusting, low infiltration low hydraulic conductivity, gully and tunnel erosion. Soils with an ESP of 0-6% are considered non-sodic, 6-14% was

considered marginally sodic to sodic, and greater than 14% are considered strongly sodic (Peverill et al. 2005).

# 4.2.4 Acid Base Accounting

The methodologies discussed in the LPSDPMI (2007) and GARD guidelines (INAP 2009) are primarily used in the overburden and interburden ABA, as well as to classify overburden materials as either Non-Acid Forming (NAF) or Potentially Acid Forming (PAF). Measured total metal concentrations were also assessed against generic environment protection guidelines (NEPC, 1999a,b) *in lieu* of risk based guidelines specific to the site or coal mine waste material.

Acid Rock Drainage (ARD) or Acid and Metalliferous Drainage (AMD) results from sulfide minerals such as pyrite and similar minerals oxidizing when exposed to water and atmospheric oxygen. An early identification of potentially ARD-generating mine minerals is important in the timely implementation of mine waste management strategies.

Acid-Base Accounting (ABA) procedures were used for the samples to assist in assessing the acid-forming characteristics of mine waste material. This method is referred to as a geochemical static procedure as it involves a single measurement in time and is considered to be cost-effective for preliminary assessment.

The static laboratory procedures evaluate the balance between acid generation processes (i.e. oxidation of sulfide minerals) and acid neutralising processes (i.e. dissolution of alkaline carbonates, displacement of exchangeable bases, and weathering of silicates). Values generated from the acid-base account are referred to as the Maximum Potential Acidity (MPA) and the Acid Neutralising Capacity (ANC), respectively. The difference between the MPA and ANC value is referred to as the net acid producing potential (NAPP) (LPSDP, 2007).

# 4.2.4.1 Total Sulfur

Total sulfur content was determined by the LECO high temperature combustion method. The total sulfate content is determined by the Inductively Coupled Plasma Atomic Emission Spectroscopy (ICP-AES) method. The total oxidisable sulfur (TOS) content is calculated as the total sulfur less the sulfate sulfur content. The TOS is then used to calculate the Maximum Potential Acidity (MPA) based on the assumption that only the TOS content is present as reactive pyrite.

# 4.2.4.2 Maximum Potential Acidity

The MPA that can be generated by a sample is determined from the sample sulfur content. The total sulfur content of a sample is determined by the LECO high temperature combustion method. The calculation assumes that all the sulfur measured in the sample occurs as pyrite ( $FeS_2$ ) and that the pyrite reacts under oxidising conditions to generate acid according to the reaction:

According to this reaction, the MPA of a sample containing 1% S as pyrite would be 30.6 kilograms of  $H_2SO_4$  per tonne of material (i.e. kg  $H_2SO_4/t$ ). Hence the MPA of a sample is calculated from the total sulfur content using the following formula:

MPA (kg 
$$H_2SO_4/t$$
) = (Total %S) x 30.6

The use of the total sulfur assay to estimate the MPA is a conservative approach because some sulfur may occur in forms other than pyrite. Sulfate-sulfur and native sulfur, for example, are non-acid generating sulfur forms. Also, some sulfur may occur as other metal sulfides (e.g. covellite, chalcocite, sphalerite, and galena) which yield less acidity than pyrite when oxidised or, in some cases, may be non-acid generating.

# 4.2.4.3 Acid Neutralising Capacity

The acid formed from pyrite oxidation will to some extent continue to react with acid neutralising minerals contained within the sample. This inherent acid buffering is quantified in terms of the ANC.

The ANC is routinely determined using the Modified Sobek method, which involves the addition of a known amount of standardised hydrochloric acid (HCl) to an accurately weighed sample, allowing the sample time to react (with heating), then back-titrating the mixture with standardised sodium hydroxide (NaOH) to determine the amount of unreacted HCl. The amount of acid consumed by reaction with the sample is then calculated and expressed in the same units as the MPA that is kg  $H_2SO_4/t$ .

# 4.2.4.4 Net Acid Producing Potential

This is a theoretical calculation is commonly used to indicate if a material has potential to produce acidic drainage. It represents the balance between the capacity of a sample to generate acid (MPA) and its capacity to neutralise acid (ANC). NAPP is also expressed in units of kg  $H_2SO_4/t$  and is calculated as follows:

If the MPA is less than the ANC then the NAPP is negative, which indicates that the sample may have sufficient ANC to prevent acid generation. Conversely, if the MPA exceeds the ANC then the NAPP is positive, which indicates that the material may be acid generating.

# 4.2.4.5 Net Acid Generation (NAG) Test

This test is used in association with the NAPP to classify the acid generating potential of a sample. The NAG test involves reaction of a sample with hydrogen peroxide to rapidly oxidise any sulfide minerals contained within a sample. During the NAG test both acid generation and acid neutralisation reactions can occur simultaneously. Therefore, the end result represents a direct measurement of the net amount of acid generated by the sample. This value is commonly referred to as the NAG capacity and is expressed in the same units as NAPP, i.e. kg  $H_2SO_4/t$ .

### 4.2.4.6 Single Addition NAG Test

This test involves the addition of 250 mL of 15% hydrogen peroxide to 2.5 g of sample. The peroxide is allowed to react with the sample overnight and the following day the sample is gently heated to accelerate the oxidation of any remaining sulfides, vigorously boiled thereafter for several minutes to decompose any residual peroxide. When cool, the pH and acidity of the NAG liquor are measured.

The acidity of the liquor is then used to estimate the net amount of acidity produced per unit weight of sample. An indication of the form of the acidity is provided with initial titration of the NAG liquor to pH 4.5, then continuing the titration up to pH 7. The titration value at pH 4.5 includes acidity due to free acid (i.e.  $H_2SO_4$ ) as well as soluble iron and aluminium. The titration value at pH 7 also includes metallic ions that precipitate as hydroxides at pH values between 4.5 and 7.

# 4.2.4.7 Sample Classification

The NAG test was limited only for samples adjacent to the target coal seams (i.e. interburden) and only provides for a guide in this assessment. The Total Oxidisable Sulfur (TOS) and NAPP data were used to classify the acid forming nature of overburden and interburden (reject materials) at the Meteor Downs site according to **Table 4-3**.

Total Oxidisable Sulfur	NAPP	Sample Classification
< 0.1	-	Non Asid Forming (NAF)
0.1 ≤ <i>TO</i> S ≤ 0.2	≤ -20	Non-Acid Forming (NAF)
0.1 ≤ <i>TO</i> S ≤ 0.2	-20 < NAPP ≤ 0	Uncertain - Non-Acid Forming (UC-NAF)
0.1 ≤ <i>TO</i> S ≤ 0.2	> 0	
>0.20	≤ 0	oncertain (OC)
0.2 < <i>TO</i> S ≤ 1.0	0 > <i>NAPP</i> ≤ 20	Uncertain - Potentially Acid Forming (UC-PAF)
> 1.0	> 20	Potentially Acid Forming (PAF)

# Table 4-3 Sample Classification of Acid producing potential

\*Modified from the Managing Acid and Metalliferous Drainage, Leading Practice Sustainable Development Program for the Mining Industry, 2007

# 4.2.5 Metal Scans

Metal scans have been carried out to identify any elements present in a material at concentrations that may be of environmental concern with respect to surface water quality and revegetation. In addition to the assessed exchangeable cations, samples were analysed for the following suite of elements using ICP-AES:

- Aluminium Al
- Antimony Sb
- Arsenic As
- Barium Ba
- Beryllium Be
- Boron B
- Cadmium Cd
- Cobalt Co
- Chromium Cr
- Copper Cu
- Iron Fe
- Lead Pb

- Manganese Mn
- Mercury Hg
- Molybdenum Mo
- Nickel Ni
- Selenium Se
- Silver Ag
- Strontium Sr
- Tin Sb
- Titanium Ti
- Thallium Tl
- Vanadium V
- Zinc Zn

In lieu of definite guidelines pertaining to total metal concentrations in the overburden and interburden materials, all metal scan results were assessed against the EHP (2006) Environmental Investigation Levels (EIL) (EHP 2006 for contaminated soil, and the Health-based Investigation Levels (HIL) of NEPC (1999a) for parks and recreations (or open spaces). EHP (2006) guidelines are primarily aimed at contaminated land investigations and provide a suitable guideline for an industrial facility, such as a mine. The NEPC (1999a) guidelines for 'open spaces' are less stringent than the EHP (2006) guidelines as they apply to the land use of the mine likely to apply after closure.

In this Study the critical issue is the potential to leach and soluble metals from the overburden and interburden (reject materials) at concentrations that may affect human health and the environment. Water extracts were used to determine the immediate element solubilities under the existing sample pH conditions. Element concentrations were compared with those recommended in relevant surface water (ANZECC, 2000) and groundwater (NEPM, 1999a) guidelines in order to determine their environmental significance.

# 4.3 Geochemical Characterisation Results of Overburden Material

Three different types of overburden material where identified within the MDS Project area, comprising: 1) Basalt igneous material (uppermost overburden); 2) Tertiary sedimentary material (overburden immediately beneath the Basalt material); and 3) Permian material (lowermost overburden). The overburden is discussed as a whole suite of materials as well as according to each of the defined horizons. The full suite of test results for overburden samples is attached in **Appendix 3**.

# 4.3.1 pH

The test results for current pH as well as OX pH values for all the **53** samples, from 2011, and **31** samples, from 2012 drill core analysis are presented in **Table 4-4**. The average pH values presented both for the OX and standard pH tests indicate moderate alkalinity across overburden horizons. However, the Permian lower end OX pH value (sampling core ORD130HC) was slightly acidic. This lower range pH was recorded in sample taken close to the interburden (see **Appendix 3 Laboratory Results**). As provided in **Table 4-4** below, each of the drill core horizon values correlated between drill cores — supporting prediction that the leachate from the overburden remote from the coal seam was likely to be neutral to moderately alkaline.

Drill Core/Overburden Horizon	Standard pH Range	Average	OX pH Range	Average
Drill Core ORD130HC (2011)	8.0-9.9	9.31	5.5-10.5	8.58
- Basalt	8.2-9.4	8.73	8.1-9.7	8.99
- Tertiary	9.2-9.7	9.57	8-10.5	9.03
- Permian	8.0-9.9	9.62	5.5-10	8.10
Drill Core ORD133HC (2012)	7.6-9.8	9.19	8.5-11	9.56
- Basalt	7.8-9.8	9.21	8.1-10.3	9.87
- Tertiary	8.6-9.5	9.16	7.5-10.9	9.48
- Permian	8.8-9.4	9.18	7.6-11	9.22

### Table 4-4 pH Ratings Results

# 4.3.2 Electrical Conductivity

The EC test results for overburden samples range from 98-168  $\mu$ S/cm and 95-388  $\mu$ S/cm, with an average of 130.774 and 234.581  $\mu$ S/cm for each of the drill cores across the three overburden horizons respectively **(Table 4-5)**. The EC values are presented in  $\mu$ S/cm and dS/m (dS/m is equivalent to  $\mu$ S/cm\*1000). These values are indicative of low salinity, and further interpretation of the EC results are provided in Section **7.4.1**.

Drill Core/Overburden Horizon	Measured EC Range (µS/cm)	Average	Standardized EC Range (dS/m)	Average
Drill Core ORD130HC (2011)	98-168	130.774	0.098-0.168	0.131
- Basalt	98-152	126.667	0.098-0.152	0.127
- Tertiary	132-168	150.9	0.132-0.168	0.151
- Permian	95-152	125.68	0.095-0.152	0.126
Drill Core ORD133HC (2012)	95-388	234.581	0.095-0.388	0.234
- Basalt	95-388	187.071	0.095-0.388	0.187
- Tertiary	220-352	253.0	0.220-0.352	0.253
- Permian	198-320	282.334	0.198-0.320	0.282

### **Table 4-5 EC Ratings Results**

# 4.3.3 Cation Exchange Capacity and Sodicity

The reference ratings for the CEC (**Table 4-6**) and ESP (**Table 4-7**) that were used to assess overburden horizons refer to the Australian Soil Classification (Isbell, 2002). The CEC and ESP ratings summary for overburden horizons is presented in **Table 4-8**.

CEC Rating	CEC meq/100g
very low	<6
low	6-12
moderate	12-25
high	25-40
very high	>40

### Table 4-6 Reference Ratings for Cation Exchange Capacity

### Table 4-7 Reference Ratings for Exchangeable Sodium Percentage (ESP)

ESP Characteristic	ESP Average (%)
Low sodicity	<6%
Marginally sodic	6%-10%
Sodic	10%-14%
Strongly sodic	>14%

Drill Core/Overburden Horizon	Measured CEC Range (meq/100g)	CEC Average (meq/100g)	CEC Rating	ESP Range (%)	ESP Average (%)	Characteristic
Drill Core ORD130HC (2011)	15.6-82.8	45.119	Very high	1.087-7.447	4.388	Non-sodic
- Basalt	20.2-82.8	59.084	Very high	1.087-7.426	2.751	Non-sodic
- Tertiary	30.3-46.4	40.300	Very high	3.233-7.261	4.906	Non-sodic
- Permian	15.6-54.6	36.992	High	4.179-7.447	5.360	Non-sodic
Drill Core ORD133HC (2012)	28.6-83.7	48.910	Very high	1.321-14.249	8.467	Marginally Sodic
- Basalt	44.5-83.7	60.171	Very high	1.321-10.787	6.594	Marginally Sodic
- Tertiary	29.4-48.1	39.180	High	8.163-10.773	8.648	Marginally Sodic
- Permian	28.6-57.2	39.825	High	7.838-14.249	10.578	Sodic

The average CEC rating was very high for both drill cores (45.119 meq/100g and 48.910 meq/100g). Each of the overburden horizons had high to very high CEC ratings, which indicates that they have high potential fertility for use in supporting rehabilitated ecosystems.

The average ESP ratings typified non sodic material in drill core ORD130HC. The average ESP ratings typified moderately sodic (Basalt and Tertiary) to sodic (Permian) material in overburden horizons in drill core ORD133HC. ESP profiles for both drill cores are plotted in **Figure 4-2**. The 10% average sodicity for drill core ORD133HC with 14% sodicity peaks at different depths indicate a moderate sodicity risk to stockpile management.

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Figure 4-2 Exchangeable Sodium Percentage Depth Profile

# 4.3.4 Acid Base (NAPP) Results

Acid base assessment results for all the overburden and interburden samples (55 from 2011 batch drill core ORD130HC and 32 samples from 2012 batch drill core ORD133HC) are summarised for each overburden horizon and sampling batch/drill core in **Figure 4-3** to **Figure 4-9**. 83 of the overburden samples were considered to be Non-Acid Forming (NAF). Total sulfur concentrations for NAF samples were <0.1%. This result confirmed that the NAF tested samples are likely to be unreactive in above grade stockpiles that will be rehabilitated.

One of the assessed 84 overburden samples were in the Uncertain-Potential Acid-Forming (UC-PAF) range and the three interburden samples were within the Uncertain-Non-Acid Forming (UC-NAF) according to **Figure 4-3**. These materials require further evaluation from kinetic testing.

The assessment of the samples according to their respective horizons indicates that the basalt upper horizon is considerably inert based on consistently low sulfur content and low NAPP range between -70 and -140 kg  $H_2SO_4/t$  (Figure 4-4).

The Tertiary sedimentary horizon similarly indicates low sulfur values except for one sample exceeding the 0.1% criteria (**Figure 4-5**). The average NAPP range values fell between -50 and -20 kg H2SO4/t. Three samples had low NAPP values and were considered to be Acid-Consuming Material (ACM) according to Australian Guidelines (LPSDPMI, 2007). These sub-horizons (sample codes 9963, 9964 and 9965 as listed in **Table 4-1**) in the Tertiary horizon are recommended for further assessment of their potential for use as material in managing removed PAF material from the subsurface.

Within the Permian Horizon (**Figure 4-6**), the single sample assessed as UC-PAF was taken from the subhorizon adjacent to the interburden (reject material), while the two other samples assessed as UC-NAF are taken from other sub-horizons that span within the geological unit. Most samples cluster in the 0 to -70 kg  $H_2SO_4/t$  NAPP range, which is indicative of geochemical characteristics for most of the sub-horizons within this unit.

Results of the interburden (reject) assessment (**Figure 4-7**) indicate that sampling from the 2011 core fall within the UC-PAF criteria whereas the 2012 core is Unclassified (UC). Further assessment is recommended to establish the PAF character of the interburden, which may require additional management strategies appropriate to the estimated volume that will be removed or disturbed in the extraction of the coal resource.

The depth ranges relating to AMD risk are summarised as NAF-PAF profiles for Core ORD130HC1 (**Figure 4-8**) and Core ORD133HC1 (**Figure 4-9**).

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Figure 4-4 Correlation between Overburden TOS and NAPP values, Basalt Overburden Samples

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Figure 4-7 Correlation between Overburden TOS and NAPP values, Permian Interburden Samples

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Figure 4-8 NAF-PAF Signatures of Overburden Horizons, Core ORD130HC1



Figure 4-9 NAF-PAF Signatures of Overburden Horizons, Core ORD133HC1

# 4.3.5 Metal Scans

The results of the overburden and interburden samples assessed for metals are provided in **Table 4-9** below. Across all the three horizons and the interburden (reject material) horizon, all samples indicated levels that are well below the NEPC (1999b) health-based investigation levels (HIL) for soil assessment, except for one sample within the Permian horizon which indicated elevated values for manganese.

Within the Basalt Overburden horizon, a number of samples have indicated levels above the QLD-DME (1995-b) Environmental Investigation Levels (EIL) for Barium, Chromium, Cobalt, Copper, Manganese, Nickel, Selenium, Vanadium and Tin. Elevated values were also noted for non-critical elements aluminium and iron. Critical HIL values can be encountered in metalliferous mineralized areas. Nickel, iron and manganese are typical components of the rock-forming minerals of the basalt which make up the Horizon and the values reflect background values. The remaining metals may typically co-exist as accessory elements, depending on the magmatic geochemistry of the basalt prior to its crystallization and deposition.

Within the Tertiary Overburden Horizon, 3 samples indicated levels above the EIL for manganese. Such values may indicate the presence of manganese mineral nodules within the Tertiary sedimentary units, which is consistent with a marine depositional setting. Natural leaching through geological time may also explain the occurrence of such values within the units of this horizon.

A similar observation is noted for the Permian Horizon, wherein 8 samples indicated above EIL values for manganese. In addition, one sample indicated above EIL values for mercury, which may require further assessment to determine if some of the units within the horizon have values that might require management.

All Interburden Horizon values were observed to be below the EIL guidelines, which indicate low level risk management is appropriate for metals in seepage. Further assessment or monitoring, however, maybe required particularly during the handling of the interburden (reject) material in the processing of coal after extraction.

Multi-element results from this assessment indicate that metal concentration in the overburden and interburden materials are unlikely to present critical environmental issues to the revegetation and rehabilitation of any out-of-pit overburden storage facilities and on-site or downstream water quality.

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	Environmental Investigation	N/A	20	20	400	N/A	N/A	3	50	50	60	N/A	300	500	<del>.</del>	40	60			
Health Investigation Levels (HIL's) (Exposure Setting E - NEPC 1999) (mg/kg)			N/A	N/A	200	N/A	40	6000	40	200	200	2000	N/A	600	3000	30	N/A	600		
en Results	r Results Horizon	Average (mg/kg)	2206.667	5.000	5.000	23.333	3.333	53.333	1.000	3.333	3.333	21.000	9813.333	10.333	100.667	0.133	2.000	8.667		
Interburde	Interburde	Range (mg/kg)	780 to 5000	5 to 5	5 to 5	10 to 50	1 to 6	50 to 60	1 to 1	2 to 6	2 to 4	11 to 32	1440 to 16900	5 to 19	8 to 153	0.1 to 0.2	2 to 2	3 to 13		
	Permian Horizon	Average (mg/kg)	9749.783	5.000	8.508	53.533	1.712	50.000	1.0200	10.700	9.793	18.532	26732.767	16.227	556.520	0.110	2.020	12.935		
		Range (mg/kg)	2100 to 14900	5 to 5	5 to 19	30 to 100	1 to 3	50 to 50	1 to 2	2 to 21	2 to 26	5 to 58	4640 to 150000	7 to 33	35 to 3480	0.1 to 0.2	2 to 3	5 to 28		
esults	izon	Average (mg/kg)	11456.00	5.000	6.800	50.500	1.450	50.000	1.000	12.900	8.850	8.850	14570.000	10.650	286.300	0.100	2.000	13.700		
Overburden R	Tertiary Ho	Range (mg/kg)	5010 to 19600	5 to 5	5 to 14	20 to 90	1 to 2	50 to 50	1 to 1	5 to 26	2 to 17	5 to 24	6940 to 29700	6 to 16	5 to 855	0.1 to 0.1	2 to 2	6 to 28		
	uo	zon	izon	Average (mg/kg)	34832.140	5.000	5.071	165.040	1.639	20.000	1.028	68.508	40.270	54.929	55880.159	5.036	887.004	0.100	2.139	147.504
	Basalt Hori	Range (mg/kg)	23900 to 50800	5 to 5	5 to 7	20 to 1820	1 to 3	50 to 50	1 to 2	18 to 126	23 to 59	35 to 81	30700 to 76000	5 to 6	523 to 1810	0.1 to 0.1	2 to 3	95 to 191		
Metal		Aluminum	Antimony	Arsenic	Barium	Beryllium	Boron	Cadmium	Chromium	Cobalt	Copper	Iron	Lead	Manganese	Mercury	Molybdenu m	Nickel			

Table 4-9: Meteor Downs Overburden and Interburden Metal Scan Results

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# 4.3.6 Volume Estimates for Overburden and Interburden (Reject) NAF and PAF Material

Volumetric estimates for PAF and NAF generation according to the proposed mine schedule is limited by the available number of sampling cores. It can be assumed that the upper two horizons, the Basalt and Tertiary sedimentary units are NAF from correlation of the stratigraphic association with the ABA results. This assumption needs to be confirmed as additional core data becomes available. The estimated total overburden waste rock output from the proposed activity is 74,512,881 BCM. Of this total waste rock volume there is an estimated 1,181,127 BCM of interburden/reject material.

PAF and NAF volume estimates in the proposed mine schedule are presented in **Table 4-10**. All Interburden (reject) material has been considered as PAF in this study, which is subject to review as more data becomes available to refine the split between PAF and NAF material in this horizon. Calculations of generated PAF and NAF volume estimates are based on data current at the time of reporting. Changes in the scheduled mined volume and material moved will the generated PAF and NAF volume estimates to be reviewed and modified to manage the associated environmental risks. The bulk of waste material generated as NAF can be considered inert and safely stockpiled in the proposed overburden stockpile area. However, significant environmental risks were associated with the planned volume of UC-PAF material in the proposed overburden stockpile. Volume of actual PAF and NAF material can further be deduced from the UC-PAF estimate as more data becomes available from further, detailed PAF assessment.

Overburden waste material volumes peak during the first half of the mining operation (2013-2019), and decrease towards the end of the mine life (**Figure 4-10**). Overburden volumes in the mining schedule decline in the last two years of the mine life. Volumes of UC-PAF material mined peak at the beginning of 2014, when most of the upper horizon materials have been removed and access to largely Permian lower horizons are being phased in to the mine schedule. Much lower volumes of PAF material relative to NAF and UC-PAF volumes are generated from the interburden over the mine life.

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				_						_
Total Volume		74,512,883		41,780,085		32,732,798		1,181,127		
	2023		143,533		0		143,533		10,297	
	2022		3,493,906		1,406,267		2,087,639		59,038	
	2021		6,419,779		3,230,121		3,189,658		114,518	
	2020		7,736,996		3,767,812		3,969,184		129,761	
year	2019		8,185,432		3,847,764		4,337,668		167,561	
enerated per	2018		8,272,664		3,714,621		4,558,043		179,299	
e of material g	2017		7,964,548		3,822,035		4,142,513		160,685	
Volum	2016		7,954,641		4,197,230		3,757,411		123,994	
	2015		9,344,247		5,360,928		3,983,319		96,137	
	2014		7,526,958		6,287,659		1,239,299		UC-PAF (All BCM 93,959 45,877 96,137 123,994 160,685 179,299 167,561 129,761 114,518 59,038 10,297 1,181,127 Interburden/Reject Material)	
	2013		7,470,178		6,145,647	UC-PAF (Overburden         BCM         1,324,531         1,239,299         3,757,411         4,142,513         4,558,043         4,337,668         3,969,184         3,189,658         2,087,639         143,533           Material Adjacent to         BCM         1,324,531         1,239,299         3,983,319         3,757,411         4,142,513         4,558,043         4,337,668         3,969,184         3,189,658         2,087,639         143,533           Interburden)         ECM         93,959         45,877         96,137         123,994         160,685         179,299         167,561         114,518         59,038         10,297	93,959			
- Inite			BCM		BCM		BCM		BCM	
Matorial Catagory			Estimated available overburden waste material		NAF (Overburden Material composite, includes Basalt, Tertiary Sedimentary and non-PAF Permian Horizon)		UC-PAF (Overburden Material Adjacent to Interburden)		UC-PAF (All Interburden/Reject Material)	

# Table 4-10 Meteor Downs Estimated NAF and PAF Material Generation Based on Mine Schedule







Figure 4-10 Graph of projected NAF-PAF generation within the operating life of mine

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# 4.4 Chemical Characterisation of Interburden (Reject Materials) and Tailings

Non-coal material above, in-between, and below the seams are commonly included in the coal extraction process which is termed "dilution". This non-coal material is termed in this Study as the Interburden ("Reject"), which is typically separated from the coal product after extraction through a number of processes that results in two general materials, the coarse reject and the fine material. Further processing of the fine material results in the generation of the actual "mine waste" comprised of a mixture of water, process additives, ground and saturated rock particles that are referred to as the fine reject or tailings.

Neither coarse nor fine separation processes are completely effective, and a proportion of coal is typically captured in both waste streams. The actual amounts depend on the efficiency of both mining and coal preparation but coarse reject typically includes 20-30% coal; for tailings a representative range is 40-70% coal. Physically, coarse reject is predominantly gravel-sized fragments >20mm, while tailings depends heavily on strata close to the coal seam (roof and floor) but is a mixture of sand, silt and clay sized particles. There is no fine rejects waste stream because a Coal Handling and Preparation Plant (CHPP) is not a part of the MDS Project plan.

The component Interburden materials are analysed separately in this study to simulate the coarse reject for potential leachate which will comprise the waste stream for the Meteor Downs Project. Three samples were collected from the two drill cores previously discussed. Analytes included normal soil water characteristics and parameters listed in Table 3 of the February 2012 Manual for Assessing Hazard Categories and Hydraulic Performance of Dams (DERM), except for metals for leachate chemistry. The results are summarised in **Table 4-9** and **Table 4-10**.

			Sample	
Analytes	Units	ORD130HC1 9991 INTERBURDEN	ORD130HC1 9992 INTERBURDEN	ORD133HC1 117363 INTERBURDEN
Total Sulfur	%	0.62	0.34	0.18
Acid Neutralising Capacity	kg H <sub>2</sub> SO <sub>4</sub> equiv./t	12.1	9.7	5.70
pH (OX) as NAG pH	pH Unit	2.6	3.8	4.2
Net Acid Production Potential	kg H₂SO₄/t	6.9	0.7	<0.5
Aluminum	mg/kg	840	780	5000
Antimony	mg/kg	<5	<5	<5
Arsenic	mg/kg	<5	<5	<5
Barium	mg/kg	10	<10	50
Beryllium	mg/kg	6	3	<1
Boron	mg/kg	<50	60	<50
Cadmium	mg/kg	<1	<1	<1
Chromium	mg/kg	2	2	6
Cobalt	mg/kg	4	4	<2
Copper	mg/kg	20	11	32
Iron	mg/kg	16900	1440	11100
Lead	mg/kg	5	7	19
Manganese	mg/kg	153	8	141
Mercury	mg/kg	<0.1	<0.1	0.2
Molybdenum	mg/kg	<2	<2	<2

### Table 4-9 Meteor Downs Interburden (Reject Solids) Chemistry

Analytes	Units	Sample			
Nickel	mg/kg	13	10	3	
Selenium	mg/kg	<5	<5	<5	
Silver	mg/kg	<2	<2	<2	
Strontium	mg/kg	22	21	100	
Thallium	mg/kg	<5	<5	<5	
Tin	mg/kg	<5	<5	<5	
Titanium	mg/kg	270	320	300	
Vanadium	mg/kg	51	15	37	
Zinc	mg/kg	<5	6	28	

Table 4-10 Meteor Downs Interburden (Reject) Leachate Chemistry

		Sample				
Analyte	Units	ORD130HC1 9991 INTERBURDEN	ORD130HC1 9992 INTERBURDEN	ORD133HC1 117363 INTERBURDEN		
pH Value	pH Unit	7.6	7.8	7.6		
Electrical Conductivity µS/cm		64	31	120		
Calcium	mg/L	28	14	14		
Magnesium	mg/L	12	5	8		
Sodium	mg/L	4	3	4		
Potassium	mg/L	2	14	3		
Chloride	mg/L	<1	<1	<1		
Sulfur (as S)	mg/L	70	40	19		

Referring to the NAPP vs. TOS plot in **Figure 4-7** for Interburden samples, the two samples from the 2011 coring activities were Uncertain-Potentially Acid Forming (UC-PAF) due to Oxidisable Sulfur above the 0.2% threshold and lower ANC values. However, the NAPP values were low (<10 kg  $H_2SO_4/t$ ) and consequently, the PAF potential of these materials needs to be confirmed to assess operational risks.

None of the results for contaminant concentrations exceeded the limits in the EHP (2006) guideline, which suggests that water in contact with reject material would not automatically be considered a regulatory issue. The NAPP and NAG pH values indicate that sediment storage facilities for PAF material are a Significant Hazard and qualify as regulated dams, based on the physical consequences of discharge.

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# **5.0 LAND SUITABILITY ASSESSMENTS**

The assessment of land suitability for agricultural activities and its relative agricultural importance for the region was made in four stages, namely:

- Strategic Cropping Land (SCL) assessment;
- Land Suitability Assessment;
- Agricultural Land Class Assessment; and
- Good Quality Agricultural Land Class Assessment.

# 5.1 Methods

Strategic cropping land identified in the MDS Project area from SCL trigger mapping was checked against the criteria (DERM, 2011c). Secondly the MDS Project area's overall suitability ranking for each soil type was determined according to the DERM land suitability classification system. Thirdly, these suitability rankings are interpreted from the *Planning Guidelines: The Identification of Good Quality Agricultural Land* (DPI, 1993) and translated into Agricultural Land Classes. Lastly, these land classes were compared to the local shire planning document to determine which classes are considered to be Good Quality Agricultural Land (GQAL) for the specific region.

# 5.1.1 Strategic Cropping Land Assessment

Development constraints apply to land assessed as SCL. SCL trigger maps for the Western Cropping Zone were reviewed and potential SCL was identified in three separate areas to the south west of the MDS Project area, comprising a total area of 106.9 ha (**Figure 5-1**).

Areas of potential SCL land were validated in the field survey. The SCL validation referred to zonal criteria (DERM, 2011b) and assessment guidelines (DERM, 2011c), which are framed to meet the requirements of the *Strategic Cropping Land Act 2011*. The eight zonal SCL assessment criteria used to validate the SCL trigger mapping were:

- i. Criterion 1 Slope is less than or equal to 3 per cent.
- ii. **Criterion 2 -** The average density of rocks greater than 60 mm diameter in the soil surface is less than or equal to 20 per cent.
- iii. **Criterion 3 -** The average density of gilgai microrelief of greater than 500 mm depth is less than 50 per cent of the land surface.
- iv. **Criterion 4 -** The soil depth is greater than or equal to 600 mm.
- v. **Criterion 5 -** The site has favourable drainage.
- vi. **Criterion 6 -** For non-rigid soils, the soil pH at 300 mm and 600 mm soil depth must be greater than pH 5.0. For rigid soils, the soil pH at 300 mm and 600 mm soil depth must be within the range of pH 5.1 to pH 8.9, inclusive
- vii. **Criterion 7 -** Soil at 600 mm depth or shallower contains a chloride content of less than 800 mg/.kg soil.
- viii. **Criterion 8 -** The soil water storage of the soil is 100 mm or greater to a soil depth or soil physicochemical limitation of up to 1000 mm.

The field survey included validation of SCL in the trigger map areas in the MDS Project area. Slope was measured in percent from a detailed digital elevation model (DEM) and confirmed in the field. Slope was the first criterion for excluding an observation site from SCL. Rockiness refers to the presence of unattached coarse rock fragments and rock outcrops at the soil surface. Rockiness was assessed visually on current soil conditions, irrespective of whether management actions have improved land suitability. Gilgai microrelief is a natural soil feature associated with non-rigid, cracking clay soils and is assessed according to accepted standards for field survey (NCST 2009). Soil types with gilgai microrelief were described in regional soil mapping (Gunn and Nix 1977) for land unit in the MDS Project area.

Soil profile inspections verified soil depth. Soil depth is the depth from the surface to the base of the soil profile — either C horizon or a physical barrier, including bedrock, weathered rock, hard pans and continuous gravel layers. Soil wetness caused by poor drainage occurring in valley floors and swamps can severely reduce crop productivity. Soil wetness is identified with redoximorphic features, including gley colours, mottles and segregations, from soil morphological descriptions. Soil pH measures the alkalinity or acidity of the soil, which was measured in the field with an indicator kit and in the laboratory on 1:5 soil:water suspension. Soil salinity refers to the concentration of soluble salts present in a soil. Salinity degrades soil structure and limits root development and the ability of plants to extract water and nutrients from the soil.

Soil water storage refers to the amount of water that can be stored in a soil and be available for plant use. Soil water storage was estimated in the field based on the soil texture look up table (DERM, 2011c) which lists the average estimated amount of water expected to be stored in each 100mm increment of soil. Further to this, Plant Available Water Capacity (PAWC) was calculated using laboratory analysis on sites that qualified as SCL on all other zonal criteria.

Strategic Cropping Land is defined as a finite resource that must be conserved and managed for long term food and fibre production (DERM, 2011c).

# 5.1.2 Land Suitability

Land suitability in the MDS Project area was assessed according to Queensland technical guidelines for mining (DME, 1995b). The method accounts for climate, soils, geology, geomorphology, soil erosion, topography and past land uses. The classification may not reflect the existing land use. Rather, it indicates the potential of the land for crop production, pasture improvement and grazing. The agricultural land suitability classes are described in **Table 5-1**.

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Orders	Class	Class Descriptor	Description
	1	S1 None/Minor Limitations (Highly Suitable)	Land with negligible limitations, which is highly productive requiring only simple management practices to maintain economic production.
S Suitable	2	S2 Minor Limitations (Moderately Suitable)	Land with minor limitations which either reduce production or require more than the simple management practices of Class 1 land to maintain economic production.
	3	S3 Moderate Limitations (Marginally suitable)	Land with moderate limitations which either further lower production or require more than those management practices of Class 2 land to maintain economic production.
N Not Suitable	4	N1 (or S4) Marginal Land (Presently Unsuitable)	Marginal lands with severe limitations which make it doubtful whether the inputs required achieving and maintaining production outweigh the benefits in the long term (presently considered unsuitable due to the uncertainty of the land to achieve sustained economic production)
	5	N2 (or S5) Unsuitable	Unsuitable land with extreme limitations that preclude its use for the proposed purpose.

Table 5-1	Scheme f	for	Classifying	Land	Suitability
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Reproduced from CSIRO, 2008.

Soil type characteristics (e.g. Plant Available Water Capacity and pH) have been cross–referenced against the Queensland technical guidelines for 'rainfed broadacre cropping' and 'beef cattle grazing' in DME (1995b). The most severe limitation determined the overall land suitability ranking for each specific soil type, while the combination of different limitations was recorded.

Available water storage for plant growth is the primary land suitability assessment attribute. Plant Available Water Capacity (PAWC) estimates the amount of moisture stored in the soil profile that is available to plant extraction. PAWC can be estimated from the soil's effective rooting depth (ERD), soil texture and structure recorded in field soil profile descriptions or in combination with laboratory measurements. PAWC was calculated for the soil profile by summing the available water capacity over depth.

Effective rooting depth is defined as the soil depth to which 90% of the plant roots will extract water (Burgess, 2003). It can be estimated from observed rooting depth and soil chemical parameters (McKenzie et al., 2008). The effective rooting depth criteria that were used in this assessment are listed in **Table 5-2**. PAWC suitability guidelines are listed in **Table 5-3**.

	Descriptor	ERD occurs where:
Electrical Conductivity <sup>1</sup>	EC <sub>1:5</sub> for sorghum and wheat <sup>1</sup> (90% yield reduction threshold)	>0.8 dS/m
Chloride Levels	CI 1:5	>800 mg/kg
Sodicity	ESP	>15%
рН	pH for any soil in any zone pH for rigid soils in any zone	≤5.0 >8.9
Bedrock	Depth to C horizons	
Soil Structure	Unsuitable subsoil structure	Moderate or strong columnar structure Sandy free draining horizons >90% rock fragments

# Table 5-2 Effective Rooting Depth Criteria (DERM 2011<sub>c</sub>)

Guideline Source	Land Suitability ranking for rain fed cropping								
	1 2 3 4								
DME (1995)	PAWC> 150 mm	PAWC 125-150 mm	PAWC100-125 mm	PAWC 75-100 mm	PAWC <75 mm				
Burgess 2010	PAWC> 150 mm	PAWC 130-150 mm	PAWC115-130 mm	PAWC 70-115 mm	PAWC <70 mm				
Guideline Source	Land suitability ranking for beef cattle grazing								
	1	2	3	4	5				
DME (1995)	PAWC> 125 mm	PAWC 100-125 mm	PAWC 75-100 mm	PAWC 50-75 mm	PAWC <50 mm				
Burgess 2010	PAWC> 90 mm	PAWC70-90 mm	PAWC 35-70 mm	PAWC <35 mm	_				

Table 5-3 Current and draft Land Suita	bility PAWC Guidelines
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# 5.1.3 Agricultural Land Classes

An Agricultural Land Class (ALC) assessment aims to provide local authorities and development proponents with a system to identify areas of good quality agricultural land for planning and project approval purposes. This information is used to grade the land in terms of its suitability for agriculture. Agricultural land is defined as land used for crop or animal production, but excluding intensive animal uses (i.e. feedlots and piggeries). Good quality agricultural land is capable of sustainable use for agriculture, with a reasonable level of input, and without causing degradation of land or other natural resources.

The agricultural land class assessment was conducted in accordance with *Planning Guidelines: The Identification of Good Quality Agricultural Land* (QDPI, 1993). The ALC assessment is reported using a four class system (A to D) with Class A being the best quality agricultural land and Class D being non-agricultural land (**Table 5-4**).

The agricultural land class system is related to the land suitability assessment system, with the five class land suitability ranking system translated into a four class agricultural land class system. The correlation between these systems is shown in **Table 5-5.** Class C of the agricultural land class system is further divided into three sub-classes of C1, C2 and C3 (**Table 5-6**).

Class		Description				
Α	Crop Land	Land that is suitable for current and potential crops with limitations to production which range from none to moderate levels.				
В	Limited Crop Land	Land that is marginal for current and potential crops due to severe limitations; and suitable for pastures. Engineering and/or agronomic improvements may be required before the land is considered suitable for cropping.				
С	Pasture Land	Land that is suitable only for improved or native pastures due to limitations which preclude continuous cultivation for crop production; but some areas may tolerate a short period of ground disturbance for pasture establishment.				
D	Non-agricultural Land	Land not suitable for agricultural uses due to extreme limitations. This may be undisturbed land with significant habitat, conservation and/or catchment values or land that may be unsuitable because of very steep slopes, shallow soils, rock outcrop or poor drainage.				

# Table 5-4 Agricultural Land Class System

Source: DME (1995)

### Table 5-5 Broadacre Cropping Land Suitability Ranking and Agricultural Land Class Correlation

LS Ranking	Description	ALC
1	High quality land with few or minor limitations.	А
2	Land with minor limitations.	А
3	Moderate limitations to sustaining its use.	A or B
4	Marginal land requiring major inputs to sustain the use.	B or C
5	Unsuitable due to extreme limitations.	D (Not Suitable)

### Table 5-6 Land Suitability Ranking and Agricultural Land Class Correlation

LS Class	LS Description (DME, 1995)	ALC	Pastoral Management and	Typical Vegetative Cover
1	High quality land with few or minor limitations	C1	Good quality grazing and/or highly suitable for	Brigalow vegetation; appropriate for fattening beef cattle; good grazing on sown pastures and can withstand ground disturbance.
2	Land with minor limitations		pasture improvement	Brigalow vegetation and/or transitional vegetation to Poplar Box vegetation communities.
3	Moderate limitations to sustaining its use	C2	Moderate quality grazing and/or moderately suitable for pasture improvement.	Eucalypt woodland, Poplar Box, narrow- leaved Eucalyptus, gum-top woodlands; low-moderate PAWC and low-moderate fertility; good grazing on native pastures without ground disturbance; appropriate for beef cattle breeders.
4	Marginal land requiring major inputs to sustain the use	C3	Low quality grazing, grazing of native pastures with limited suitability for pasture improvement.	Tea-tree vegetation; usually characterised by steep country or mangrove flats.
5	Unsuitable due to extreme limitations.	D	Not suitable	Unsuitable due to extreme limitations.

# 5.1.4 Good Quality Agricultural Land (GQAL)

The Bauhinia Shire Council, Duaringa Shire Council, Emerald Shire Council and Peak Downs Shire Council were revised to become the Central Highlands Regional Council. Original planning schemes are still currently available and the MDS Project area is located within the former Bauhinia Shire Council planning scheme. This planning scheme is still current for the MDS Project area and has been used to determine if the agriculture land classes within the MDS Project area are considered by the relevant planning scheme as GQAL.

Class A, Class B and Class C1 land is considered to be GQAL in the Bauhinia Shire Council planning scheme. Class C2 is not considered to be GQAL in the scheme.

# 5.2 Results

# 5.2.1 Plant Available Water Content

The estimated PAWC for soil types mapped in the MDS Project area is presented in **Table 5-7**. Soil depth limited the effective rooting depths across each soil type in the MDS Project area. Consequently, soil depth variation led to varying PAWC — typically 50 - 100 millimetres based on soil depth.

	GSSE Repre	ERD	Depth Limitation	PAWC			
Site#	Map unit/soil family	ASC	m		mm		
Oxford Land System							
1,3	107, Rugby	Haplic, Self-Mulching, Brown Vertosol; Slightly Gravelly, Fine, Fine, Shallow to Moderate	0.35-0.8	C Horizon at 0.35 m	69		
12	108, Bruce	Haplic, Self-Mulching, Brown Vertosol; Non-Gravelly, Fine, Fine, Moderate	0.6	C horizon at 0.6 m	63		
10, 11,14	109, Arcturus	Haplic, Self-Mulching, Grey Vertosol; Non-Gravelly, Fine, Fine, Moderate	0.6	C horizon at 0.6 m	115-129		
8	110, May Downs	Haplic, Self-Mulching, Brown Vertosol; Non-Gravelly, Fine, Fine, Deep	1.4	C horizon at 1.4 m	141		
Waterford Land System							
2,7,9	105, Rugby	Haplic, Self-Mulching, Black Vertosol; Non-Gravelly, Fine, Fine, Shallow to Moderate	0.4-0.9	C horizon at 0.9 m	54-115		

### Table 5-7 Effective Rooting Depth and Plant Available Water Capacity

# 5.2.2 Strategic Cropping Land (SCL)

Laboratory analysis reports are provided in **Appendix 1**. SCL criterion assessment for full profile description sites with analytical data in SCL trigger mapped areas is presented in **Table 5-8**. Eight full profile descriptions were assessed against the SCL criteria. Three of the soil profile observations (S11, S14 and S16) in the MDS Project area met SCL criteria, while SCL criteria were not met at five profile observations.

Slope was the first criterion for excluding an observation site from SCL. Slope mapping (**Figure 5-2**) identified areas towards the eastern boundary that exceeded the slope  $\geq$ 3% criterion. Approximately a third of the MDS Project area had unfavorable slope. Unfavorable slopes were associated with Tertiary Basalt outcrop. Three sites (S10, S12, and S15) failed the SCL criteria on the soil depth **Table 5-8**.

There were multiple observation sites throughout MDS Project area with high gravel contents that did not exceed the 60 mm size limit for rockiness. This may be because the areas had been raked or rock picked to improve land suitability for cropping. The SCL criteria guidelines refer to current land suitability and state that the rockiness criterion does not apply to coarse fragments found within the soil profile.

Gilgai micro relief was not detected in the MDS Project area. Soil wetness constraint was not detected in the MDS Project area. Soil pH ranged between slightly acid to strongly alkaline. No sites were excluded based on unfavourable laboratory pH results. No sites were excluded based on laboratory determination of salinity from chloride concentration. Plant Available Water Capacity (PAWC) was identified as a constraint for sites S6 and S13, all other sites that met PAWC criteria.

Map Unit/Soil Family	Site #	Comments	SCL Criterion								
			1-slope (s)	2-rockiness (r)	3-gilgai microrelief (g)	4- soil depth (d)	5- wetness (w)	(d) Hd =9	7- salinity (e)	8- water storage (w)	SCL
108, Bruce	S6	Weathered horizon encountered at 0.5 m.	Р	Р	Р	Р	Р	Р	Р	F	No
108, Bruce	S12	Weathered horizon at 0.50 m.	Р	Р	Р	F					Νο
108, Bruce	S13	Soil water storage is less than 100 mm at 0.5 m weathered	Ρ	Р	Ρ	Ρ	Ρ	Ρ	Ρ	F	No
109, Arcturus	S10	Weathered horizon at 0.50 m.	Р	Р	Р	F					No
109, Arcturus	S11	Nil constraints	Р	Р	Р	Р	Р	Р	Р	Р	Yes
107, Rugby	S14	Nil constraints	Р	Р	Р	Р	Р	Р	Р	Р	Yes
109, Arcturus	S15	Weathered horizon at 0.50 m.	Р	Р	Р	F					No
109, Arcturus	S16	20 % tertiary basalt rocks (200 mm).	Р	Р	Р	Р	Р	Р	Р	Р	Yes

Table 5-8 SCL Assessment Criterion

# 5.2.3 Confirmed SCL

Land validated as SCL in the MDS Project area is depicted in **Plate 5-1**. SCL ground truthing field survey work confirmed SCL trigger mapping at three sites (S11, S16) in the soil map unit 109, Arcturus and (S14) in the soil map unit 107 Rugby (**Table 3-3**). Figure 5-7 Strategic Cropping Ground Truthing, shows observation sites in relation to pass/fail assessment criteria.



Plate 5-1 Strategic Cropping Land at S11

While this survey confirmed the presence of SCL on the MDS Project, the area did not fulfill the minimum area requirement of 100 ha as identified in the *Strategic Cropping Land Act*.

# 5.2.4 Agricultural Land Classes (ALC)

The primary land use in the MDS Project area was identified as grazing land use on natural pastures. Dry land cropping was identified as a secondary land use over relatively less extensive areas in land use mapping. The Bauhinia Shire Council planning scheme identifies the following agricultural land classes (ALC) occurring in the MDS Project area:

- Class A Land that is suitable for current and potential crops with limitations to production which range from none to moderate levels.
- Class C2 Moderate quality grazing and/or moderately suitable for pasture improvement.

The ALC for each soil map unit is identified in **Table 5-9** for rainfed cropping and beef cattle grazing.

The ALC for the MDS Project as presented in the Bauhinia Shire Council planning scheme is provided in **Figure 5-3**.

# 5.2.5 Good Quality Agricultural Land (GQAL)

The MDS Project area was assessed to be Class B cropping and Class C1 and Class C2 grazing. Distributions for ALCs are provided in **Figure 5-4**. Additional detail is provided below:

 Class B cropping is land that is marginal for current and potential crops due to severe limitations; and suitable for pastures. Engineering and/or agronomic improvements may be required before the land is considered suitable for cropping (227 ha).

- Class C1 indicates that the land is good quality grazing and/or highly suitable for pasture improvement (126 ha).
- Class C2 indicates that the land can be managed for moderate quality grazing and/or moderately suitable for pasture improvement (1253 ha).

# 5.2.6 Land Suitability

Land suitability guidelines for rainfed cropping identified four of the ten mapped soil families as suitable for cropping (**Table 5-9**) and all of the mapped soil families as suitable for beef cattle grazing. Soil types were assigned the following limitations and the level of severity according to the technical guidelines (DME, 1995):

- Nitrogen Soil Nitrogen levels (N)
- PAWC Plant Available Water Capacity (P);
- Rockiness (R);
- pH Soil pH levels (pH); and
- Water Erosion Water erosion susceptibility (E).

Land suitability classes for Rainfed Cropping and Beef Cattle Grazing are presented in **Figure 5-5** and **Figure 5-6** respectively.

### Table 5-9 Land Suitability Assessment

	GSS	SE Representative Soil Type	Main Limitation (s) <sup>1</sup>	Rainfed Cropping	Main Limitation (s) <sup>1</sup>	Beef Cattle Grazing	class					
Site #	Map Unit/Soil Family	ASC	Description	Class	Description	Class	ALC (					
Oxford Land System												
1	107, Rugby	Haplic, Self-Mulching, Brown Vertosol; Slightly Gravelly, Fine, Fine, Shallow	P <sub>5</sub> , N <sub>3</sub> , E <sub>3</sub>	5	P <sub>3</sub> , pH <sub>2</sub> , E <sub>1</sub>	3	C2					
3	107, Rugby	Haplic, Self-Mulching, Brown Vertosol; Slightly Gravelly, Fine, Fine, Moderate	P <sub>2</sub> , N <sub>3</sub> , E <sub>3</sub>	3	N <sub>2</sub> , pH <sub>2</sub>	2	В					
12	108, Bruce	Haplic, Self-Mulching, Brown Vertosol; Non- Gravelly, Fine, Fine, Moderate	P <sub>5</sub> , N <sub>3</sub> , E <sub>3</sub>	5	P <sub>3</sub> , pH <sub>2</sub>	3	C2/ C1 <sup>2</sup>					
10	109, Arcturus	Self-Mulching, Grey Vertosol; Non-Gravelly, Fine, Fine, Moderate	P4, N3, R3	4	P <sub>2</sub> , N <sub>2</sub> , pH <sub>2</sub> , R <sub>2</sub>	2	В					
14	109, Arcturus	Haplic, Self-Mulching, Grey Vertosol; Non- Gravelly, Fine, Fine, Moderate	P <sub>2</sub> , N <sub>3</sub> , E <sub>3</sub>	3	N <sub>2</sub> , pH <sub>2</sub>	2	В					
11	109, Arcturus	Self-Mulching, Grey Vertosol; Non-Gravelly, Fine, Fine, Moderate	P <sub>3</sub> , N <sub>3</sub> , E <sub>3</sub>	3	N <sub>2</sub> , pH <sub>2</sub>	2	В					
8	110, May Downs	Haplic, Self-Mulching, Brown Vertosol; Non- Gravelly, Fine, Fine, Deep	P <sub>2</sub> , N <sub>3</sub> , E <sub>3</sub>	3	N <sub>2</sub> , pH <sub>3</sub> , E <sub>3</sub>	3	В					
Waterford Land System												
2	105, Rugby	Haplic, Self-Mulching, Black Vertosol; Non- Gravelly, Fine, Fine, Moderate	P <sub>3</sub> , N <sub>3</sub> , E <sub>3</sub>	3	N <sub>2</sub> , pH <sub>2</sub>	2	В					
7	105, Rugby	Haplic, Self-Mulching, Black Vertosol; Slightly Gravelly, Fine, Fine, Shallow	P <sub>4</sub> , N <sub>3</sub> , E <sub>3</sub>	4	N <sub>2</sub> , pH <sub>2</sub> , E <sub>2</sub>	2	C1					
9	105, Rugby	Haplic, Eutrophic, Brown Dermosol; Slightly Gravelly, Fine, Fine, Shallow	P <sub>5</sub> , E <sub>3</sub>	5	P <sub>3</sub> , pH <sub>2</sub>	3	C2					

1 Limitation classes assigned rank from 1 (most suitable) to 5 (least suitable) in accordance to (DME, 1995)

2 ALC is predominately ALC C2, with minor areas of ALC C1.



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## 6.0 DISTURBANCE MANAGEMENT

Different parts of the MDS Project infrastructure will have a disturbance footprint during construction and operational phases. Some parts will be rehabilitated during construction and others (such as the pit and stockpile areas) being rehabilitated progressively or at the end of their operational use. A disturbance footprint has been provided for the calculation and removal of soil resources and is depicted in **Figure 6-1**.

#### 6.1 Disturbance Footprint

This assessment of the MDS Project covers a MDS Project area of 1606 ha, with approximately 521 ha within the mine footprint disturbance area including:

- Mine site infrastructure approximately 83 ha;
- Mine pit area and out of pit spoil dump approximately 337 ha;
- Haul road approximately 5 ha;
- Sediment dams approximately 11 ha;
- Quarry approximately 47 ha; and
- Access roads and tracks approximately 38 ha.

#### 6.2 Soil Resource Assessment

#### 6.2.1 Soil Stripping Assessment

The maximum recommended stripping depths of *primary media* and *secondary media* are shown in **Table 6-1**. High clay content was a constraint to suitability for stripping and reuse. However, stockpiling operations provide a level of mixing that mitigate the effect from relatively small areas with high clay content. Recommended soil stripping depths for primary and secondary media are mapped in **Figure 6-2** and **Figure 6-3** respectively.

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	Represent	ative Soil Type	Primary Media Recommended Stripping Depth	Secondary Media Recommended Stripping Depth	Main Limitation(s)	Suitability <sup>1</sup>
Site #	Map Unit/ Soil Type	ASC	m	m	Description	
Oxfo	rd Land Syster	n				
1	107, Rugby	Haplic, Self-Mulching, Brown Vertosol; Slightly Gravelly, Fine, Fine, Shallow	0.0 – 0.1	0.1 – 0.35	Nil	Suitable
3	107, Rugby	Haplic, Self-Mulching, Brown Vertosol; Slightly Gravelly, Fine, Fine, Moderate	0.0 – 0.20	0.20 - 0.60	Nil	Suitable
12	108, Bruce	Haplic, Self-Mulching, Brown Vertosol; Non- Gravelly, Fine, Fine, Moderate	0.0 – 0.1	0.1 – 0.6	Nil	Suitable
10	109, Arcturus	Self-Mulching, Grey Vertosol; Non-Gravelly, Fine, Fine, Moderate	0.0 – 0.1	0.1 – 0.6	Nil	Suitable
14	109, Arcturus	Haplic, Self-Mulching, Grey Vertosol; Non- Gravelly, Fine, Fine, Moderate	0.0 – 0.15	0.15 – 0.8	Nil	Suitable
11	109, Arcturus	Self-Mulching, Grey Vertosol; Non-Gravelly, Fine, Fine, Moderate	0.0 – 0.1	0.1 – 0.6	Nil	Suitable
8	110, May Downs	Haplic, Self-Mulching, Brown Vertosol; Non- Gravelly, Fine, Fine, Deep	0.0 – 0.1	0.1 – 0.6	Nil	Suitable
Wate	erford Land Sys	stem				
2	105, Rugby	Haplic, Self-Mulching, Black Vertosol; Non- Gravelly, Fine, Fine, Moderate	0.0 – 0.1	0.1 – 0.6	Nil	Suitable
7	105, Rugby	Haplic, Self-Mulching, Black Vertosol; Slightly Gravelly, Fine, Fine, Shallow	0.0 – 0.1	0.1 – 0.6	Nil	Suitable
9	105, Rugby	Haplic, Eutrophic, Brown Dermosol; Slightly Gravelly, Fine, Fine, Shallow	0.0 – 0.1	0.1 – 0.55	Nil	Suitable

#### Table 6-1 Growth Media Stripping Depths

<sup>1</sup> Suitability assessment refers to the nominated maximum stripping depth.

#### 6.2.2 Topdressing Volumes

Volumes of topsoil and subsoil for rehabilitation works (calculated from tabulated stripping depths and mapped areas) are presented in **Table 6-2**. The major project component areas represent the current

understanding of the disturbance associated with the MDS Project. Topsoil management is addressed in the Topsoil Management Plan (**Appendix 2**) and will need to be considered in the erosion and sediment control plan for the MDS Project.

The volume of primary media (topsoil) available across the MDS Project area was estimated at 683,000 m<sup>3</sup> and secondary media (subsoil) at 2,469,000 m<sup>3</sup>. When a handling loss of 10% is allowed, volumes are reduced to 614,700 m<sup>3</sup> and 2,222,100 m<sup>3</sup>, primary media and secondary media respectively.

Project Component	Land unit, Soil type	Area disturbed (ha)	Estimated volume of suitable topsoil (m <sup>3</sup> )	Estimated volume of suitable subsoil (m <sup>3</sup> )
Infrastructure	107 Rugby	50	100,000	200,000
	108 Bruce	33	66,000	134,000
Mine Pit and Out	105 Rugby	42	42,000	210,000
of Pit Dump	107 Rugby	40	80,000	160,000
	108 Bruce	243	243,000	1,215,000
	109 Arcturus	12	18,000	78,000
Haul road	107 Rugby	4	8,000	16,000
	108 Bruce	1	1,000	5,000
Sediment dams	108, Bruce	11	11,000	55,000
Quarry	105 Rugby	22	22,000	110,000
	107 Rugby	15	30,000	60,000
	108 Bruce	10	10,000	50,000
Access Roads	107, Rugby	14	28,000	56,000
and Tracks	108, Bruce	24	24,000	120,000
Total		521	683,000	2,469,000

Table 6-2 Topsoil and Subsoil Volumes for Rehabilitation works

#### 6.3 Topdressing Management

The MDS Project's disturbance activities will require immediate reuse, progressive rehabilitation and long term storage. As such stripped and salvaged soil will need to be re-used within a short period of time (less than three months) and stored in longer term in stockpiles whilst the mine is in operation. The *Topsoil Management Plan* (**Appendix 2**) was developed for construction and operation phases of the MDS Project to address topsoil stripping and handling, topsoil respreading, seedbed preparation and weed management.

#### 6.4 Rehabilitation Objective and Post-development Agricultural Land Class

Outside the immediate vicinity of the pit, final void and the overburden stockpile, the rehabilitation objective is to return the land to the pre-development Agricultural Land Class.

The proposed rehabilitation objective for the pit, final void and overburden stockpile area (337 ha) will be the establishment of a native ecosystem, including revegetation with native flora, and consistent with Class D Agricultural Land Class (refer **Figure 6-6** Proposed Post Development Agricultural Land Classes). Grazing will be excluded from the rehabilitated pit and stockpile area.

#### 6.5 Soil Erosion Hazard

Soil erosion is a significant hazard on and downstream of construction sites when vegetative cover is disturbed and the soil is subject to the erosive agents of water and wind. Soil erosion occurs when soil particles detach and are transported offsite. A range of site specific factors affect detachment. The main factor for the MDS Project area is slope.

Soil loss estimates were computed to enable effective erosion and sediment control measures to be put in place during project development and to aid mitigation measures designed to reduce the erosion potential in post-mining landforms. These are likely to be low relief above grade landforms with flat crests approximately 300 m length,  $2^{\circ}$  (3.5%) gradient, and gently to moderately inclined slopes length 100 m and  $10^{\circ}$  (17.6%) gradient.

#### 6.5.1 Methodology

Soil loss (A) was computed using the Revised Universal Soil Loss Equation (RUSLE) in accordance with Managing Urban stormwater: Soils and Construction Volume 1 – Appendix A (Landcom 2004). The RUSLE is a factor model that predicts the long term annual soil loss by water erosion. The equation models five factors: rainfall erosivity (R), soil erodibility (K), slope length/gradient (LS), erosion control practice (P) and ground cover/management factor (C).

Soil erodibility was quantified using the soil erodibility factor (hereafter referred to as the K factor in the Revised Universal Soil Loss Equation). Soil texture is the principle component affecting K; however, other factors such as soil structure, soil organic matter content as well as soil profile permeability also contribute to the soil's inherent soil erodibility. Soils that have the highest erodibility are those which have weak bonds between soil particles and contain an abundance of easily transportable soil particles.

Soil erodibility was quantified for the recommended primary media stripping depths and secondary media stripping depths (**Section 6.2.1**) for the disturbed MDS Project footprint. Topsoil volumes for soils to be disturbed were estimated in **Section 6.2.2**. Slope gradient is a major factor for erosion risk in the MDS Project area as steeper slopes increase erosion rates.

#### 6.5.2 Soil Erosion Hazard Assessment

The MDS Project area's disturbance footprint covers land that has low to moderate soil erosion hazard ratings (**Figure 6-4** and **Figure 6-5**). Erosion hazard ratings for the MDS Project area are summarised in **Table 6-3**.

Meteor Downs South Disturbance Management

		Soil Type	Are	a	Dominant Slope	Primary Media K Factor	Primary Media Erosion Hazard	Secondary Media K Factor	Secondary Media Erosion Hazard
Soil type #	Map Unit/Soil Type	ASC	(ha)	%	Description	Rating	Rating		
Oxford u	Indulating low	lands and plains							
~	107, Rugby	Haplic, Self-Mulching, Brown Vertosol; Slightly Gravelly, Fine, Fine, Shallow	0	00	Gently Undulating Plain	0.025	Moderate	0.026	Moderate
ę		Self-Mulching, Brown Vertosol; Slightly Gravelly, Fine, Fine, Shallow	- D T	000	Gently Undulating Plain	0.024	Moderate	0.021	Moderate
12	108, Bruce	Haplic, Self-Mulching, Brown Vertosol; Non-Gravelly, Fine, Fine, Moderate	835	52	Gently Undulating Plain	0.021	Moderate	0.021	Moderate
10		Haplic, Self-Mulching, Grey Vertosol; Non-Gravelly Fine, Fine, Moderate			Gently Undulating Plain	0.021	Moderate	0.020	Moderate
14	109, Arcturus	Haplic, Self-Mulching, Grey Vertosol; Non – Gravelly, Fine, Fine, Moderate	126	ø	Gently Undulating Plain	0.018	Low	0.026	Moderate
11		Haplic, Self-Mulching, Grey Vertosol; Non-Gravelly, Fine, Fine, Moderate*			Gently Undulating Plain	0.018	Low	0.022	Moderate
œ	110, May Downs	Haplic, Self-Mulching, Brown Vertosol; Non-Gravelly, Fine, Fine, Deep	30	5	Gently Undulating Plain	0.027	Moderate	0.036	Moderate
Waterfor	d Low Hills								
2		Haplic, Self-Mulching, Black Vertosol; Non- Gravelly, Fine, Fine, Moderate			Gently Undulating Plain	0.020	Low	0.025	Moderate
7	105, Rugby	Haplic, Self-Mulching, Black Vertosol; Slightly Gravelly, Fine, Fine, Shallow	124	ø	Gently Undulating Plain	0.021	Moderate	0.020	Low
6		Eutrophic, Brown Dermosol; Slightly Gravelly, Fine, Fine, Shallow			Gently Undulating Plain	0.041	High	0.030	Moderate
Total			1606	100					

Table 6-3 Erosion Hazard Assessment

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#### 6.5.3 Results

Estimated soil loss for primary media and secondary media identified on the MDS Project area for each representative soil type, including both flat and sloping post-mining landforms is quantified in **Table 6-4** and **Table 6-5**.

Each soil type represented was assessed for flats (3.5%) and slopes (17.6%). The erosion rate of primary media ranged from 33 to 74 tonnes/ha/yr on flat land and 202 to 461 tonnes/ha/yr on sloping land. Secondary media erosion rates range from 36 to 64 tonnes/ha/yr and 225 to 404 tonnes/ha/yr for flats and sloping landforms respectively.

The Bruce soil type (Self-Mulching, Brown Vertosol; Non-Gravelly Fine, Fine, Moderate) had the highest erodibility rating and is expected to generate the greatest soil loss and erosion mitigation considerations are of particular importance for this unit. Revegetation will reduce computed soil loss rates. Vegetative covers of 25 to 50% could reduce predicted soil loss rates will reduce by 65% to 85%.

Wind erosion could remove material from overburden dumps during the mining process. Management practices such as watering and reducing truck movements can limit the impact of wind erosion on highly exposed stockpiles during windy periods. Additionally, mine planning considerations for minimising exposed surfaces and timely rehabilitation activities will protect primary and secondary media stockpiles from wind erosion.

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Soils, Land, Overburden and Process Waste Study **Meteor Downs South** 

Factor					Representati	ve Soil Types				
	-	2	S	7	œ	6	10	14	12	11
Я	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850
¥	0.025	0.020	0.024	0.021	0.027	0.041	0.021	0.018	0.021	0.018
LS - flat	1.82	1.82	1.82	1.82	1.82	1.82	1.82	1.82	1.82	1.82
LS - slope	7.59	7.59	7.59	7.59	7.59	7.59	7.59	7.59	7.59	7.59
Ч	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
C	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
A (flats) = (tonne/ha/yr)	45	36	43	38	49	74	38	33	38	33
A (slopes) = (tonne/ha/yr)	281	225	270	236	303	461	236	202	236	202

Table 6-4 Primary Media RUSLE Results

# Table 6-5 Secondary Media RUSLE Results

Factor					Representativ	ve Soil Types				
	-	2	e	7	8	6	10	14	12	1
Я	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850
¥	0.026	0.025	0.021	0.020	0.036	0:030	0.020	0.026	0.021	0.022
LS - flat	1.82	1.82	1.82	1.82	1.82	1.82	1.82	1.82	1.82	1.82
LS - slope	7.59	7.59	7.59	7.59	7.59	7.59	7.59	7.59	2.59	7.59
۵.	0.8	0.8	0.8	0.8	0.8	0.8	8.0	0.8	8.0	0.8
С	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
A (flats) = (tonne/ha/yr)	47	45	38	36	65	54	36	47	38	40
A (slopes) = (tonne/ha/yr)	292	281	236	225	404	337	225	292	236	247

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 0
 1km
 2km

 Scale 1:45 000

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GSS ENVIRONMENTAL Environmental, Land and Project Management Consultants

Projection:

MGA 94 Zone 55

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# 7.0 CONCLUSIONS

#### 7.1 Strategic Cropping Land Constraints

The MDS Project is in the Central SCL Protection Area on the boundary of extensive areas mapped as SCL across the region. SCL trigger mapping in the MDS Project area did not fulfill the SCL zonal criteria over 32.9 ha due to depth and PAWC criteria. SCL zonal criteria confirmed trigger mapping in over 74 ha (Land unit 109, Arcturus and Land unit 107 Rugby), which is less than the 100 ha minimum area requirement to be mapped as SCL according to DERM (2011c). Presence of confirmed trigger mapping is presented in **Figure 5.7**.

While our findings summarized in **Table 7-1** support an SCL validation application to revise down the area mapped as SCL in the MDS Project area, disturbance of marginal and confirmed SCL (both trigger mapped and confirmed) should be avoided. Soil depth was the critical factor in the SCL determination. Soil depth and rockiness assessment in this survey was consistent with published soil information for land units identified from regional survey (Gunn and Nix 1977) in the MDS Project area.

Area	На	%
DERM Original Potential SCL (Trigger Mapped Area)	106.9	100
Trigger Mapped Confirmed	74	69
Trigger Map Reductions ( - )	32.9	31
Trigger Map Expansions ( + )	0	0
Net Change (-)	32.9	31
GSSE Revised SCL	74	69

#### Table 7-1 Comparison of Trigger Maps to Survey Findings

#### 7.2 Good Quality Agricultural Land Constraints

Most of the MDS Project area (1253 ha) is Class C2 — indicating that the land can be managed for moderate quality grazing and/or moderately suitable for pasture improvement. This area does not qualify as GQAL under the local government land use plan.

Class B cropping land (227 ha) that is marginal for current and potential crops and Class C1 land (126 ha) that is good quality grazing and/or highly suitable for pasture improvement does qualify as GQAL. Approximately 353 ha of the MDS Project area are afforded protection under the local government land use plan as GQAL.

#### 7.3 Land Suitability

Land suitability was assessed for the MDS Project area as being Class 2 to Class 5 for rainfed cropping or Class 2 to Class 3 beef cattle grazing.

#### 7.4 Overburden material

#### 7.4.1 Overburden Material

Initial surface runoff and seepage from overburden materials is likely to be alkaline and have low salinity as defined under Queensland technical guidelines (DME, 1995e) in Table 7-2.

	Very Low	Low	Medium	High	Very High
pH1:5 (sample:water)	< 4.5	4.5 – 5.5	5.5 – 7.0	7.0 – 9.0	> 9.0
EC1:5 (sample:water) µS/cm	< 150	150 - 450	450 - 900	900 - 2000	> 2000

Table 7-2 Salinity and pH criteria for assessment of coal and mining waste materials

(Reproduced from DME, 1995e, 1000 µS/cm is 0.1dS/m)

Erosion and sediment controls on site, prior to, and during the development of the overburden emplacements need to account for potentially sodic material. Monitoring overburden sodicity in the mining operation, using ESP or surrogate pH measurements is recommended. Containment and gypsum application in rehabilitation plans can be used to mitigate marginally sodic material in sub-units of each overburden horizon (DME 1995e).

All overburden samples had very low sulfur content of <0.1%, which is classed as inert. All the Overburden ANC values across all horizons generally exceeded the MPA, indicating that the material has sufficient buffering capacity to neutralise the small amount of acidity that may be generated from sulfide oxidation. Except for four overburden samples, all were classified as definitive NAF, with three samples classified as UC-NAF and a single near coal roof sample, which can be considered as part of the Interburden Reject material, as UC-PAF. The majority of NAPP values are negative, and only one sample is slightly positive, being 4.2 kg  $H_2SO_4/t$ .

Rainfall infiltration will leach salts from the surface layers of overburden over time. Water management structures to handle leachates from solid reject disposal sites should be monitored for salinity levels and appropriate management and release actions should be followed. The overburden particularly the Basalt Horizon has low salinity, non-restricting for plant growth, and could be used as a cover construction material in some layer combination with stockpiled topsoil on overburden landforms in the rehabilitation design. The Basalt material eventually weathers into cracking clay (Vertosols). The reported high CEC values indicated potentially high fertility consistent with local soil material.

It is recommended that the range of water quality analyses in runoff/seepage monitoring programs from constructed overburden or reject storage facilities focus on pH, EC and Total Dissolved Solids (TDS). Periodic sampling and testing of the full suite of dissolved metals described in this report (i.e. annually) should be included in the water quality monitoring program developed for the MDS Project. Elevated background dissolved metal concentrations for the Basalt Horizon was within the general (DME, 1995a and 1995e and NEPC, 1999a and 1999b) guideline values. Igneous materials such as Basalts are normally observed to have higher natural metal levels in contrast to most sedimentary rock units as a consequence of mineralogical composition (i.e. Iron-Magnesium Silicate minerals as part of the composition of Basalts, which weathers over time and releases free Iron and Magnesium elements).

The Basalt horizons in the overburden are likely to be geotechnically stable, depending on how these are stockpiled. The sandstone units in the Tertiary and Permian sedimentary horizons are also likely to be relatively coherent and geotechnically stable. Low strength clay and mudstone sedimentary units could

have a level of geotechnical stability risk, due to differential compaction after it is disturbed, transported and placed in final position. Further geotechnical assessment of the load bearing properties of these materials is strongly recommended as a preliminary activity for a stable pit and overburden landform design. The Queensland Guidelines (DME, 1995f) provides guideline information for areas with proposed excavation depths of no more than 20 m and volumes of up to 100,000 cu. m. In areas where these values are exceeded, site-specific geotechnical evaluation will provide an in-depth analysis of material properties and their structural limits.

The overburden stockpile site location can be considered as suitable with regards to its proximity from the resource pit, and in relation to the overall topography of the MDS Project Area, wherein topographic lows are generally situated along the southern MDS Project Area boundary. The overburden stockpiles located to the west-northwest of the void are designed with an average perimeter slope of (18-32%). All of the NAF Approximately 41,780,085 BCM of overburden will be stockpiled in this location during the planned mining operation. Most of the material can be considered as inert and Non-PAF from this initial evaluation.

Provided that erosion and sediment control measures are in place to manage runoff or leachate, the contamination risk to areas surrounding the overburden stockpile can be considered low. A slope stability assessment in conjunction with the proposed geotechnical assessment is recommended to provide optimum and safe slope values compatible with the load-bearing capacities of the material involved (i.e. basalts and sediment overburden).

The proposed overburden stockpiles slopes are higher than the recommended slopes for soil and spoil landform designs under the DME (1995f) guidelines. However, the overburden is generally considered to be competent rock material, with geotechnical properties that can sustain higher-angle slopes. Although, these stockpiles of overburden and process coarse rejects (i.e. material sorted according to particle size) will need to be designed according to their acceptable slope limits. Also, the strategic placement of diversion drains and weep pipes placed need to be considered to reduce the risk of slope failure within the stockpile.

Controlling site drainage and managing runoff quality will require placement and design of erosion and sediment control structures (drop structures and check dams) within the overburden stockpiles and around the void. Establishing vigorous and extensive revegetated cover on the overburden will be a key factor in the sediment and erosion control design. The waste rock materials have relatively high potential fertility and are generally suitable for use in the rehabilitation as a growth substrate, with topsoil, to support revegetation.

We recommend further testing of the horizons with PAF or NAF uncertainties (**Table 4-3**) to refine the management strategies appropriate to the estimated volume being removed or disturbed in the extraction of the coal resource. Based on the static test results, further evaluation from kinetic testing is warranted to quantify AMD based on:

- One overburden sample classified as Uncertain-Potential Acid-Forming (UC-PAF): Core ORD130HC1 Sample Number 53 (73-56-73.62 m depth; Sandstone medium grained material)
- Three interburden samples classified as Uncertain-Non-Acid-Forming (UC-NAF): Core ORD130HC1 Sample Number 44 (64.84-64.9 m depth: Siltstone material) and Number 49 (69-69.06 m depth; Siltstone material); and Core ORD133HC1 Sample Number 15 (46.33-46.76 m depth; Carbonaceous mudstone material).

#### 7.4.2 Interburden (Reject) Material Summary and Recommendations

Initial surface runoff and seepage from coarse rejects (Interburden) is likely to have a pH range of 7.6-7.8 (documented in **Table 4-10**) and have low salinity as defined under Queensland technical guidelines (DME, 1995e, Table 1: Indicative criteria for sample analysis test results).

Sediment storage facilities for PAF material are considered to represent a Significant Hazard and qualify as regulated dams, based on the physical consequences of discharge. In-pit placement of interburden (rejects) material will mitigate risks and minimize potential contamination at the surface. Other coarse rejects (waste rock) can be placed and homogenized in the overburden stockpiles. The estimated volume

of reject material as PAF is estimated at 1,181,126 BCM, which can be readily accommodated in the two nominated locations.

While interburden NAPP results ranging from <0.5 to 6.9 kg  $H_2SO_4/t$  indicate leachate water is not generally expected to be acidic or metalliferous, it is reiterated that the quality of water discharge (including runoff) from the coarse rejects stockpiles will need to be controlled and initially captured in the mine water system prior to discharge. Water management structures will need to be designed as controlled drainage systems and demonstrated to manage metals in leachate to acceptable (ANZECC 2000) standards prior to discharge.

Construction of an inert cover is recommended to isolate the interburden stockpile. The interburden has low salinity and relatively low fertility that could compromise that rehabilitation program. Also, there is a combustion risk associated with the coal material that may be included in the reject that needs to be managed.

Inert cover designs will require a capillary break layer (to prevent moisture from being drawn out of the codisposed reject); favourable growth medium properties, neutralising capacity and erosion resistance appropriate to the landform design. Some of these characteristics exist in the overburden horizons, which could be utilised to pre-treat the interburden prior to disposal into the stockpiles.

#### 7.5 Erosion and Sediment Control Recommendations

The MDS Project area's disturbance footprint has a low to moderate erosion hazard rating. Appropriate erosion and sediment controls need to be installed to address adverse effects from construction and operations activities. A detailed *Erosion and Sediment Control Plan* is needed prior to the commencement of construction works. The principle objectives of the *Erosion and Sediment Control Plan* are outlined below.

#### 7.5.1 Minimising Disturbance

Implementing a permit system to ensure that the smallest practical area of land is cleared ahead of construction, as well as ensuring the land is disturbed for the shortest possible and practical time will reduce potential land disturbance. Limiting clearing can be achieved by:

- Limiting the cleared width to that required to accommodate the proposed operations;
- Staging the clearing activities where ever possible so that only the areas which are being actively cleared, therefore, limiting the time the areas are exposed; and
- Rehabilitating topsoil stockpiles as soon as practical.

General vegetation clearing and soil stripping should not be undertaken until earthwork and construction operations are ready to commence. Soil stripping activities should be avoided during high intensity rainfall seasons (e.g. mid-summer). All proposed erosion and sediment control measures will be implemented in advance of, or in conjunction with, clearing activities.

Prior to clearing and soil stripping commencing, the limits of these works should be clearly delineated by pegs placed at intervals on each side of the disturbed area by a suitably qualified supervisor. All operations will be planned to ensure that there is no damage to any trees and pasture areas outside the limits to be cleared.

#### 7.5.2 Surface Water Diversion

Prior to construction starting, diverting run-on water around disturbed areas into clean water drainage lines and off site into the natural creek systems will minimise the volume of potential sediment laden water to be treated. Suitably designed and constructed diversion drains will be needed on drainage lines in the MDS Project area.

#### 7.5.3 Stockpiles

A detailed *Topsoil Management Plan* is provided in **Appendix 2**). Stockpile management measures refer to growth media management guidelines (DME 1995a). Stockpiling the topsoil and cleared vegetation prior to any excavation or earthworks will facilitate rapid rehabilitation of disturbed areas. Buffering the stockpiles from road and other drainage and installing perimeter sediment fences and drainage interception structures will mitigate risks to the surrounding environment. Sowing a cover crop of pasture/grasses, keeping stockpile height below a critical level and managing weed species on long term stockpiles (i.e. greater than 3 months) will reduce erosion risk and improve rehabilitation quality (DME 1995a).

#### 7.6 Monitoring

Monitoring erosion from disturbed areas during the operations phase of mining will focus on environmental management and rehabilitation plans. The recommended monitoring objective is to ensure that the erosion rate on the disturbed/rehabilitated land does not exceed the rates occurring at corresponding reference sites. Where erosion rates exceed reference rates, control structures (e.g. diversion drains and sediment ponds) should be installed to minimise downstream impact.

Erosion monitoring and mitigation needs to respond to changing project plans and activities and, as such, needs to be included in operational project subcontractor management. Recommended areas for erosion monitoring include:

- Stockpiles (ROM and product);
- Spoil dumps, specifically batter faces;
- Topsoil stockpiles;
- Cleared land ahead of mining;
- Hardstand areas; and
- Roads and tracks.

Identifying erosion monitoring reference sites prior to construction will support long term rehabilitation objectives. Post-operation monitoring is designed to manage rehabilitation risks over the decommissioning period, during which infrastructure will be removed and the rehabilitation works undertaken; and the closure period during which the site closure objectives are verified.

Erosion monitoring involves selecting representative catchments several hectares in size. Ideally monitoring should be conducted annually and in a replicable manner that provides sufficient spatial and temporal repetition to enable statistically valid conclusions. Erosion rates need to be measured over a medium to long term period due to the high variability in rainfall conditions experienced throughout Queensland. Monitoring may include:

- Sediment depth measurement in sediment traps;
- Sediment movement and runoff data from instrumented catchments;
- Low level oblique or vertical aerial photography that allows counting of eroded areas by type;
- Field traverses which are used to observe and record the incidence of erosion;
- Basal area counts of vegetation from which the percentage of the soil surface protected by vegetation can be determined; and
- Profile gauges (installed across a representative range of slope, soil, and vegetation conditions) which are read annually. These gauges measure (in millimetres) soil removed from the site. While relatively inexpensive to install, large numbers of gauges are required to be monitored to obtain representative data.

In practice, a combination of the above is needed in conjunction with vegetation, dust and water quality monitoring.

Criteria to measure the success of erosion controls may be based on the examples provided in **Table 7-3**. Final criteria will need to be determined through discussions with the regulatory authority and consideration of community expectations.

Rehabilitation Objective	Indicator	Success Criteria	
Landform stability	Erosion control	Erosion control structures are installed commensurate with the slope of the landform. Average annual soil loss is <40 tonnes/ha/yr (sheet erosion). Dimensions and frequency of occurrence of erosion rills and gullies are 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. No water is observed leaching from the storage facility.	
	Capping	Landfills are capped to a depth to be defined in field trials, which includes a minimum topsoil depth of 200mm on the cap.	
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 <sup>2</sup> in area or >10 m in length down slope.	

#### Table 7-3 Proposed Success Criteria for Erosion

#### 7.7 Landform Stability

Landform stability has geotechnical and surface erosion components. It is one of the core completion criteria post operations: that a site is safe, stable and non-polluting. A stable landform includes areas where mining activity has altered topography (overburden stockpiles, final void) and former infrastructure areas where the natural land surface is intact. Erodibility assessment of stockpiled topsoil, stable landform design requires detailed information on the geotechnical, hydraulic and geochemical characteristics of stockpiled waste rock, pit head walls, cover construction materials for ecosystem support and material containment.

Landform stability will also rely on detailed design of drainage constructed to reduce slope lengths and direct runoff and seepage into controlled waterways. The drainage design will change between construction, operation, decommissioning and closure phases of the MDS Project. It is important that erosion and sediment rates are controlled to support a stable cover and self-sustaining vegetation at each stage of the mine life. The best means of assuring long term stability is a dense, permanent vegetation cover.

For slopes over 18%, the use of special precautions such as terracing, rock armouring, pitting or the use of lining materials, such as stone, coarse coal reject or hay mulch, should be considered. Where steep slopes are unavoidable, it can be important to minimise the catchment area above the slope, divert runoff water away from the slope or construct drop structures (flumes, pipes) that are engineered to acceptable design standards. The hard facing material used in closure construction should be obtained on site if possible.

There will be regulatory requirements for the stability of contaminated areas, landfills, and tailing dams that the erosion monitoring program will address. The landform design will be site specific to match end land use, mining methods, soil and spoil characteristics, soil and spoil handling, climatic conditions, and the local environmental conditions. Site maintenance requirements will need to be consistent with the agreed post-mining land use objectives. Proposed criteria to measure the success of landform stability are listed in **Table 7-4**.

Rehabilitation Objectives	Indicators	Success Criteria
Landform stability	Erosion rate	Erosion rates from disturbed areas and rehabilitated areas are comparable with reference (undisturbed) areas
	Slope stability	Highwalls in the final void and slopes on overburden landforms are geotechnically stable enough to maintain covers constructed for containment of hazardous material and for ecosystem support.
Water storages, creek diversions	Stable landform	Clean water storages and diversions to be stabilised and left as required. Dirty water storages to be cleaned out and rehabilitated to a stable non-polluting condition.
Vegetation	Resilience to disturbance	A perennial, self-sustaining ground cover is maintained that is resilient to environmental stresses such as fire, drought and pest species; is extensive enough to control erosion; and contributes to the integrity of constructed covers.
Land use	Infrastructure removal/retention	Predicted economics and /or benefits have been defined and agreed by the stakeholders. Buildings, water management structures, roads (except those used by the public) and other infrastructure have been removed unless stakeholders have entered into formal written agreements for their retention. Where practicable area accomplishes and remains as sustainable grazing.
	Beneficial use values of surface and groundwater	The interaction groundwater and surface water in the MDS Project area supports natural environmental values and beneficial land use values associated with the primary land use as beef cattle grazing land and secondary use for rainfed cropping.

#### 7.8 Disturbance Management

The MDS Project area has been cleared for beef cattle grazing land use and secondary land use for rainfed cropping. The location of the void is remote from land use constraints (SCL) and surface drainage. The overburden stockpile intersects with local ephemeral drainage lines. Avoiding stream lines in the placement of overburden in stockpiles adjacent to the pit will reduce risks to the receiving environment. Design of overburden stockpiles and other mine infrastructure needs to allow for a vegetated buffer and sediment and erosion controls on the local drainage system.

Outside the immediate vicinity of the pit, final void and the overburden stockpile, the rehabilitation objective is to return the land to the pre-development Agricultural Land Class.

The proposed rehabilitation objective for the pit, final void and overburden stockpile area (337 ha) will be the establishment of a native ecosystem, including revegetation with native flora, and consistent with Class D Agricultural Land Class. Grazing will be excluded from the rehabilitated pit and stockpile area.

#### 7.8.1 Topsoil Management Recommendations

Successful progressive rehabilitation will comprise topsoil management measures including:

- Placing and spreading topsoil material as it is stripped directly onto reshaped overburden stockpiles when mining sequences, equipment scheduling and weather conditions permit to avoid the requirement for stockpiling;
- A register of soils that have been stripped and stockpiled, which records date, location, volume, soil type and source location.
- Maintaining a maximum topsoil stockpile height of 2 m. Clay soils should be stored in lower stockpiles for shorter periods of time compared to sandy soils;

- Soil stockpiles surfaces will be roughened by ripping to promote aeration, infiltration and minimise erosion until vegetation is established;
- Sediment and erosion control measures will be implemented to for soil stockpiles to minimise soil loss from site and sedimentation off site;
- Stockpile batters will be constructed with a 3:1 slope to prevent reduce the risk of slope failure (slumping) and promote establishment of a protective cover crop vegetation;
- Seed and fertiliser will be applied to long term soil stockpiles (six months or longer), and an annual cover crop species that produce sterile florets or seeds will be sown;
- Develop and implement an erosion and sedimentation control plan that aims to mitigate identified sediment and erosion risks, propose strategies and techniques and monitor implementation during the mining operation.

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# 8.0 GLOSSARY

Term/Abbreviation	Description
AHD	Australian Height Datum.
ALC	Agricultural Land Classification identified in local government plans.
Alluvial soil	A soil that has accumulated by deposition of water-borne sediments (e.g. in a flood plain).
ASC	Australian Soil Classification according to Isbell 1996.
Basalt	Igneous rock formed at the land surface from cooling magma.
CEC	Cation Exchange Capacity usually expressed in meq/100g.
Chromosol	Soils with a clear or abrupt textural B horizon and in which the major part of the upper 0.2 m of the B2 horizon is not strongly acid.
Colluvial soil	A soil that has accumulated by the downslope deposition of materials moved by water from progressive weathering and erosion of the upper slopes.
Cutans	Illuvial clay coatings on the soil structure or fabric in sub- soil horizons that result from soil forming processes. Distinguished from stress cutans, or slickensides, described below.
DCDB	Digital Cadastral Data Base. Map base showing the location of all Lots on Registered Plans.
Dermosols	Soils with B2 horizons that have structure more developed than weak throughout the major part of the horizon.
Duricrust	An indurated layer exposed at the land surface that is resistant to dissolution and dispersion by water.
EPC	Exploration Permit Coal.
ERD	Effective Rooting Depth.
ESCP	Erosion and Sediment Control Plan.
ESP	Exchangeable Sodium Percentage - exchangeable sodium cation concentration expressed as a percentage of the total exchangeable cations.
Gley Colour	Soil colour with hues of blue, bluish-green, green, greenish-yellow or purplish-blue. Gley colours typically occur in wetland soils or soils which experience extended periods of waterlogging.

Term/Abbreviation	Description
GQAL	Good Quality Agricultural Land is land that is capable of sustainable use for broadacre agriculture, either crop or animal production but excluding intensive animal or horticultural land use. GQAL is recognised under the planning guidelines administered by local government.
Hardpan	A subsurface soil horizon having higher bulk density, lower total porosity, and lower permeability to both air and water than horizons directly above and below as a result of cultivation practices.
Lcm	Loose cubic metres – calculated volume in stockpiles from in-ground volume, rock density and decompaction a factor.
Lenticular structure	A natural aggregation of soil particles arranged around an elliptical or circular plane and bounded by curved faces with much accommodation to the faces of adjoining peds. They are often wedge-shaped and show prominent slickensides.
Mesa	An isolated flat-topped hill with steep sides, found in landscapes with horizontal strata.
MDL	Mining Development Lease.
Mtpa	Million tonnes per annum.
PAWC	Plant Available Water retained between -0.3 and 15 bar in the root zone.
Ped	The basic unit of soil structural organisation formed from aggregation of primary soil particles (sand, silt and clay) as a result of biological, chemical or physical soil forming processes.
Primary Media	The upper-most layer of soil placed over the rehabilitation area. In most situations it will be up to 30 cm deep and will consist of the surface soil material existing prior to mining.
Redoximorphic features	Gley colours, mottles and segregations that form in the soil profile from prolonged reducing conditions caused by waterlogging. These features are diagnostic for wetness constraints to land use.
Regolith	The zone comprising soil, sediments and weathered bedrock.
SCL	Strategic Cropping Land representing the state's best cropping land and is defined under the <i>Strategic Cropping Land Act</i> 2011 which came into effect on 30 January 2012.
Secondary Media	The lower-most layer of soil material placed directly in contact with overburden or other spoil material. It may include weathered material from below the soil. Depth of

Term/Abbreviation	Description
	placement will vary depending on how suitable or otherwise the overburden or spoil material may be to plant growth.
Silcrete	A strongly indurated siliceous layer that forms by the weathering of rock and the subsequent re-deposition within the regolith of silica mixed with iron and other mineral oxides. Often appears as an exposed or duricrust landform following weathering and erosion of the softer overlying materials. Very brittle and resistant to further weathering.
Slickensides	Stress cutans that form in cracking clay subsoils as a result of differential movement due to the wetting and drying of swelling clay minerals. These cutans are associated with lenticular ped structure in the subsoil.
Sodic	Soil material with an ESP greater than 6%.
Sodosol	Soils with a clear or abrupt textural B horizon and in which the major part of the upper 0.2 m of the B2 horizon is sodic and is not strongly sub-plastic.
Soil horizon	Diagnostic layer in a soil profile derived from parent material or substrate due to chemical, physical and biological soil forming processes.
Soil profile	Sequence of soil horizons overlying parent material or substrate at 1.5 m depth.
Tenosol	Soils with no pedologic organisation other than an A horizon and with a range of other attributes that do not fit the more defined soil orders.
TMP	Topsoil Management Plan.
UMA	Unique Map Area – describes a map unit in regional survey reporting for which specific information is contained in a database that details a range of properties for the soils, landforms and land use limitations of that map unit.
Vertosol	Soils that have more than 35% clay throughout the profile; that have defined cracking through to the surface or to the base of a plough layer at some time in most years; and that at some depth in the profile have slickensides or lenticular structure.

# 9.0 LIMITATIONS

GSS Environmental has prepared this report for a project that lies wholly within EPC1517, Dawson Highway, Rolleston in accordance with their proposal and acceptance received from Endocoal on 10 October 2011. The report is provided for the exclusive use of McCollum Environmental Management Services for this project only and for the purpose(s) described in the report. It should not be used for other projects. In preparing this report GSS Environmental has necessarily relied upon information provided by the client and/or their agents.

The results provided in the report are indicative of the sub-surface conditions only at the specific sampling or testing locations, and then only to the depths investigated and at the time the work was carried out. Sub-surface conditions can change abruptly due to variable geological processes and also as a result of anthropogenic influences. Such changes may occur after GSS Environmental's field testing has been completed.

GSS Environmental's advice is based upon the conditions encountered during this investigation. The accuracy of the advice provided by GSS Environmental in this report may be limited by undetected variations in ground conditions between sampling locations. The advice may also be limited by budget constraints imposed by others or by site accessibility.

This report must be read in conjunction with all of the attached notes and should be kept in its entirety without separation of individual pages or sections. GSS Environmental cannot be held responsible for interpretations or conclusions made by others unless they are supported by an expressed statement, interpretation, outcome or conclusion given in this report.

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## **11.0 APPENDICES**

# Appendix 1

## **Soil Laboratory Results**

#### Field site number. as per ALS Laboratory Equivalent site number used in this report. Certificate of Analysis 001 **S**1 002 **S**2 004 **S**3 006 **S**4 007 **S**5 008 **S6** 009 **S**7 011 **S**8 012 **S**9 014 S10 034 S11 035 S12 036 S13 037 S14 S15 038 040 S16 041 S17

#### Soil Site Sampling Location Number Conversion Table

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te number : BN/355/12 te report supersedes any previous report(s) wi ase.		Issue Date	: 15-JUN-2012
te number : BN/355/12 report supersedes any previous report(s) wi ase.		No. of samples received	
report supersedes any previous report(s) with ase.		No. of samples analysed	: 67
	h this reference. Results apply	to the sample(s) as submitted.	All pages of this report have been checked and app
<ul> <li>Certificate of Analysis contains the following inform</li> <li>General Comments</li> <li>Analytical Results</li> </ul>	ation:		
NATA Accredited Laboratory 825	Signatories	dectronically signed by the author	rized signatories indicated helow Flectronic signing h
Accredited for compliance with	carried out in compliance with pro	ocedures specified in 21 CFR Part 11.	
ISO/IEC 17025.	Signatories	Position	Accreditation Category
	Kim McCabe	Senior Inorganic Chem	st Brisbane Inorganics
	Stephen Hislop	Senior Inorganic Chemi	st Brisbane Inorganics

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# **General Comments**

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society. LOR = Limit of reporting Key:

A = This result is computed from individual analyte detections at or above the level of reporting

- ED021 (Bicarbonate Extractable K) Particular samples required dilution prior to analysis due to matrix interferences. LOR values have been adjusted accordingly.
- Subcontracted analysis reported in this work order is conducted by Soil Conservation Service. Soil Conservation Service does not hold NATA Accreditation for these parameters. •

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# **Analytical Results**

			L					
sub-Matrix: SOIL		Clie	nt sample ID	C-007 - 0.0-0.1	C-007 - 0.1-0.2	C-007 - 0.2-0.3	C-007 - 0.3-0.4	C-007 - 0.4-0.5
	Cli	ent samplin	g date / time	23-MAY-2012 15:00				
Compound	CAS Number	LOR	Unit	EB1213989-001	EB1213989-002	EB1213989-003	EB1213989-004	EB1213989-005
EA002 : pH (Soils)								
pH Value		0.1	pH Unit	7.3	7.3	7.7	7.8	7.9
EA010: Conductivity						-		
Electrical Conductivity @ 25°C		-	µS/cm	25	56	26	42	43
EA055: Moisture Content							-	
Moisture Content (dried @ 103°C)	-	1.0	%	29.9	28.9	28.2	27.4	27.5
ED002: Exchangeable Soil Acids								
Exchangeable Soil Acids	-	0.1	meq/100g	3.4		2.4		
ED007: Exchangeable Cations								
Exchangeable Calcium		0.1	meq/100g	55.9		55.1		
Exchangeable Magnesium		0.1	meq/100g	10.5		9.6		
Exchangeable Potassium		0.1	meq/100g	0.5		0.2		
Exchangeable Sodium	1	0.1	meq/100g	0.1		0.3		
Cation Exchange Capacity		0.1	meq/100g	67.1		65.2		
ED021: Bicarbonate Extractable Potassium	(Colwell)							
Bicarbonate Extractable K (Colwell)		10	mg/kg	<200				
ED040: Sulfur as SO4 2-								
Sulfate as SO4 2-	14808-79-8	100	mg/kg	220				
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)		0.01	%	<0.01		<0.01		
ED045G: Chloride Discrete analyser								
Chloride	16887-00-6	10	mg/kg	<10	<10	<10	<10	<10
ED093S: Soluble Major Cations								
Potassium	7440-09-7	10	mg/kg	<10		<10		
EG005T: Total Metals by ICP-AES								
Aluminium	7429-90-5	50	mg/kg	31200	-			
Boron	7440-42-8	50	mg/kg	<50	-			
Copper	7440-50-8	5	mg/kg	44				
Iron	7439-89-6	50	mg/kg	49100				
Manganese	7439-96-5	5	mg/kg	1920				
Molybdenum	7439-98-7	2	mg/kg	<2				
Zinc	7440-66-6	5	mg/kg	48				
EK059G: Nitrite plus Nitrate as N (NOx) by	Discrete Anal	lyser						
Nitrite + Nitrate as N (Sol.)	-	0.1	mg/kg	0.6	-			
EK061G: Total Kjeldahl Nitrogen By Discret	e Analyser							
4 of 24	EB1213989	<b>GSS ENVIRONMENTAL</b>	MEM08-001					
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Sub-Matrix: SOIL	CI	ient sample ID	C-007 - 0.0-0.1	C-007 - 0.1-0.2	C-007 - 0.2-0.3	C-007 - 0.3-0.4	C-007 - 0.4-0.5
Q	lient sampl	ing date / time	23-MAY-2012 15:00				
Compound CAS Number	LOR	Unit	EB1213989-001	EB1213989-002	EB1213989-003	EB1213989-004	EB1213989-005
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser - (	Continued						
Total Kjeldahl Nitrogen as N	20	mg/kg	1040				
EK062: Total Nitrogen as N (TKN + NOx)							
Total Nitrogen as N	20	mg/kg	1040				
EK067G: Total Phosphorus as P by Discrete Analyser							
Total Phosphorus as P	2	mg/kg	376		283		
EP003: Total Organic Carbon (TOC) in Soil							
Total Organic Carbon	0.02	%	1.73				
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ub-Matrix: SOIL		Clier	it sample ID	C-007 - 0.5-0.6	C-007 - 0.6-0.7	C-002 - 0.0-0.1	C-002 - 0.1-0.2	C-002 - 0.2-0.3
	Client	sampling	g date / time	23-MAY-2012 15:00				
Compound	CAS Number	LOR	Unit	EB1213989-006	EB1213989-007	EB1213989-011	EB1213989-012	EB1213989-013
EA002 : pH (Soils)								
pH Value		0.1	pH Unit	8.8	8.8	7.3	7.6	7.6
EA010: Conductivity								
Electrical Conductivity @ 25°C		1	µS/cm	76	76	27	39	37
EA055: Moisture Content								
Moisture Content (dried @ 103°C)		1.0	%	18.4	16.9	22.9	24.7	22.1
ED002: Exchangeable Soil Acids								
Exchangeable Soil Acids		0.1	meq/100g		0.6	2.6		
ED007: Exchangeable Cations								
Exchangeable Calcium	-	0.1	meq/100g		47.0	28.7		
Exchangeable Magnesium		0.1	meq/100g		5.4	16.8		
Exchangeable Potassium		0.1	meq/100g		<0.1	0.5		
Exchangeable Sodium		0.1	meq/100g		0.4	0.1		
Cation Exchange Capacity	1	0.1	meq/100g		52.9	46.2		
ED021: Bicarbonate Extractable Potassium	n (Colwell)							
Bicarbonate Extractable K (Colwell)		10	mg/kg			<200		
ED040: Sulfur as SO4 2-								
Sulfate as SO4 2-	14808-79-8	100	mg/kg			260		
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)		0.01	%		<0.01	<0.01		
ED045G: Chloride Discrete analyser								
Chloride	16887-00-6	10	mg/kg	<10	<10	<10	<10	<10
ED093S: Soluble Major Cations								
Potassium	7440-09-7	10	mg/kg		<10	<10		
EG005T: Total Metals by ICP-AES								
Aluminium	7429-90-5	50	mg/kg			22800		
Boron	7440-42-8	50	mg/kg			<50		
Copper	7440-50-8	5	mg/kg			42		
Iron	7439-89-6	50	mg/kg		-	38600		
Manganese	7439-96-5	5	mg/kg			1360		
Molybdenum	7439-98-7	2	mg/kg		1	<2		
Zinc	7440-66-6	5	mg/kg			27		
EK059G: Nitrite plus Nitrate as N (NOx) by	y Discrete Analys	er						
Nitrite + Nitrate as N (Sol.)		0.1	mg/kg			0.6		-
EK061G: Total Kjeldahl Nitrogen By Discre	ete Analyser							

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Sub-Matrix: SOIL	0	lient sample ID	C-007 - 0.5-0.6	C-007 - 0.6-0.7	C-002 - 0.0-0.1	C-002 - 0.1-0.2	C-002 - 0.2-0.3
	Client sam	oling date / time	23-MAY-2012 15:00				
Compound CAS Numbe	r LOR	Unit	EB1213989-006	EB1213989-007	EB1213989-011	EB1213989-012	EB1213989-013
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser	- Continue	π					
Total Kjeldahl Nitrogen as N	- 20	mg/kg			930		
EK062: Total Nitrogen as N (TKN + NOx)							
Total Nitrogen as N	- 20	mg/kg			930		
EK067G: Total Phosphorus as P by Discrete Analyser	-						
Total Phosphorus as P	12	mg/kg		750	232		
EP003: Total Organic Carbon (TOC) in Soil							
Total Organic Carbon	0.02	%			1.60		
	-	-					

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tub-Matrix: SOIL		Clie	nt sample ID	C-002 - 0.3-0.4	C-002 - 0.4-0.5	C-002 - 0.5-0.6	C-002 - 0.6-0.7	C-002 - 0.7-0.8	
	G	ient samplin	ig date / time	23-MAY-2012 15:00					
Compound	CAS Number	LOR	Unit	EB1213989-014	EB1213989-015	EB1213989-016	EB1213989-017	EB1213989-018	
EA002 : pH (Soils)									
pH Value		0.1	pH Unit	8.1	8.2	8.4	5.5	8.6	
EA010: Conductivity									
Electrical Conductivity @ 25°C		-	µS/cm	56	135	79	160	46	
EA055: Moisture Content									
Moisture Content (dried @ 103°C)	-	1.0	%	23.0	23.4	24.8	24.4	25.9	
ED002: Exchangeable Soil Acids									
Exchangeable Soil Acids		0.1	meq/100g	1.0			0.7	-	
ED007: Exchangeable Cations									
Exchangeable Calcium		0.1	meq/100g	32.2			33.6		
Exchangeable Magnesium		0.1	meq/100g	18.5			22.4		
Exchangeable Potassium		0.1	meq/100g	<0.1			<0.1		
Exchangeable Sodium		0.1	meq/100g	0.4			1.1		
Cation Exchange Capacity		0.1	meq/100g	51.2			57.2		
ED042T: Total Sulfur by LECO									
Sulfur - Total as S (LECO)		0.01	%	<0.01			<0.01		
ED045G: Chloride Discrete analyser									
Chloride	16887-00-6	10	mg/kg	<10	10	<10	<10	<10	
ED093S: Soluble Major Cations									
Potassium	7440-09-7	10	mg/kg	<10			<10		
EK067G: Total Phosphorus as P by Discre	ete Analyser								
Total Phosphorus as P		2	mg/kg	182			185	-	
		-							

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Sub-Matrix: SOIL		Client sample ID	C-002 - 0.8-0.9	C-002 - 0.9-1.0	C-001 - 0.0-0.1	C-001 - 0.1-0.2	C-001 - 0.2-0.3
	Client sa	Impling date / time	23-MAY-2012 15:00				
Compound CAS Nu	umber LOI	R Unit	EB1213989-019	EB1213989-020	EB1213989-025	EB1213989-026	EB1213989-027
EA002 : pH (Soils)							
pH Value	0.1	I pH Unit	8.6	8.7	7.0	7.4	7.4
EA010: Conductivity							
Electrical Conductivity @ 25°C	-	µS/cm	54	75	14	17	26
EA055: Moisture Content							
Moisture Content (dried @ 103°C)	1.0	%	24.0	13.6	21.0	22.1	24.8
ED002: Exchangeable Soil Acids							
Exchangeable Soil Acids	0.1	1 meq/100g		0.7	1.6		1.9
ED007: Exchangeable Cations							
Exchangeable Calcium	0.1	1 meq/100g		41.7	27.7		31.5
Exchangeable Magnesium	0.1	1 meq/100g		22.3	14.7		15.9
Exchangeable Potassium	0.1	1 meq/100g		<0.1	0.3		0.2
Exchangeable Sodium	0.1	l meq/100g		1.4	0.1		0.2
Cation Exchange Capacity	0.1	I meq/100g		65.4	42.8		47.9
ED021: Bicarbonate Extractable Potassium (Colwe	(						
Bicarbonate Extractable K (Colwell)	10	mg/kg			<200		
ED040: Sulfur as SO4 2-							
Sulfate as SO4 2- 14808	3-79-8 100	0 mg/kg			340		
ED042T: Total Sulfur by LECO							
Sulfur - Total as S (LECO)	0.0	1 %		<0.01	<0.01		<0.01
ED045G: Chloride Discrete analyser							
Chloride 16887	7-00-6 10	mg/kg	20	<10	<10	10	<10
ED093S: Soluble Major Cations							
Potassium 7440	-09-7 10	mg/kg		<10	<10		<10
EG005T: Total Metals by ICP-AES							
Aluminium 7429	)-90-5 50	mg/kg			26100		
Boron 7440	)-42-8 50	mg/kg			<50		
<b>Copper</b> 7440	)-50-8 5	mg/kg			45		
<b>Iron</b> 7439	9-89-6 50	mg/kg			47200		
Manganese 7439	9-96-5 5	mg/kg			1000		
Molybdenum 7439	9-98-7 2	mg/kg			<2		
Zinc 7440	)-66-6 5	mg/kg			38		
EK059G: Nitrite plus Nitrate as N (NOx) by Discret	te Analyser						
Nitrite + Nitrate as N (Sol.)	0.1	l mg/kg			0.7		
EK061G: Total Kjeldahl Nitrogen By Discrete Analy	/ser						

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Sub-Matrix: SOIL	U U	lient sample ID	C-002 - 0.8-0.9	C-002 - 0.9-1.0	C-001 - 0.0-0.1	C-001 - 0.1-0.2	C-001 - 0.2-0.3
	Client samp	ling date / time	23-MAY-2012 15:00				
Compound CAS Numbe	r LOR	Unit	EB1213989-019	EB1213989-020	EB1213989-025	EB1213989-026	EB1213989-027
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser	- Continued						
Total Kjeldahl Nitrogen as N	- 20	mg/kg			1100		
EK062: Total Nitrogen as N (TKN + NOx)	-				-		
Total Nitrogen as N	- 20	mg/kg			1100		
EK067G: Total Phosphorus as P by Discrete Analyser					-		
Total Phosphorus as P	- 2	mg/kg		425	369		302
EP003: Total Organic Carbon (TOC) in Soil	-				-		
Total Organic Carbon	- 0.02	%			1.70		
	-	-	-	-	-		



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ub-Matrix: SOIL		Clier	nt sample ID	C-001 - 0.3-0.4	C-001 - 0.4-0.5	C-001 - 0.5-0.6	C-001 - 0.6-0.7	C-011 - 0.0-0.1
	Cli	ent samplin	g date / time	23-MAY-2012 15:00				
Compound	CAS Number	LOR	Unit	EB1213989-028	EB1213989-029	EB1213989-030	EB1213989-031	EB1213989-036
EA002 : pH (Soils)								
pH Value		0.1	pH Unit	7.7	7.7	8.3	8.4	8.4
EA010: Conductivity								
Electrical Conductivity @ 25°C		-	µS/cm	29	21	91	27	75
EA055: Moisture Content								
Moisture Content (dried @ 103°C)		1.0	%	22.5	21.0	24.2	18.8	13.7
ED002: Exchangeable Soil Acids								
Exchangeable Soil Acids		0.1	meq/100g		1.6		0.8	0.3
ED007: Exchangeable Cations								
Exchangeable Calcium	-	0.1	meq/100g		35.3		31.5	33.0
Exchangeable Magnesium		0.1	meq/100g		14.9		12.7	9.3
Exchangeable Potassium		0.1	meq/100g	-	<0.1		<0.1	<0.1
Exchangeable Sodium		0.1	meq/100g	-	0.4		0.3	<0.1
Cation Exchange Capacity		0.1	meq/100g		50.7		44.6	42.5
ED021: Bicarbonate Extractable Potassium	n (Colwell)					-		
Bicarbonate Extractable K (Colwell)		10	mg/kg					<200
ED040: Sulfur as SO4 2-								
Sulfate as SO4 2-	14808-79-8	100	mg/kg					210
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)		0.01	%		<0.01		<0.01	<0.01
ED045G: Chloride Discrete analyser								
Chloride	16887-00-6	10	mg/kg	<10	<10	<10	<10	<10
ED093S: Soluble Major Cations								
Potassium	7440-09-7	10	mg/kg		<10		<10	<10
EG005T: Total Metals by ICP-AES								
Aluminium	7429-90-5	50	mg/kg	-				17400
Boron	7440-42-8	50	mg/kg					<50
Copper	7440-50-8	5	mg/kg					19
Iron	7439-89-6	50	mg/kg		-			31800
Manganese	7439-96-5	5	mg/kg					709
Molybdenum	7439-98-7	2	mg/kg					<2
Zinc	7440-66-6	Ð	mg/kg	-	1			26
EK059G: Nitrite plus Nitrate as N (NOx) by	y Discrete Anal	yser						
Nitrite + Nitrate as N (Sol.)		0.1	mg/kg	-				0.1
EK061G: Total Kjeldahl Nitrogen By Discre	ete Analyser							

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Sub-Matrix: SOIL	CI	ient sample ID	C-001 - 0.3-0.4	C-001 - 0.4-0.5	C-001 - 0.5-0.6	C-001 - 0.6-0.7	C-011 - 0.0-0.1
0	Client sampli	ing date / time	23-MAY-2012 15:00				
Compound CAS Number	LOR	Unit	EB1213989-028	EB1213989-029	EB1213989-030	EB1213989-031	EB1213989-036
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser -	Continued						
Total Kjeldahl Nitrogen as N	20	mg/kg					920
EK062: Total Nitrogen as N (TKN + NOx)							
Total Nitrogen as N	20	mg/kg					920
EK067G: Total Phosphorus as P by Discrete Analyser							
Total Phosphorus as P	2	mg/kg		1010		1180	291
EP003: Total Organic Carbon (TOC) in Soil							
Total Organic Carbon	0.02	%					1.07

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Sub-Matrix: SOIL		Clie	nt sample ID	C-011 - 0.1-0.2	C-011 - 0.2-0.3	C-011 - 0.3-0.4	C-011 - 0.4-0.5	C-011 - 0.5-0.6	
	Cli	ent samplin	g date / time	23-MAY-2012 15:00					
Compound	CAS Number	LOR	Unit	EB1213989-037	EB1213989-038	EB1213989-039	EB1213989-040	EB1213989-041	
EA002 : pH (Soils)									
pH Value		0.1	pH Unit	8.1	8.0	8.1	8.2	8.2	
EA010: Conductivity									
Electrical Conductivity @ 25°C		-	µS/cm	46	42	50	48	62	
EA055: Moisture Content						-			
Moisture Content (dried @ 103°C)		1.0	%	15.7	15.1	16.5	16.3	15.9	
ED002: Exchangeable Soil Acids						-			
Exchangeable Soil Acids		0.1	meq/100g		6.0				
ED007: Exchangeable Cations						-	-		
Exchangeable Calcium		0.1	meq/100g		21.2			ł	
Exchangeable Magnesium		0.1	meq/100g		11.3				
Exchangeable Potassium		0.1	meq/100g		<0.1				
Exchangeable Sodium		0.1	meq/100g		0.2				
Cation Exchange Capacity	1	0.1	meq/100g		32.8			-	
ED042T: Total Sulfur by LECO									
Sulfur - Total as S (LECO)		0.01	%		<0.01				
ED045G: Chloride Discrete analyser									
Chloride	16887-00-6	10	mg/kg	<10	<10	<10	<10	<10	
ED093S: Soluble Major Cations									
Potassium	7440-09-7	10	mg/kg		<10				
EK067G: Total Phosphorus as P by Discr	ete Analyser								
Total Phosphorus as P		2	mg/kg		207				

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ub-Matrix: SOIL		Clie	ent sample ID	C-011 - 0.6-0.7	C-011 - 0.7-0.8	C-011 - 0.8-0.9	C-011 - 0.9-1.0	C-011 - 1.0-1.1
	Cli	ent samplir	ng date / time	23-MAY-2012 15:00				
punoamo	CAS Number	LOR	Unit	EB1213989-042	EB1213989-043	EB1213989-044	EB1213989-045	EB1213989-046
5A002 : pH (Soils)								
pH Value		0.1	pH Unit	8.4	8.3	8.6	8.6	8.7
A010: Conductivity								
Electrical Conductivity @ 25°C		-	µS/cm	97	81	112	211	161
A055: Moisture Content								
Moisture Content (dried @ 103°C)		1.0	%	15.7	16.2	18.7	19.1	20.4
D002: Exchangeable Soil Acids								
Exchangeable Soil Acids		0.1	meq/100g	0.8				0.5
D007: Exchangeable Cations		-				-	-	
Exchangeable Calcium		0.1	meq/100g	20.4				47.9
Exchangeable Magnesium		0.1	meq/100g	14.6				27.6
Exchangeable Potassium		0.1	meq/100g	<0.1				<0.1
Exchangeable Sodium		0.1	meq/100g	0.8				2.0
Cation Exchange Capacity		0.1	meq/100g	35.9				77.6
D042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)		0.01	%	<0.01			-	<0.01
D045G: Chloride Discrete analyser								
Chloride	16887-00-6	10	mg/kg	<10	<10	<10	<10	10
D093S: Soluble Major Cations								
Potassium	7440-09-7	10	mg/kg	<10				<10
K067G: Total Phosphorus as P by Discret	te Analyser							
Total Phosphorus as P		2	mg/kg	160				265

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tub-Matrix: SOIL		Clie	nt sample ID	C-011 - 1.1-1.2	C-011 - 1.2-1.3	C-011 - 1.3-1.4	C-011 - 1.4-1.5	C-006 - 0.0-0.1
	CI	ent samplin	g date / time	23-MAY-2012 15:00				
Compound	CAS Number	LOR	Unit	EB1213989-047	EB1213989-048	EB1213989-049	EB1213989-050	EB1213989-055
EA002 : pH (Soils)								
pH Value		0.1	pH Unit	8.7	8.5	8.6	8.6	7.6
EA010: Conductivity								
Electrical Conductivity @ 25°C		~	µS/cm	311	352	407	392	53
EA055: Moisture Content								
Moisture Content (dried @ 103°C)		1.0	%	21.4	22.1	24.1	22.8	29.0
ED002: Exchangeable Soil Acids								
Exchangeable Soil Acids		0.1	meq/100g					3.4
ED007: Exchangeable Cations							•	
Exchangeable Calcium		0.1	meq/100g					47.4
Exchangeable Magnesium		0.1	meq/100g					20.0
Exchangeable Potassium		0.1	meq/100g					0.9
Exchangeable Sodium		0.1	meq/100g					0.1
Cation Exchange Capacity		0.1	meq/100g					68.5
ED021: Bicarbonate Extractable Potassium	ו (Colwell)						•	
Bicarbonate Extractable K (Colwell)		10	mg/kg					240
ED040: Sulfur as SO4 2-								
Sulfate as SO4 2-	14808-79-8	100	mg/kg					300
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)		0.01	%					<0.01
ED045G: Chloride Discrete analyser								
Chloride	16887-00-6	10	mg/kg	40	60	50	70	<10
ED093S: Soluble Major Cations								
Potassium	7440-09-7	10	mg/kg					<10
EG005T: Total Metals by ICP-AES								
Aluminium	7429-90-5	50	mg/kg					42900
Boron	7440-42-8	50	mg/kg		-			<50
Copper	7440-50-8	5	mg/kg					58
Iron	7439-89-6	50	mg/kg		-			69700
Manganese	7439-96-5	5	mg/kg					1250
Molybdenum	7439-98-7	2	mg/kg					<2
Zinc	7440-66-6	5	mg/kg					87
EK059G: Nitrite plus Nitrate as N (NOx) by	/ Discrete Ana	lyser						
Nitrite + Nitrate as N (Sol.)		0.1	mg/kg					0.3
EK061G: Total Kjeldahl Nitrogen By Discre	te Analyser							

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Sub-Matrix: SOIL		Client sample ID	C-011 - 1.1-1.2	C-011 - 1.2-1.3	C-011 - 1.3-1.4	C-011 - 1.4-1.5	C-006 - 0.0-0.1
	Client sam	npling date / time	23-MAY-2012 15:00				
Compound CAS Numb	er LOR	Unit	EB1213989-047	EB1213989-048	EB1213989-049	EB1213989-050	EB1213989-055
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser	- Continue	þé					
Total Kjeldahl Nitrogen as N	20	mg/kg					1140
EK062: Total Nitrogen as N (TKN + NOx)							
Total Nitrogen as N	20	mg/kg					1140
EK067G: Total Phosphorus as P by Discrete Analyser	-	-					
Total Phosphorus as P	- 2	mg/kg					1110
EP003: Total Organic Carbon (TOC) in Soil							
Total Organic Carbon	0.02	%					1.67
	-	-					

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ub-Matrix: SOIL		Clie	nt sample ID	C-006 - 0.1-0.2	C-006 - 0.2-0.3	C-006 - 0.3-0.4	C-006 - 0.4-0.5	C-006 - 0.5-0.6
	CI	ent samplin	g date / time	23-MAY-2012 15:00				
Compound	CAS Number	LOR	Unit	EB1213989-056	EB1213989-057	EB1213989-058	EB1213989-059	EB1213989-060
EA002 : pH (Soils)								
pH Value		0.1	pH Unit	7.2	7.5	7.8	7.8	8.1
EA010: Conductivity						-		
Electrical Conductivity @ 25°C		-	µS/cm	53	29	38	39	41
EA055: Moisture Content						-		
Moisture Content (dried @ 103°C)		1.0	%	29.0	29.0	27.9	27.0	23.1
ED002: Exchangeable Soil Acids						-		
Exchangeable Soil Acids		0.1	meq/100g			1.6		-
ED007: Exchangeable Cations						-		
Exchangeable Calcium		0.1	meq/100g			48.8		
Exchangeable Magnesium		0.1	meq/100g			19.1		
Exchangeable Potassium		0.1	meq/100g			0.3		
Exchangeable Sodium		0.1	meq/100g			0.3		-
Cation Exchange Capacity	-	0.1	meq/100g			68.5		-
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)		0.01	%			<0.01		
ED045G: Chloride Discrete analyser								
Chloride	16887-00-6	10	mg/kg	<10	<10	<10	<10	<10
ED093S: Soluble Major Cations								
Potassium	7440-09-7	10	mg/kg			<10		
EK067G: Total Phosphorus as P by Discret	e Analyser							
Total Phosphorus as P		2	mg/kg			1490		-

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ub-Matrix: SOIL	č	Clie '	nt sample ID	C-006 - 0.6-0.7	C-009 - 0.0-0.1	C-009 - 0.1-0.2	C-009 - 0.2-0.3	C-009 - 0.3-0.4
	Cie	ent samplin	g date / time	23-MAY-2012 15:00	23-MAY-2012 15:00	23-MAY-2012 15:00	Z3-MAY-Z012 15:00	Z3-MAY-Z012 15:00
Compound	CAS Number	LOR	Unit	EB1213989-061	EB1213989-065	EB1213989-066	EB1213989-067	EB1213989-068
EA002 : pH (Soils)								
pH Value		0.1	pH Unit	8.2	7.3	7.3	7.6	7.8
EA010: Conductivity						-	-	
Electrical Conductivity @ 25°C		-	µS/cm	35	33	31	33	47
EA055: Moisture Content						-	-	
Moisture Content (dried @ 103°C)		1.0	%	14.4	27.3	28.7	26.0	26.2
ED002: Exchangeable Soil Acids								
Exchangeable Soil Acids		0.1	meq/100g	1.5	2.4			1.8
ED007: Exchangeable Cations								
Exchangeable Calcium		0.1	meq/100g	43.8	42.3			48.3
Exchangeable Magnesium		0.1	meq/100g	14.7	19.3			19.8
Exchangeable Potassium		0.1	meq/100g	0.2	1.6			0.2
Exchangeable Sodium		0.1	meq/100g	0.4	0.1			0.3
Cation Exchange Capacity		0.1	meq/100g	59.0	63.3			68.7
ED021: Bicarbonate Extractable Potassium	ו (Colwell)					-		
Bicarbonate Extractable K (Colwell)		10	mg/kg		390			
ED040: Sulfur as SO4 2-								
Sulfate as SO4 2-	14808-79-8	100	mg/kg		220			
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)		0.01	%	<0.01	<0.01			<0.01
ED045G: Chloride Discrete analyser								
Chloride	16887-00-6	10	mg/kg	<10	<10	<10	<10	<10
ED093S: Soluble Major Cations								
Potassium	7440-09-7	10	mg/kg	<10	<10			<10
EG005T: Total Metals by ICP-AES								
Aluminium	7429-90-5	50	mg/kg		36600			
Boron	7440-42-8	50	mg/kg		<50			
Copper	7440-50-8	£	mg/kg		46			
Iron	7439-89-6	50	mg/kg		50500			
Manganese	7439-96-5	5	mg/kg		1620			
Molybdenum	7439-98-7	2	mg/kg		<2			
Zinc	7440-66-6	Ð	mg/kg		60			
EK059G: Nitrite plus Nitrate as N (NOx) by	/ Discrete Anal	yser						
Nitrite + Nitrate as N (Sol.)		0.1	mg/kg		2.7			
EK061G: Total Kjeldahl Nitrogen By Discre	te Analyser							

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Sub-Matrix: SOIL	U	Client sample ID	C-006 - 0.6-0.7	C-009 - 0.0-0.1	C-009 - 0.1-0.2	C-009 - 0.2-0.3	C-009 - 0.3-0.4
	Client sam	oling date / time	23-MAY-2012 15:00				
Compound CAS Numbe	er LOR	Unit	EB1213989-061	EB1213989-065	EB1213989-066	EB1213989-067	EB1213989-068
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser	- Continue	p					
Total Kjeldahl Nitrogen as N	20	mg/kg		1310			
EK062: Total Nitrogen as N (TKN + NOx)							
Total Nitrogen as N	20	mg/kg		1310			
EK067G: Total Phosphorus as P by Discrete Analyser							
Total Phosphorus as P	- 2	mg/kg	1260	590			452
EP003: Total Organic Carbon (TOC) in Soil							
Total Organic Carbon	0.02	%		1.62			

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ub-Matrix: SOIL	č	Clie Clie	nt sample ID	C-009 - 0.4-0.5	C-009 - 0.5-0.6	C-012 - 0.0-0.1	C-012 - 0.1-0.2	C-012 - 0.2-0.3
	5		d date / III.ie	00.01 21 02-14141-02	00.61 2102-1414-62	00.01 ZI 0Z-1 KINI-0Z	00.01 2102-1414-02	00.01 2102-1414-02
Compound	CAS Number	LOR	Unit	EB1213989-069	EB1213989-070	EB1213989-075	EB1213989-076	EB1213989-077
EA002 : pH (Soils)								
pH Value		0.1	pH Unit	8.1	8.2	6.9	7.0	7.1
EA010: Conductivity					-			
Electrical Conductivity @ 25°C		~	µS/cm	59	104	35	29	19
EA055: Moisture Content								
Moisture Content (dried @ 103°C)		1.0	%	24.3	24.8	19.3	22.3	22.8
ED002: Exchangeable Soil Acids								
Exchangeable Soil Acids		0.1	meq/100g		0.8	2.7		2.2
ED007: Exchangeable Cations								
Exchangeable Calcium		0.1	meq/100g		49.5	23.5		36.3
Exchangeable Magnesium		0.1	meq/100g		13.6	6.4		7.6
Exchangeable Potassium	1	0.1	meq/100g		0.2	2.2		2.3
Exchangeable Sodium		0.1	meq/100g		0.4	<0.1		0.1
Cation Exchange Capacity		0.1	meq/100g		63.6	32.2		46.4
ED021: Bicarbonate Extractable Potassium	ו (Colwell)							
Bicarbonate Extractable K (Colwell)		10	mg/kg			720		
ED040: Sulfur as SO4 2-								
Sulfate as SO4 2-	14808-79-8	100	mg/kg			520		
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)		0.01	%		<0.01	<0.01		<0.01
ED045G: Chloride Discrete analyser								
Chloride	16887-00-6	10	mg/kg	<10	<10	<10	<10	<10
ED093S: Soluble Major Cations								
Potassium	7440-09-7	10	mg/kg	-	<10	30		10
EG005T: Total Metals by ICP-AES								
Aluminium	7429-90-5	50	mg/kg			25600		
Boron	7440-42-8	50	mg/kg			<50		
Copper	7440-50-8	5	mg/kg			48		
Iron	7439-89-6	50	mg/kg			77200		
Manganese	7439-96-5	5	mg/kg			1430		
Molybdenum	7439-98-7	2	mg/kg		1	<2		
Zinc	7440-66-6	5	mg/kg	-		78		
EK059G: Nitrite plus Nitrate as N (NOx) by	/ Discrete Ana	lyser						
Nitrite + Nitrate as N (Sol.)		0.1	mg/kg			0.3		
EK061G: Total Kjeldahl Nitrogen By Discre	te Analyser							

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Sub-Matrix: SOIL	G	lient sample ID	C-009 - 0.4-0.5	C-009 - 0.5-0.6	C-012 - 0.0-0.1	C-012 - 0.1-0.2	C-012 - 0.2-0.3
O	lient samp	ling date / time	23-MAY-2012 15:00				
Compound CAS Number	LOR	Unit	EB1213989-069	EB1213989-070	EB1213989-075	EB1213989-076	EB1213989-077
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser - (	Continued	_					
Total Kjeldahl Nitrogen as N	20	mg/kg			2210		
EK062: Total Nitrogen as N (TKN + NOx)					-		
<sup>A</sup> Total Nitrogen as N	20	mg/kg			2210		
EK067G: Total Phosphorus as P by Discrete Analyser							
Total Phosphorus as P	7	mg/kg		537	1460		976
EP003: Total Organic Carbon (TOC) in Soil					-		
Total Organic Carbon	0.02	%			2.72		

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bub-Matrix: SOIL		Clier	nt sample ID	C-012 - 0.3-0.4	C-012 - 0.4-0.5	C-012 - 0.5-0.6	C-004 - 0.0-0.1	C-004 - 0.1-0.2
	Clie	ent sampling	g date / time	23-MAY-2012 15:00				
Compound CA	S Number	LOR	Unit	EB1213989-078	EB1213989-079	EB1213989-080	EB1213989-084	EB1213989-085
EA002 : pH (Soils)								
pH Value	-	0.1	pH Unit	7.4	7.5	7.9	7.0	6.8
EA010: Conductivity								
Electrical Conductivity @ 25°C		-	µS/cm	40	38	21	58	15
EA055: Moisture Content								
Moisture Content (dried @ 103°C)	1	1.0	%	25.4	14.8	17.5	13.6	16.1
ED002: Exchangeable Soil Acids								
Exchangeable Soil Acids	-	0.1	meq/100g	-		1.2	2.8	
ED007: Exchangeable Cations								
Exchangeable Calcium		0.1	meq/100g			24.8	18.6	
Exchangeable Magnesium		0.1	meq/100g			4.5	7.9	
Exchangeable Potassium		0.1	meq/100g			0.7	0.4	
Exchangeable Sodium		0.1	meq/100g			0.2	<0.1	
Cation Exchange Capacity	1	0.1	meq/100g			30.2	27.0	
ED021: Bicarbonate Extractable Potassium (Cd	olwell)							
Bicarbonate Extractable K (Colwell)	-	10	mg/kg		-		<200	
ED040: Sulfur as SO4 2-								
Sulfate as SO4 2-	4808-79-8	100	mg/kg				370	
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)		0.01	%			<0.01	<0.01	
ED045G: Chloride Discrete analyser								
Chloride	6887-00-6	10	mg/kg	<10	<10	<10	<10	<10
ED093S: Soluble Major Cations								
Potassium	7440-09-7	10	mg/kg			<10	10	
EG005T: Total Metals by ICP-AES								
Aluminium	7429-90-5	50	mg/kg				15000	
Boron	7440-42-8	50	mg/kg	1			<50	
Copper	7440-50-8	5	mg/kg				34	
Iron	7439-89-6	50	mg/kg		-		37900	
Manganese	7439-96-5	5	mg/kg			-	1140	
Molybdenum	7439-98-7	2	mg/kg		1		<2	
Zinc	7440-66-6	5	mg/kg				33	
EK059G: Nitrite plus Nitrate as N (NOx) by Dis	screte Analy	yser						
Nitrite + Nitrate as N (Sol.)	-	0.1	mg/kg			-	1.1	
EK061G: Total Kjeldahl Nitrogen By Discrete A	nalyser							

: 22 of 24	; EB1213989	<b>GSS ENVIRONMENTAL</b>	: MEM08-001
Page	Work Order	Client	Project



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Sub-Matrix: SOIL		Client sample ID	C-012 - 0.3-0.4	C-012 - 0.4-0.5	C-012 - 0.5-0.6	C-004 - 0.0-0.1	C-004 - 0.1-0.2
	Client san	npling date / time	23-MAY-2012 15:00				
Compound CAS Numbe	r LOF	c Unit	EB1213989-078	EB1213989-079	EB1213989-080	EB1213989-084	EB1213989-085
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser	- Continu	ed					
Total Kjeldahl Nitrogen as N	- 20	mg/kg				1810	
EK062: Total Nitrogen as N (TKN + NOx)							
Total Nitrogen as N	- 20	mg/kg				1810	
EK067G: Total Phosphorus as P by Discrete Analyser							
Total Phosphorus as P	- 7	mg/kg			698	469	
EP003: Total Organic Carbon (TOC) in Soil							
Total Organic Carbon	- 0.02	%				1.38	
	_	-					

: 23 of 24	: EB1213989	: GSS ENVIRONMENTAL	: MEM08-001
Page	Work Order	Client	Project



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ub-Matrix: SOIL		Clie	nt sample ID	C-004 - 0.2-0.3	C-004 - 0.3-0.4	C-004 - 0.4-0.5	C-004 - 0.5-0.6	C-004 - 0.6-0.7
	CI	ent samplin	ig date / time	23-MAY-2012 15:00				
Compound	CAS Number	LOR	Unit	EB1213989-086	EB1213989-087	EB1213989-088	EB1213989-089	EB1213989-090
EA002 : pH (Soils)								
pH Value		0.1	pH Unit	6.8	7.0	7.1	7.2	7.4
EA010: Conductivity								
Electrical Conductivity @ 25°C		-	µS/cm	11	12	15	27	30
EA055: Moisture Content						-		
Moisture Content (dried @ 103°C)		1.0	%	17.1	19.5	21.0	21.7	22.8
ED002: Exchangeable Soil Acids						-		
Exchangeable Soil Acids		0.1	meq/100g		3.0			
ED007: Exchangeable Cations						-	-	
Exchangeable Calcium		0.1	meq/100g		19.1			
Exchangeable Magnesium		0.1	meq/100g		9.4			
Exchangeable Potassium		0.1	meq/100g		<0.1			-
Exchangeable Sodium		0.1	meq/100g		0.2			l
Cation Exchange Capacity	-	0.1	meq/100g		28.8			l
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)		0.01	%		<0.01			
ED045G: Chloride Discrete analyser								
Chloride	16887-00-6	10	mg/kg	<10	<10	<10	<10	<10
ED093S: Soluble Major Cations								
Potassium	7440-09-7	10	mg/kg		<10			
EK067G: Total Phosphorus as P by Discre	ete Analyser							
Total Phosphorus as P		2	mg/kg		215			





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ub-Matrix: SOIL		Clie	nt sample ID	C-004 - 0.7-0.8	C-004 - 0.8-0.9		-	
	CI	ent samplir	ig date ∕ time	23-MAY-2012 15:00	23-MAY-2012 15:00	-		
Compound	CAS Number	LOR	Unit	EB1213989-091	EB1213989-092			
EA002 : pH (Soils)								
pH Value		0.1	pH Unit	7.7	8.0			
EA010: Conductivity								
Electrical Conductivity @ 25°C	-	-	µS/cm	23	30	-		
EA055: Moisture Content								
Moisture Content (dried @ 103°C)		1.0	%	21.8	22.8			
ED002: Exchangeable Soil Acids								
Exchangeable Soil Acids		0.1	meq/100g	1.6		-		
ED007: Exchangeable Cations								
Exchangeable Calcium		0.1	meq/100g	38.5				
Exchangeable Magnesium		0.1	meq/100g	17.8	-	-	-	-
Exchangeable Potassium		0.1	meq/100g	<0.1				
Exchangeable Sodium		0.1	meq/100g	0.9				
Cation Exchange Capacity		0.1	meq/100g	57.3		-		
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)		0.01	%	<0.01				
ED045G: Chloride Discrete analyser								
Chloride	16887-00-6	10	mg/kg	<10	<10			
ED093S: Soluble Major Cations								
Potassium	7440-09-7	10	mg/kg	<10				
EK067G: Total Phosphorus as P by Disc	crete Analyser							
Total Phosphorus as P		2	mg/kg	267				
				-	-	-	-	-



Experienced people protecting your resources

709 Gundy Road, Scone NSW 2337 PO Box 283, Scone NSW 2337 P: 02 6545 1666 F: 02 6545 2520 M: 0408 446 132

Australian Laboratory Services 32 Shand Street Stafford Qld 4053

17 July 2012

SCO12/174R1

Dear Sir/Madam

### Soil erodibility factor – Twenty eight soil samples (EB1213989)

The soil erodibility factor (K factor) has been determined (as described by Rosewell 1993) for soil test report SCO12/174R1 (Ref: 1213989) using the particle size analysismechanical dispersion (clay, silt, fine sand, coarse sand and gravel) and the organic carbon (OC). The surface soil structure was assumed to be medium granular and the profile permeability was assumed to be slow to moderate.

Lab No	Sample Id	K factor	Rating
1	8	0.019	Low
2	9	0.020	Low
3	10	0.018	Low
4	21	0.020	Moderate
5	22	0.025	Moderate
6	23	0.025	Moderate
7	24	0.028	Moderate
8	32	0.025	Moderate
9	33	0.026	Moderate
10	34	0.034	Moderate
11	35	0.038	Moderate
12	51	0.027	Moderate
13	52	0.036	Moderate
14	53	0.032	Moderate
15	54	0.029	Moderate
16	62	0.020	Moderate
17	63	0.022	Moderate
18	64	0.033	Moderate
19	71	0.021	Moderate
20	72	0.020	Moderate
21	73	0.019	Low
22	74	0.018	Low
23	81	0.041	High
24	82	0.030	Moderate
25	83	0.025	Moderate
26	93	0.024	Moderate
27	94	0.021	Moderate
28	95	0.031	Moderate

This interpretation was based on the soil samples being representative, and literature guidelines. If you have any queries, please contact me on (02) 6545 1666.

Yours sincerely

SRJaury

SR Young

### References

Rosewell CJ (1993) Soiloss – A program to assist in the selection of management practices to reduce erosion. Department of Conservation and Land Management.



### SOIL TEST REPORT

Page 1 of 3

Scone Research Centre

REPORT NO:	SCO12/174R1
REPORT TO:	Australian Laboratory Services 32 Shand Street Stafford Qld 4053
REPORT ON:	Twenty eight soil samples Ref: EB1213989
REPORT STATUS:	Preliminary
DATE REPORTED:	17 July 2012
METHODS:	Information on test procedures can be obtained from Scone Research Centre

TESTING CARRIED OUT ON SAMPLE AS RECEIVED THIS DOCUMENT MAY NOT BE REPRODUCED EXCEPT IN FULL

SKJaury

SR Young (Laboratory Manager)

SOIL CONSERVATION SERVICE Scone Research Service Centre

> Report No: Client Reference:

SCO12/174R1 (Preliminary) Australian Laboratory Services 32 Shand Street Stafford Qld 4053

	Method		P7B/2 Part	icle Size A	nalysis (%		P7C/2	Particle Si	ze Analysi	s – mech d	is (%)	P9B/2	C6A/2	Col	our
	Sample Id	clay	silt	f sand	c sand	gravel	clay	silt	f sand	c sand	gravel	EAT	OC (%)	Dry	Moist
1	8	75	17	9	2	0	51	20	16	13	0	5	1.44	10YR2/2	10YR2/1
2	6	79	15	4	2	0	50	20	16	14	0	5	1.22	10YR2/2	10YR2/1
3	10	21	10	8	20	41	18	12	8	21	41	4	0.46	10YR5/3	10YR3/3
4	21	57	14	12	12	5	37	17	15	26	5	5	1.33	10YR3/2	10YR2/2
5	22	65	13	11	10	1	34	16	23	26	1	4	0.87	10YR3/2	10YR2/1
6	23	64	13	10	12	1	39	21	18	21	1	4	0.71	10YR3/1	10YR2/1
7	24	45	15	15	22	3	35	24	17	21	3	4	09.0	10YR4/2	10YR3/2
8	32	50	14	17	19	$\leq$	34	20	21	25	$\leq 1$	5	1.71	10YR3/2	10YR3/2
6	33	56	16	15	13	0	36	20	21	23	0	5	1.08	10YR4/3	10YR3/3
10	34	29	16	23	32	0	22	23	19	36	0	5	0.65	10YR5/4	10YR3/4
11	35	13	13	25	49	0	6	18	22	51	0	4	0.22	10YR6/3	10YR4/4
12	51	41	11	28	20	$\leq$	28	14	29	29	$\overline{\nabla}$	5	1.37	10YR3/2	10YR3/2
13	52	43	12	25	20	$\leq$	23	15	35	27	<1	5	69.0	10YR3/4	10YR3/3
14	53	45	10	24	20	1	30	17	29	23	1	5	0.51	10YR3/3	10YR3/3
15	54	53	10	19	17	1	34	16	27	22	1	4	0.47	10YR4/2	10YR3/2

SRYaung

Page 2 of 3

Page 3 of 3

### SOIL CONSERVATION SERVICE Scone Research Service Centre

Report No: Client Reference:

SCO12/174R1 (Preliminary) Australian Laboratory Services 32 Shand Street Stafford Qld 4053

Lab No	Method		P7B/2 Part	icle Size A	nalysis (%)		P7C/2	Particle Si	ze Analysi	s – mech c	lis (%)	P9B/2	C6A/2	Col	our
	Sample Id	clay	silt	f sand	c sand	gravel	clay	silt	fsand	c sand	gravel	EAT	OC (%)	Dry	Moist
16	62	67	22	6	2	0	44	22	17	17	0	5	2.03	10YR4/2	10YR3/2
17	63	65	18	13	4	$\leq$	42	18	20	20	$\sim$	5	1.16	10YR4/1	10YR3/2
18	64	12	13	28	47	0	13	14	23	50	0	4	0.32	10YR5/4	10YR3/4
19	71	68	16	11	4	1	43	16	23	17	1	5	1.49	10YR3/1	10YR2/1
20	72	70	11	10	9	3	42	14	22	19	3	5	1.22	10YR3/1	10YR2/1
21	73	65	12	6	12	2	48	17	17	16	2	5	1.02	10YR3/1	10YR2/1
22	74	33	8	14	33	12	31	11	13	33	12	4	0.68	10YR4/1	10YR2/1
23	81	30	27	31	12	0	17	32	36	15	0	3(1)	2.49	7.5YR3/2	7.5YR2.5/2
24	82	30	17	22	31	0	27	21	21	31	0	3(1)	76.0	10YR5/3	10YR3/2
25	83	21	13	21	43	2	20	12	19	47	2	5	0.54	10YR5/2	10YR3/3
26	93	43	13	23	21	<1	30	13	27	30	<1	3(1)	1.85	10YR3/2	7.5YR2.5/2
27	94	60	10	14	15	1	41	13	22	23	1	5	0.91	5YR4/3	5YR3/3
28	95	32	15	23	30	0	28	18	24	30	0	5	0.51	7.5YR5/3	7.5YR3/4

END OF TEST REPORT

SRaung

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Vork Order ⊲&sib ⊣NVrsII ⊟V F@ Fsæ. hois BFD © @s	: EB1214004	CERTIFIC	<b>CATE OF ANALYSIS</b>	
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**PIGHT SOLUTIONS** RIGHT PARTNER

PFgs	: 2 <b>e</b> ofei3
I orkeSrNsr	: EB1213993
yassib	: GRREE- d,MS- c E- TH4
ProjsDb	; c Ec 97\991
Conord Commo	afe.



# **General Comments**

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- ED021 (Bicarbonate Extractable K Colwell) : The LOR for EB1214004 has been raised due to matrix interference.
- EK061 (TKN as N By Discrete Analyser); Sample EB1214004 015 (C-037 0-0.1) shows poor spike recovery due to sample heterogeneity. This was confirmed by visual inspection. •
- Subcontracted analysis reported in this work order is conducted by Soil Conservation Service. Soil Conservation Service does not hold NATA Accreditation for these parameters. •

: cofe13	: EB1213993	: GRREE- d,MS- c E- TH4	; c Ec 97 <b>1</b> 991
Fgs :	orkeSrNsr :	aßib	rojs Do



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ULK Fb@: SOIL		Clien	it sample ID	C-037 - 0-0.1	C-037 - 0.1-0.2	C-037 - 0.2-0.3	C-037 - 0.3-0.4	C-037 - 0.4-0.5
	Clie	nt sampling	g date / time	2216 HA 12912d 0:99	22K HAY2912d0:99	2216 HAY2912ef 0:99	2216 HA 2912d 0:99	22% HAY2912et0:99
Compound CAS N	Vumber	LOR	Unit	EB1214004-015	EB1214004-016	EB1214004-017	EB1214004-018	EB1214004-019
EA002 : pH (Soils)								
pH Value	жж.	<b>©</b> 6	. Oam (b	7.4	7.4	7.8	8.0	8.1
EA010: Conductivity								
Electrical Conductivity @ 25°C	ЖЖ	~	μR/D/	46	27	33	29	59
EA055: Moisture Content								
Moisture Content (dried @ 103°C)	ЖЖ	1 (0)	%	30.6	30.6	29.4	29.1	28.8
ED002: Exchangeable Soil Acids								
Exchangeable Soil Acids	ЖЖ	<b>@</b> 6	v sq/199g	1.6	ЖЖ	ЖЖ	1.5	ХША
ED007: Exchangeable Cations								
Exchangeable Calcium	ЖЖ	<b>0</b> 06	v sq/199g	59.7	YYY	XXX	65.4	YWY
Exchangeable Magnesium	ЖЖ	<b>@</b> 6	v sq/199g	12.0	YYY	YYYY	10.8	YWY
Exchangeable Potassium	жж	<b>@</b> 6	v sq/199g	0.7	YYY	YYYY	0.2	YWY
Exchangeable Sodium	ЖЖ	<b>@</b> 6	v sq/199g	0.2	YYY	YYYY	0.4	YWY
Cation Exchange Capacity	ЖЖ	<b>0</b> 06	v sq/199g	72.6	YYY	YYYY	76.8	YWY
ED021: Bicarbonate Extractable Potassium (Colwe	/ell)							
Bicarbonate Extractable K (Colwell)	ЖЖ	19	v g/kg	200	ЖЖ	ЖЖ	XXX	ЖЖ
ED040: Sulfur as SO4 2-								
Sulfate as SO4 2- 1379	97Y6UY7	199	v g/kg	270	XXX	XXX	XXX	, XXXX
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	ЖЖ	9 <b>@</b> 1	%	<b>₩</b> 06>	XXX	XXX	<b>10</b> 6>	, XXX
ED045G: Chloride Discrete analyser								
Chloride 1+77	76¥99¥	19	v g/kg	20	<19	<19	<19	<19
ED093S: Soluble Major Cations								
Potassium 633	3979UVG	19	v g/kg	<19	жж	ЖЖ	<19	λ₩
EG005T: Total Metals by ICP-AES								
Aluminium 632	2 UNUBYO	60	v g/kg	32700	, www	XXX	XXX	λ₩
<b>Boron</b> 633	39 <b>\</b> 32\7	60	v g/kg	60>	ЖЖ	ЖЖ	, www.	ХЖХ
<b>Copper</b> 633	39\09\7	0	v g/kg	44	жж	ЖЖ	XXX	λ₩
<b>Iron</b> 63 1	1770	60	v g/kg	46400	жж	ЖЖ	Y	YWY
Manganese 63 t	0,40YU	0	v g/kg	1740	жж	жж	Y	YWY
Molybdenum 63 t	9K/JNN	2	v g/kg	<2	жж	ЖЖ	, www	Y
<b>Zinc</b> 633:	39 <b>\</b> 4+\4	0	v g/kg	49	, www	, www	XXX	ХША
EK059G: Nitrite plus Nitrate as N (NOx) by Discre	ete Analy	/ser						
Nitrite + Nitrate as N (Sol.)	ЖЖ	<b>0</b> 0	v g/kg	5.5	XXX	ЖЖ	, www.	ЖЖ
EK061G: Total Kjeldahl Nitrogen By Discrete Anal	lyser							

: 3 <b>ඬ</b> ්ස්3	: EB1213993	: GRREE- d,MS- c E- TH4	: c Ec 97 <b>9</b> 91
PFgs	I orkeSrNsr	ya£Gib	ProjsDb



RULY: Fbro: SOIL	Ũ	lient sample ID	C-037 - 0-0.1	C-037 - 0.1-0.2	C-037 - 0.2-0.3	C-037 - 0.3-0.4	C-037 - 0.4-0.5
0	Client samp	ling date / time	22% HAY2912d 0:99	22K HAV2912d0:99	2216 HAY2912d10:99	2216 HA 2912610:99	2216 HAY2912ef0:99
Compound CAS Number	LOR	Unit	EB1214004-015	EB1214004-016	EB1214004-017	EB1214004-018	EB1214004-019
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser -	Continued						
Total Kjeldahl Nitrogen as N	۲ 29	v g/kg	1420	ЖЖ	XXX	λ	YYYY
EK062: Total Nitrogen as N (TKN + NOx)							
<sup>Ae</sup> Total Nitrogen as N	۲ 29	v g/kg	1420	ЖЖ	XXX.	λ	λ₩Υ
EK067G: Total Phosphorus as P by Discrete Analyser							
Total Phosphorus as P	2	v g/kg	483	ЖЖ	XXX	335	YYYY
EP003: Total Organic Carbon (TOC) in Soil							
Total Organic Carbon	۲ 9	%	1.77	ЖЖ	, www.	XXX	λ₩Υ
	-	-		-	-		

0କୀମ୍ବ 3	EB1213993	GRREE- d,MS- c E- TH4	c Ec 97 <b>19</b> 91
PFgs	orkeSrNsr :	aßib :	rojs Do



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RULKE FIRG: SOIL		Clie	nt sample ID	C-037 - 0.5-0.6	C-037 - 0.6-0.7	C-037 - 0.7-0.8	C-037 - 0.8-0.9	C-037 - 0.9-1.0
	CI	ent samplin	g date / time	2216 HA 22912et 0:99	2216 HA12912610:99	2216 HAY2912610:99	2216 HA 12912610:99	2216 HAY2912e10:99
Compound	CAS Number	LOR	Unit	EB1214004-020	EB1214004-021	EB1214004-022	EB1214004-023	EB1214004-024
EA002 : pH (Soils)								
pH Value	<b>WWY</b>	<b>@</b> 6	. Oem (C)	8.2	8.3	8.4	8.6	8.6
EA010: Conductivity								
Electrical Conductivity @ 25°C	<b>XXXX</b>	-	μR/D/	76	128	140	105	107
EA055: Moisture Content								
Moisture Content (dried @ 103°C)	<b>WWY</b>	1 (0)	%	30.3	29.4	27.8	23.9	20.4
ED002: Exchangeable Soil Acids								
Exchangeable Soil Acids	XXXX	<b>@</b> 6	v sq/199g	ЖЖ	1.2	жж	YYYY	0.5
ED007: Exchangeable Cations		-						
Exchangeable Calcium	<b>WW</b>	<b>@</b> 6	v sq/199g	YYY	74.6	YYYY	YYYY	52.3
Exchangeable Magnesium	XXXX	<b>@</b> 6	v sq/199g	YYYY	10.6	YYYY	YYYY	5.6
Exchangeable Potassium	XXXX	<b>@</b> 6	v sq/199g	YYYY	0.2	YYYY	YYYY	0.1
Exchangeable Sodium	жж	<b>@</b> 6	v sq/199g	YYYY	0.5	YYYY	YYYY	0.4
Cation Exchange Capacity	жж	<b>@</b> 6	v sq/199g	YYY	86.0	YYYY	Y	58.4
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	<b>WWY</b>	9 <b>@</b> 1	%	ЖЖ	<b>₩</b> 86>	жж	λ₩Υ	<b>₩</b> 06>
ED045G: Chloride Discrete analyser								
Chloride	1+776\99\4	19	v g/kg	<19	<19	<19	950	<19
ED093S: Soluble Major Cations								
Potassium	6339Y9UV6	19	v g/kg	ЖЖ	<19	жж	λ	<19
EK067G: Total Phosphorus as P by Discre	ete Analyser							
Total Phosphorus as P	<b>WWY</b>	2	v g/kg	ЖЖ	324	жж	жж	756

: +@fet3	; EB1213993	: GRREE- d,MS- c E- TH4	; c Ec 97 <b>1</b> 991
PFgs	l orkeSrNsr	ya66ib	Projs Do



SULY: Fbros: SOIL		Clie	ent sample ID	C-037 - 01.0-1.1	C-014-0.0-0.1	C-014-0.1-0.2	C-014-0.2-0.3	C-014-0.3-0.4
	Clie	ent samplii	ng date / time	2216 HAY2912610:99	22K HAY2912d0:99	2216 HAY2912610:99	2216 HAY2912610:99	2216 HAY2912e10:99
Compound	CAS Number	LOR	Unit	EB1214004-025	EB1214004-030	EB1214004-031	EB1214004-032	EB1214004-033
EA002 : pH (Soils)								
pH Value	<b>WWY</b>	<b>@</b> 6	. OAM (C)	8.8	7.7	7.7	7.8	8.0
EA010: Conductivity								
Electrical Conductivity @ 25°C	жж	~	μR/D/	79	37	26	27	35
EA055: Moisture Content								
Moisture Content (dried @ 103°C)	<b>WWY</b>	- 0	%	14.6	26.1	26.4	25.6	26.8
ED002: Exchangeable Soil Acids								
Exchangeable Soil Acids	<b>WW</b>	<b>@</b> 6	v sq/199g		2.0	жж	1.0	жж
ED007: Exchangeable Cations								
Exchangeable Calcium	<b>WW</b>	<b>@</b> 6	v sq/199g	YYY	52.9	YYYY	58.4	YYYY
Exchangeable Magnesium	жж	<b>0</b> 6	v sq/199g	YYYY	18.2	Y	15.7	YWY
Exchangeable Potassium	жж	<b>@</b> 6	v sq/199g	YYYY	1.3	XXX	0.2	YWY
Exchangeable Sodium	жж	<b>@</b> 6	v sq/199g	YYYY	<b>@</b> 6>	YYYY	0.2	YWY
Cation Exchange Capacity	жж	<b>@</b> 6	v sq/199g	YYYY	72.4	YYYY	74.5	YWY
ED021: Bicarbonate Extractable Potassiur	m (Colwell)							
Bicarbonate Extractable K (Colwell)	<b>WW</b>	19	v g/kg	YYYY	470	YYYY	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	Y
ED040: Sulfur as SO4 2-								
Sulfate as SO4 2-	1379776UM	199	v g/kg	ЖЖ	230	жж	ЖЖ	Y
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	<b>WW</b>	1 <b>0</b> 06	%	, www.	<b>₩</b> 000000000000000000000000000000000000	, www.	<b>₩</b> 06>	λ₩Υ
ED045G: Chloride Discrete analyser								
Chloride	1+776%9%	19	v g/kg	10	<19	<19	<19	<19
ED093S: Soluble Major Cations								
Potassium	6339Y9UK	19	v g/kg	жж	<19	XXX	<19	λ
EG005T: Total Metals by ICP-AES								
Aluminium	632UMBY0	60	v g/kg	AYYY.	30200	XXXX	Y	YYYY
Boron	6339 <b>\</b> 32\7	60	v g/kg	YYY	<09	YYYY	Y	YYYY
Copper	633970977	0	v g/kg	YYY	37	YYYY	Y	YWY
Iron	63 UNU4	60	v g/kg	, MMY	39500	XXX	Y	Y
Manganese	63 UNU+YO	0	v g/kg	, www.	2090	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	Ж	, www.
Molybdenum	63 UNU716	2	v g/kg	YYYY	<2	YYYY	Y	YWY
Zinc	6339 <del>/1+</del> / <del>1</del>	0	v g/kg	YYY	44	YYYY	Y	YWY
EK059G: Nitrite plus Nitrate as N (NOx) b	oy Discrete Anal	yser						
Nitrite + Nitrate as N (Sol.)	жж	<b>@</b> 6	v g/kg	XXX.	2.8	XXX	ЖЖ	Y
EK061G: Total Kjeldahl Nitrogen By Discr	ete Analyser							

: 6@fet3	: EB1213993	: GRREE- d,MS- c E- TH4	; c Ec 97 <b>1</b> 991	
PFgs	I orkeSrNsr	ya63ib	ProjsDb	



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Rult For: Soil		Clie	nt sample ID	C-037 - 01.0-1.1	C-014-0.0-0.1	C-014-0.1-0.2	C-014-0.2-0.3	C-014-0.3-0.4
	CI	ient samplin	g date / time	2216 HAY2912610:99	2216 HA 2912d0:99	2216 HAY2912610:99	2216 HAY2912610:99	2216 HAY2912e10:99
Compound CA	S Number	LOR	Unit	EB1214004-025	EB1214004-030	EB1214004-031	EB1214004-032	EB1214004-033
EK061G: Total Kjeldahl Nitrogen By Discrete A	nalyser - c	ontinued						
Total Kjeldahl Nitrogen as N	ЖЖ	29	v g/kg	YYY	1220	YYYY	YYYY	YWY
EK062: Total Nitrogen as N (TKN + NOx)							•	
<sup>^</sup> eTotal Nitrogen as N	ЖЖ	29	v g/kg	YYYY.	1220	YYYY	YYYY	ЖЖ
EK067G: Total Phosphorus as P by Discrete A	nalyser							
Total Phosphorus as P	жж	2	v g/kg	жж	361	XXX	404	ЖЖ
EP003: Total Organic Carbon (TOC) in Soil								
Total Organic Carbon	ЖЖ	9 <b>@</b> 2	%	жж	1.72	YYYY	Y	YWY
	-	-			-	-		

: 7@fet3	: EB1213993	: GRREE- d,MS- c E- TH4	; c Ec 97 <b>\9</b> 91
PFgs	l orkeSrNsr	yassib	ProjsDb



Analytical Results								
Rulty Fire: Soil		Clie	nt sample ID	C-014-0.4-0.5	C-014-0.5-0.6	C-014-0.6-0.7	C-014-0.7-0.8	C-014-0.8-0.9
	Clie	nt samplir	ig date / time	2216 HAY2912610:99	2216 HA 12912610:99	2216 HAY2912610:99	22% HAY2912610:99	2216 HAY2912ef0:99
Compound	CAS Number	LOR	Unit	EB1214004-034	EB1214004-035	EB1214004-036	EB1214004-037	EB1214004-038
EA002 : pH (Soils)								
pH Value	XXX	<b>@</b> 6	. Oem (C)	8.0	8.2	8.3	8.5	8.6
EA010: Conductivity								
Electrical Conductivity @ 25°C	XXX	<del></del>	μR/D/	41	57	109	127	134
EA055: Moisture Content								
Moisture Content (dried @ 103°C)	XXX	1 ()	%	23.5	28.0	17.5	24.8	23.1
ED002: Exchangeable Soil Acids								
Exchangeable Soil Acids	жж	<b>0</b> 06	v sq/199g	YYY	1.0	XXX	0.9	YWY
ED007: Exchangeable Cations								
Exchangeable Calcium	<b>WWY</b>	<b>0</b> 06	v sq/199g	AYYY.	60.0	жж	47.8	XXXX
Exchangeable Magnesium	ЖЖ	<b>0</b> 06	v sq/199g	YYYY	9.2	YYYY	6.7	YYYY
Exchangeable Potassium	жж	9 <b>0</b> 0	v sq/199g	YYYY	©6>	YYYY	<b>@</b> 6>	YWY
Exchangeable Sodium	ЖЖ	<b>D</b> 6	v sq/199g	YYYY	0.3	YYYY	0.3	YYYY
Cation Exchange Capacity	XXX	<b>0</b> 06	v sq/199g	XXX	69.6	WW	54.9	Y
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	XXXX	9 <b>®</b> (	%		<b>₩</b> 06>	ЖЖ	<b>₩</b> 06>	XXXX
ED045G: Chloride Discrete analyser								
Chloride	1+77619914	19	v g/kg	<19	<19	<19	<19	<19
ED093S: Soluble Major Cations								
Potassium	6339Y9UV6	19	v g/kg		<19	ЖЖ	<19	XXXX
EK067G: Total Phosphorus as P by Discr	rete Analyser							
Total Phosphorus as P	XXXX	2	v g/kg	YYYY	563	XXX	979	XXXX
		-						

: Utanfei 3	: EB1213993	: GRREE- d,MS- c E- TH4	; c Ec 971991
PFgs	l orkeSrNsr	ya£Sib	Projs Do



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ult k Fbro: Soil		Clier	nt sample ID	C-034-0.0-0.1	C-034-0.1-0.2	C-034-0.2-0.3	C-034-0.3-0.4	C-034-0.4-0.5
	Cli	ent samplin <sub>i</sub>	g date / time	2216 HAY2912d10:99	2216 HAY2912d0:99	2216 HAY2912cf 0:99	22YC HAY2912d 0:99	2216 HAN2912ef10:99
Compound CAS	S Number	LOR	Unit	EB1214004-066	EB1214004-067	EB1214004-068	EB1214004-069	EB1214004-070
EA002 : pH (Soils)								
pH Value	XXX.	<b>0</b> 06	. Oem o	7.7	7.8	7.8	7.9	8.0
EA010: Conductivity								
Electrical Conductivity @ 25°C	ЖЖ	~	μR/Dv	92	56	23	28	31
EA055: Moisture Content								
Moisture Content (dried @ 103°C)	жж	1 (0)	%	28.3	30.2	30.3	30.0	30.4
ED002: Exchangeable Soil Acids								
Exchangeable Soil Acids	жж	<b>@</b> 6	v sq/199g	1.7	ЖЖ	ЖЖ	1.5	жж
ED007: Exchangeable Cations								
Exchangeable Calcium	ЖЖ	<b>@</b> 6	v sq/199g	57.2	YYY	XXX	58.2	YYYY
Exchangeable Magnesium	жж	<b>@</b> 6	v sq/199g	19.9	YYY	YYYY	19.0	Y
Exchangeable Potassium	ЖЖ	<b>@</b> 6	v sq/199g	0.5	YYY	YYYY	0.2	YWY
Exchangeable Sodium	ЖЖ	<b>@</b> 6	v sq/199g	0.3	YYY	YYYY	0.4	YWY
Cation Exchange Capacity	жж	<b>@</b> 6	v sq/199g	77.9	YYY	YYYY	77.8	YWY
ED021: Bicarbonate Extractable Potassium (Co	lwell)				-	-		
Bicarbonate Extractable K (Colwell)	жж	19	v g/kg	<299	жж	жж	Y	Y
ED040: Sulfur as SO4 2-								
Sulfate as SO4 2-	3797Y6UM	199	v g/kg	150	XXX	, www	ЖЖ	жж
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	жж	9 <b>@</b> J	%	<b>10</b> 6>	XXX	XXX	<b>@</b> 6>	YWY
ED045G: Chloride Discrete analyser								
Chloride 1+	+77619914	19	v g/kg	<19	<19	<19	<19	<19
ED093S: Soluble Major Cations								
Potassium	3339 <b>19UK</b>	19	v g/kg	<19	жж	ЖЖ	<19	Y
EG005T: Total Metals by ICP-AES								
Aluminium	532UMBY0	60	v g/kg	32700	XXX	XXX	XXX	λ₩Υ
Boron 6	339Y32Y7	60	v g/kg	60>	ЖЖ	ЖЖ	ЖЖ	Y
Copper 6	339 <b>\</b> 09\7	0	v g/kg	41	WW	ЖЖ	ЖЖ	XXX
6 6	33 UMUM	60	v g/kg	41200	жж	ЖЖ	ЖЖ	YWY
Manganese 6	33 UNU+YO	0	v g/kg	1510	жж	WW	XXX	Y
Molybdenum	33 UMU716	2	v g/kg	<2	ЖЖ	ЖЖ	ЖЖ	Y
Zinc	339 <del>/1+/1</del>	0	v g/kg	47	, www	ЖЖ	ЖЖ	жж
EK059G: Nitrite plus Nitrate as N (NOx) by Dise	crete Anal	yser						
Nitrite + Nitrate as N (Sol.)	ЖЖ	<b>@</b> 6	v g/kg	0.5	XXX	XXX	XXX	YWY
EK061G: Total Kjeldahl Nitrogen By Discrete Ar	nalyser							

: 19@fet3	; EB1213993	: GRREE- d,MS- c E- TH4	: c Ec 97 <b>9</b> 91
PFgs	I orkeSrNsr	ya&Gib	ProjsDb



## Analytical Results

RULY: Fbro: Soil	CI	ient sample ID	C-034-0.0-0.1	C-034-0.1-0.2	C-034-0.2-0.3	C-034-0.3-0.4	C-034-0.4-0.5
	Client sampl	ing date / time	2216 HAV2912610:99	22K HAY2912d0:99	2216 HAY2912610:99	2216 HA 2912610:99	2216 HAN2912ef0:99
Compound CAS Number	LOR	Unit	EB1214004-066	EB1214004-067	EB1214004-068	EB1214004-069	EB1214004-070
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser -	Continued						
Total Kjeldahl Nitrogen as N	۲ 29	v g/kg	820	жж	жж	ЖЖ	YYYY
EK062: Total Nitrogen as N (TKN + NOx)							
ÅeTotal Nitrogen as N	۲ 29	v g/kg	820	YYYY	XXX.	Y	YYYY
EK067G: Total Phosphorus as P by Discrete Analyser						-	
Total Phosphorus as P	2	v g/kg	334	жж	XXX	262	YYYY
EP003: Total Organic Carbon (TOC) in Soil							
Total Organic Carbon	۲ 9 <b>602</b>	%	1.20	YYYY	,WW	Y	YYYY
		-					
11œfet3	EB1213993	GRREE- d,MS- c E- TH4	c Ec 97\991				
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SULYE FOR: SOIL		Clie	nt sample ID	C-034-0.5-0.6	C-034-0.6-0.7	C-034-0.7-0.8	C-034-0.8-0.9	C-034-0.9-1.0
	CI	ient samplin	ig date / time	2216 HAY2912610:99	22% HAY2912d0:99	2216 HAY2912ef 0:99	22YC HAY2912d 0:99	2216 HAY2912ef0:99
Compound	CAS Number	LOR	Unit	EB1214004-071	EB1214004-072	EB1214004-073	EB1214004-074	EB1214004-075
EA002 : pH (Soils)								
pH Value	<b>WW</b>	<b>©</b> 6	. Oem (b	8.1	8.7	9.0	9.0	9.0
EA010: Conductivity								
Electrical Conductivity @ 25°C	<b>WWY</b>	-	μR/Dv	36	95	70	73	72
EA055: Moisture Content								
Moisture Content (dried @ 103°C)	<b>XXXX</b>	1 ()	%	27.1	11.3	19.4	15.1	14.0
ED002: Exchangeable Soil Acids								
Exchangeable Soil Acids	<b>WW</b>	<b>©</b> 6	v sq/199g	1.5	ЖЖ	0.6	, www	XXX
ED007: Exchangeable Cations								
Exchangeable Calcium	XXXX	<b>@</b> 6	v sq/199g	61.7	YYYY	69.8	Y	Y
Exchangeable Magnesium	<b>WW</b>	<b>@</b> 6	v sq/199g	20.3	YYYY	15.8	Y	YWY
Exchangeable Potassium	XXXX	<b>@</b> 6	v sq/199g	0.2	YYYY	<b>@</b> 6>	Y	YWY
Exchangeable Sodium	<b>WW</b>	<b>@</b> 6	v sq/199g	0.5	YYYY	0.6	Y	YWY
Cation Exchange Capacity	жж.	<b>@</b> 6	v sq/199g	82.7	XXX	86.4	Y	Y
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	YYYY	9 <b>®</b> 0	%	<b>₩</b> 06>	, www	<b>₩</b> 06>	, www	λ₩Υ
ED045G: Chloride Discrete analyser								
Chloride	1+77619914	19	v g/kg	<19	<19	<19	<19	<19
ED093S: Soluble Major Cations								
Potassium	6339 <b>/9UK</b>	19	v g/kg	<19	, www	<19	, www	λ₩Υ
EK067G: Total Phosphorus as P by Discre	te Analyser							
Total Phosphorus as P	XXXX	2	v g/kg	247	, WW	266	Y	YYYY
		-		-				



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PFgs	l orkeSrNsr	ya66ib	Projs Do	



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ulty: Fbro: Soil		Client	t sample ID	C-035-0.0-0.1	C-035-0.1-0.2	C-035-0.2-0.3	C-035-0.3-0.4	C-035-0.4-0.5
	Client	sampling	date / time	2216 HA 2912610:99	22K HAY2912d0:99	2216 HAY2912ef 0:99	2216 HA 2912610:99	2216 HAY2912et0:99
Compound CAS Ni	umber L	.OR	Unit	EB1214004-080	EB1214004-081	EB1214004-082	EB1214004-083	EB1214004-084
EA002 : pH (Soils)								
pH Value	ΥΥΥΥ	<b>@</b> 6	. Oem (b	7.4	7.7	7.9	7.9	8.0
EA010: Conductivity								
Electrical Conductivity @ 25°C	ЖЖ	~	μR/Dv	78	29	27	41	48
EA055: Moisture Content								
Moisture Content (dried @ 103°C)	ΥΥΥΥ	1 ()	%	27.2	28.6	29.8	29.6	27.9
ED002: Exchangeable Soil Acids								
Exchangeable Soil Acids	ЖЖ	<b>@</b> 6	v sq/199g	2.4	ЖЖ	, www	1.0	λ₩
ED007: Exchangeable Cations								
Exchangeable Calcium	ЖЖ	0 <b>0</b> 6	v sq/199g	54.9	YYY	YYY	58.4	YYYY
Exchangeable Magnesium	жж	<b>D</b> 6	v sq/199g	13.1	XXX	, WW	12.7	XXX
Exchangeable Potassium	жж	9 <b>0</b> 0	v sq/199g	0.4	YYY	YYY	0.1	YWY
Exchangeable Sodium	ЖЖ	9 <b>0</b> 0	v sq/199g	0.2	YYY	YYY	0.2	YWY
Cation Exchange Capacity	ЖЖ	9 <b>0</b> 0	v sq/199g	68.7	YYY	YYY	71.4	YWY
ED021: Bicarbonate Extractable Potassium (Colwe	(IIe							
Bicarbonate Extractable K (Colwell)	ΥΥΥΥ	19	v g/kg	<299	WW.	WW.	YWY	YWY
ED040: Sulfur as SO4 2-								
Sulfate as SO4 2- 1379.	7/6UM	199	v g/kg	140	XXX	, www	, www	XXXX
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	5 	<u>@</u>	%	<b>10</b> 6>	XXX	, www	<b>10</b> 6>	XXXX
ED045G: Chloride Discrete analyser								
Chloride 1+77t	619914	19	v g/kg	<19	<19	<19	<19	<19
ED093S: Soluble Major Cations	-				-			
Potassium 633	൝ക്ര	19	v g/kg	<19	ЖЖ	ЖЖ	<19	λ₩
EG005T: Total Metals by ICP-AES								
Aluminium 6321	0.0M	60	v g/kg	29900	жж	, www	, www	Y
<b>Boron</b> 633(	9Y32Y7	60	v g/kg	60>	ЖЖ	ЖЖ	λ	YWY
<b>Copper</b> 633(	£400	0	v g/kg	41	ЖЖ	ЖЖ	λ₩Υ	YWY
<b>Iron</b> 63 1	₩124	60	v g/kg	43900	жж	жж	Y	YWY
Manganese 63 (	0X-HDVD	0	v g/kg	1660	жж	жж	Y	YWY
Molybdenum 63 (	ONU7 YG	2	v g/kg	<2	жж	жж	λ	YWY
Zinc 633!	女+女6	0	v g/kg	45	XXX	, www	, www	XXXX
EK059G: Nitrite plus Nitrate as N (NOx) by Discre	te Analys	er						
Nitrite + Nitrate as N (Sol.)	λ	00 00	v g/kg	0.8	XXX	XXX	YWY	XXX
EK061G: Total Kjeldahl Nitrogen By Discrete Analy	yser							

: 1 @fet3	: EB1213993	: GRREE- d,MS- c E- TH4	; c Ec 97 <b>9</b> 91	
PFgs	I orkeSrNsr	ya&Gib	ProjsDb	



# Analytical Results

Rultic Firg: Soil		Client sample ID	C-035-0.0-0.1	C-035-0.1-0.2	C-035-0.2-0.3	C-035-0.3-0.4	C-035-0.4-0.5
	Client sé	₹mpling date / time	2216 HAY2912610:99	22% HAY2912d0:99	2216 HAY2912610:99	22% HAY2912610:99	2216 HAV2912et0:99
Compound CAS Numbe	er LO	R Unit	EB1214004-080	EB1214004-081	EB1214004-082	EB1214004-083	EB1214004-084
EK061G: Total Kjeldahl Nitrogen By Discrete Analysen	r - Contin	ned					
Total Kjeldahl Nitrogen as N	<b>YYY</b> 25	y v g/kg	910	жж	XXX	YWY	YYYY
EK062: Total Nitrogen as N (TKN + NOx)							
<sup>h</sup> eTotal Nitrogen as N	<b>YYY</b> 25	y y/kg	910	жж	XXX	Y	YYYY
EK067G: Total Phosphorus as P by Discrete Analyser							
Total Phosphorus as P	<del>\\\\</del> 2	v g/kg	317	жж	жж	279	Y
EP003: Total Organic Carbon (TOC) in Soil							
Total Organic Carbon	9@ ***	%	1.21	ЖЖ	, WW	Y	YYYY
	-	-	-	-	-	-	





RULY: Fbros: SOIL		Clie	ent sample ID	C-035-0.5-0.6	C-035-0.6-0.7	C-035-0.7-0.8	Ж	λ	
	Cli	ent sampli	ing date / time	2216 HAY2912610:99	2216 HAV2912610:99	2216 HAY2912610:99	YYY	YYYY	
Compound	CAS Number	LOR	Unit	EB1214004-085	EB1214004-086	EB1214004-087			
EA002 : pH (Soils)									
pH Value	XXX	<b>0</b> 6	. Oem (b	8.5	8.8	8.7	ЖЖ	λ₩Υ	
EA010: Conductivity									
Electrical Conductivity @ 25°C	XXX	-	μR/D/	118	79	69	ЖЖ	λ₩Υ	
EA055: Moisture Content									
Moisture Content (dried @ 103°C)	XXX	1 1	%	22.6	16.2	12.6	ЖЖ	YYYY	
ED002: Exchangeable Soil Acids									
Exchangeable Soil Acids	XXX	<b>@</b> 6	v sq/199g	ЖЖ	0.4	ЖЖ	ЖЖ	λ	
ED007: Exchangeable Cations									
Exchangeable Calcium	XXXX	<b>@</b> 6	v sq/199g	YYYY	54.3	XXX	YWY	YYYY	
Exchangeable Magnesium	ЖЖ	<b>@</b> 6	v sq/199g	YYYY	7.7	YYYY	YYYY	YYYY	
Exchangeable Potassium	жж	<b>@</b> 6	v sq/199g	YYYY	<b>@</b> 6>	YYYY	YYYY	YYYY	
Exchangeable Sodium	ЖЖ	<b>@</b> 6	v sq/199g	YYYY	0.2	YYYY	YYYY	YYYY	
Cation Exchange Capacity	ЖЖ	<b>@</b> 6	v sq/199g	XXX	62.2	XXX	YYYY	YYYY	
ED042T: Total Sulfur by LECO									
Sulfur - Total as S (LECO)	<b>XXXX</b>	9 <b>@</b> 4	%	, www	<b>10</b> 6>	ЖЖ	ЖЖ	λ₩Υ	
ED045G: Chloride Discrete analyser									
Chloride	1+776%9%	19	v g/kg	30	<19	<19	ЖЖ	λ₩Υ	
ED093S: Soluble Major Cations									
Potassium	6339Y9UNG	19	v g/kg	, www	<19	XXX	XXXX	٨₩٢	
EK067G: Total Phosphorus as P by Discre	te Analyser								
Total Phosphorus as P	XXX	7	v g/kg	жж	580	жж	ЖЖ	λ₩Υ	
	-								



Experienced people protecting your resources

709 Gundy Road, Scone NSW 2337 PO Box 283, Scone NSW 2337 P: 02 6545 1666 F: 02 6545 2520 M: 0408 446 132

Australian Laboratory Services 32 Shand Street Stafford Qld 4053

19 July 2012

SCO12/175R1

Dear Sir/Madam

### Soil erodibility factor - Fifteen soil samples (EB1214004)

The soil erodibility factor (K factor) has been determined (as described by Rosewell 1993) for soil test report SCO12/175R1 (Ref: EB1214004) using the particle size analysismechanical dispersion (clay, silt, fine sand, coarse sand and gravel) and the organic carbon (OC). The surface soil structure was assumed to be medium granular and the profile permeability was assumed to be slow to moderate.

Lab No	Sample Id	K factor	Rating	
1	26	0.026	Moderate	
2	27	0.027	Moderate	
3	28	0.036	Moderate	
4	29	0.049	High	
5	39	0.024	Moderate	
6	40	0.025	Moderate	
7	41	0.031	Moderate	
8	42	0.038	Moderate	
9	76	0.026	Moderate	
10	77	0.024	Moderate	
11	78	0.024	Moderate	
12	79	0.049	High	
13	88	0.025	Moderate	
14	89	0.026	Moderate	
15	90	0.061	Very high	

This interpretation was based on the soil samples being representative, and literature guidelines. If you have any queries, please contact me on (02) 6545 1666.

Yours sincerely

SRJaury

SR Young

### References

Rosewell CJ (1993) Soiloss – A program to assist in the selection of management practices to reduce erosion. Department of Conservation and Land Management.



### SOIL TEST REPORT

Page 1 of 2

Scone Research Centre

REPORT NO:	SCO12/175R1
REPORT TO:	Australian Laboratory Services 32 Shand Street Stafford Qld 4053
REPORT ON:	Fifteen soil samples Ref: EB1214004
REPORT STATUS:	Preliminary
DATE REPORTED:	19 July 2012
METHODS:	Information on test procedures can be obtained from Scone Research Centre

TESTING CARRIED OUT ON SAMPLE AS RECEIVED THIS DOCUMENT MAY NOT BE REPRODUCED EXCEPT IN FULL

SKJaury

SR Young (Laboratory Manager)

SOIL CONSERVATION SERVICE Scone Research Service Centre

> Report No: Client Reference:

SCO12/175R1 (Preliminary) Australian Laboratory Services 32 Shand Street Stafford Qld 4053

our	Moist	10YR3/1	10YR3/1	10YR3/1	10YR4/2	10YR3/1	10YR3/1	10YR3/2	10YR4/2	10YR3/1	10YR3/1	10YR2/1	7.5YR3/2	10YR3/1	10YR2/2	10YR3/3
Colo	Dry	10YR4/1	10YR4/1	10YR4/1	10YR5/2	10YR4/1	10YR4/1	10YR5/1	10YR6/2	10YR4/1	10YR4/1	10YR4/1	7.5YR5/2	10YR4/1	10YR4/2	10YR5/3
C6A/2	OC (%)	2.02	1.48	1.26	0.39	1.50	1.28	1.00	0.57	0.97	1.04	06.0	0.26	1.21	1.00	0.25
P9B/2	EAT	5	5	5	4	5	5	4	4	5	5	4	4	5	5	4
is (%)	gravel	0	0	0	ю	0	0	1	12	$\overline{\vee}$	0	0	10	0	$\overline{\nabla}$	2
s – mech d	c sand	29	24	26	52	24	21	27	31	27	22	21	51	20	20	54
ze Analysi	f sand	29	24	26	52	24	21	27	31	27	22	21	51	20	20	54
Particle Si	silt	19	23	28	12	18	22	20	19	16	19	19	12	23	23	19
P7C/2	clay	39	41	32	21	41	44	32	21	44	46	43	19	43	43	15
(	gravel	0	0	0	3	0	0	1	12	$\leq$	0	0	10	0	$\leq$	2
nalysis (%)	c sand	3	1	2	46	1	3	20	30	2	2	13	48	4	3	56
cle Size A	f sand	9	4	6	16	8	6	14	21	7	3	7	16	8	8	19
P7B/2 Parti	silt	17	13	11	10	16	18	14	15	17	15	13	10	19	16	11
I	clay	74	85	81	25	75	70	51	22	74	80	67	16	69	73	12
Method	Sample Id	26	27	28	29	39	40	41	42	76	77	78	62	88	89	06
	L	-	5	ю	4	5	6	7	8	6	10	11	12	13	14	15

# END OF TEST REPORT

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### Appendix 2

### **Topsoil Management Plan**



















### 1. Introduction

### 1.1. Description

The Topsoil Management Plan forms part of the environmental management strategy for the proposed operations. This Topsoil Management Plan has been developed to manage topsoil being disturbed by mining and construction activities at Endocoal Limited's Meteor Downs South (MDS) coal mine.

This Topsoil Management Plan forms part of the Meteor Downs South Soils, Land, Overburden and Process Waste Study and has been prepared to define the overall environmental management objectives of the MDS project to the management of topsoil stripping and stockpiling associated with, but not including, rehabilitation activities.

The Topsoil Management Plan was based on an assessment of soils and land resources undertaken for the Environmental Management Plan (EMP). Principal soil units were mapped and assessed in a field survey. Laboratory analysis was performed on representative samples of each soil type identified in the field survey. Detailed mapping used remote sensing and slope analysis from a digital elevation model in a GIS. The analysis supported soil classification, land suitability, Good Quality Agricultural Land and Strategic Cropping Land assessment.

Optimal topsoil stripping depths (based on the land suitability assessment) for primary and secondary media were determined for different soil types. Primary media (topsoil) and secondary media (subsoil) resources are recommended for removal prior to disturbance. These resources need to be stockpiled for later use in rehabilitation activities.

### 1.2. Scope

The Topsoil Management Plan can be applied throughout the life of the MDS Project; including construction, operation, rehabilitation and decommissioning to manage topsoil within the Mining Lease (ML) boundary and support optimal rehabilitation activities.

The objectives of the Topsoil Management Plan include:

- 1. Ensuring that statutory requirements and corporate standards are met;
- 2. Managing operational activities in such a way as to minimise loss of topsoil through erosion and poor management;
- 3. Protecting stockpiles from weed infestation; and
- 4. Optimising re-use of soil from disturbed areas through the construction of appropriately designed stockpiles that hold viable topsoil material prior to its use in rehabilitation.

To satisfy objective 1, this management plan promotes the stripping and stockpiling of available topsoil recommended for use in rehabilitation. The stripping and stockpiling operations need to be managed to minimise the risk of erosion and sedimentation, associated with vegetation clearance and road works. An annual audit of stockpiles is needed to verify implementation of the Topsoil Management plan. More regular visual site inspections by environmental personnel or the Open Cut Examiner (OCE) are needed to identify and treat erosion and sedimentation incidents associated with topsoil stripping.

To satisfy objective 2, a pre stripping procedure needs to be included in a Ground Disturbance Permit (GDP) system that considers proactive implementation of effective erosion and sedimentation controls. Soil moisture conditions need to be assessed to ensure appropriate stripping and handling techniques are implemented.

To satisfy objective 3, weed control measures need to be implemented to mitigate weed infestation risks associated with reuse of soil.

To satisfy objective 4, the source and rehabilitation properties of each stockpile will be recorded and tracked. Parameters recorded will include; location, date of stockpiling, volume, soil type and source location. Stockpiles will be constructed according to standards that apply to mining operations in Queensland and will be internally audited against these standards.

### 2. Management

### 2.1. Environmental Aspects

Soil disturbance impacts associated with construction activities may increase the risk of erosion and sedimentation in natural watercourses and water bodies. Sedimentation of water bodies can modify the abiotic environment and smother aquatic habitats. In turn, this can have detrimental effects on the ecosystem of the near to immediate area, and have a connectivity effect on the geomorphology and ecology elsewhere in the catchment.

### 2.2. Management Actions

Management actions that reduce the risk of soil and water degradation within the project area and adjoining lands, and prepare the site for progressive rehabilitation, requires focus on three areas: (i) Vegetation clearance prior to soil stripping; (ii) Soil stripping procedure; and (iii) Stockpile establishment and maintenance. The following management controls will be implemented in order to successfully mitigate the environmental risks associated with the soil stripping process.

### 2.2.1. Vegetation Clearance prior to Soil Stripping

- Relevant GDP approval will be obtained before commencement (following the Endocoal GDP process);
- Relevant management plans (Biodiversity, Rehabilitation and Erosion and Sediment Control) and the associated procedures will be implemented and familiar to operators; and
- The soil survey undertaken for the EMP will be reviewed prior to any disturbance to identify any hostile soils that will be exposed upon the removal of vegetation, and may require specific management techniques.

### 2.2.2. Soil Stripping Procedure

- Prior to stripping, ensure the planned area for stripping has adequate sediment control measures which flow into a sediment holding dam;
- Strip and salvage material only to the depths advised in the soil survey (**Table 2.1**), or as identified during the stripping process, given a higher intensity assessment of soil during stripping;

- Soil should be maintained in a slightly moist condition during stripping. Material should not be stripped in either an excessively dry or wet condition; and
- Soil transported by dump trucks may be placed directly into stockpiles. Soil transported by dozer push is best pushed to form stockpiles to avoid tracking over previously laid soil.
- **Table 2.1** features the recommended stripping depths of both primary media (topsoil) and secondary media (subsoil) throughout the site. Where secondary media is recommended for stripping, it should be managed in the same way as primary media, however it should be stockpiled separately.

	S	оіІ Туре	Primary Media	Secondary Media
Site #	Map Unit/ Soil Type	ASC	m	m
1	107, Rugby	Haplic, Self-Mulching, Brown Vertosol; Slightly Gravelly, Fine, Fine, Shallow	0.0 – 0.1	0.1 – 0.35
3	107, Rugby	Haplic, Self-Mulching, Brown Vertosol; Slightly Gravelly, Fine, Fine, Moderate	0.0 – 0.20	0.20 – 0.60
12	108, Bruce	Haplic, Self-Mulching, Brown Vertosol; Non-Gravelly, Fine, Fine, Moderate	0.0 – 0.1	0.1 – 0.6
10	109, Arcturus	Self-Mulching, Grey Vertosol; Non-Gravelly, Fine, Fine, Moderate	0.0 – 0.1	0.1 – 0.6
14	109, Arcturus	Haplic, Self-Mulching, Grey Vertosol; Non-Gravelly, Fine, Fine, Moderate	0.0 – 0.15	0.15 – 0.8
11	109, Arcturus	Self-Mulching, Grey Vertosol; Non-Gravelly, Fine, Fine, Moderate	0.0 – 0.1	0.1 – 0.6
8	110, May Downs	Haplic, Self-Mulching, Brown Vertosol; Non-Gravelly, Fine, Fine, Deep	0.0 – 0.1	0.1 – 0.6
2	105, Rugby	Haplic, Self-Mulching, Black Vertosol; Non-Gravelly, Fine, Fine, Moderate	0.0 – 0.1	0.1 – 0.6
7	105, Rugby	Haplic, Self-Mulching, Black Vertosol; Slightly Gravelly, Fine, Fine, Shallow	0.0 – 0.1	0.1 – 0.6
9	105, Rugby	Haplic, Eutrophic, Brown Dermosol; Slightly Gravelly, Fine, Fine, Shallow	0.0 – 0.1	0.1 – 0.55

### **Table 2.1 Stripping Recommendations**

### 2.2.3. Stockpile Establishment and Maintenance

• As a general rule, a maximum topsoil stockpile height of 2 m will be maintained. Clay soils should be stored in lower stockpiles for shorter periods of time compared to sandy soils;

- Stockpile batters will be constructed with a 3:1 slope, which is the suitable angle to prevent slumping and allow the establishment of a protective cover crop vegetation;
- Where stockpiles are to be maintained for extensive periods (six months or longer), seed and fertiliser will be applied upon establishment. An annual cover crop species that produce sterile florets or seeds will be sown. (Rapid growing and healthy annual pasture sward will not persist in the rehabilitation areas, however it provides competition to minimise the emergence of undesirable weed species and enhances the desirable micro-organism activity in the soil);
- Details of soils that have been stripped and stockpiled, will be kept on a register which records date, location, volume, soil type and source location;
- Leave the surface of soil stockpiles in as coarsely textured a condition as possible to promote infiltration and minimise erosion until vegetation is established, and to prevent anaerobic zones forming;
- Place stripped material directly onto reshaped overburden and spread immediately (if mining sequences, equipment scheduling and weather conditions permit) to avoid the requirement for stockpiling;
- Place soil material that is removed from the area of operation away from concentrated overland flow to minimise soil loss from site and sedimentation off site; and
- Develop and maintain an Erosion and Sedimentation Control Plan that identified specific control strategies in each operational area to mitigate erosion occurrence and details how these may be implemented (i.e. temporary sedimentation fences).

The management actions described above will be subject to a monitoring strategy to ensure effectiveness. **Table 2.2** outlines how this monitoring will be undertaken.

Parameter	Action	Monitoring
Approvals and clearances	Updated and relevant to activity	Prior to clearance activities - Checking validity as per protocol.
Relevant management plans	Implement plans	Prior to clearance activities - Ensure all plans are in place and management actions are being followed.
Hostile soils	Identification of dispersive, sodic, saline, highly acidic or highly alkaline soils.	Prior to and during clearance activities - Use soil survey information and continued observations to avoid any stripping of hostile material.
Stripping depths	Strip to depths advised.	Prior to and during clearance activities - Clearance operators to constantly ensure stripping depths are as per recommendations.
Topsoil condition	Ensure prior to stripping that soil has appropriate moisture content. Must be slightly moist during stripping.	Prior to and during clearance activities –Visually inspect soil to be stripped and determine if its moisture content is appropriate.
Stripped material placement	Place directly onto reshaped overburden where possible.	Prior to clearance activities - Investigate influential parameters including mining sequencing, equipment scheduling and weather

### **Table 2.2.3 Monitoring Procedure**

Parameter	Action	Monitoring
		when determining placement of soil.
Stockpile surface condition	Keep surface condition as coarse as possible.	During and following stripping activities - Visually monitor activity to ensure no unnecessary handling or smoothing occurs.
Waterway contamination	Prevent sediments from stockpiles reaching waterways.	Prior to, during and following stripping activities - Ensure stockpiles are designed and protected as per the practical standards detailed in Section 2.2 and established in appropriate locations.
Soil stockpile height	Stockpiles to be a maximum of 2m in height	During stripping activities - Machinery operators to visually gauge height of stockpiles upon establishment. And confirmed by Surveyor.
Soil stockpile treatment	Seed and fertilise stockpiles intended for extended duration	Following stripping activities - The duration of the stockpile will be predicted upon establishment and seeding and fertiliser will be applied where necessary.

### Table 2.2.3 Monitoring Procedure

### 2.3. Objective and Performance Criteria

The effectiveness of the implementation of the soil stripping management actions will monitored using key performance indicators (KPI). Recommended KPIs are listed in **Table 2.3**.

Parameter	Target	KPI
Relevant management plans	Implement plans	Soil stripping process is undertaken in a manner which is consistent with all relevant management plans.
Hostile soils	Strip and salvage appropriate material	Minimal hostile/inappropriate material is stripped and salvaged.
Stripping depths	Strip to depths advised	All recoverable soil is stripped as per recommendations.
Topsoil condition	Strip when topsoil is slightly moist	Soil structure qualities are maintained at acceptable levels during stripping activities.
Stripped material placement	Minimise need for stockpiles	Soil placed onto reshaped overburden where practical, minimising volume of stockpiles.
Stockpile surface condition	Keep surface condition as coarse as possible	Surface crusting is minimal and seed germination is visible.

### Table 2.3. Key Performance Indicators

Parameter	Target	KPI
Waterway contamination	Establish stockpiles in appropriate location	Sediment from stockpiles does not reach off site waterways.
Stockpile height	Keep stockpile height minimised	Stockpiles no greater than 2 m in height.
Stockpile treatment	Treat stockpiles that are intended for six months or greater	Stockpiles intended for extended duration are treated with seed and fertiliser.

### Table 2.3. Key Performance Indicators

### 3. Contingency Actions

### 3.1. Trigger/Action Tables

Triggers have been developed to provide an early warning system and recommended actions to prevent parameters from being exceeded. Recommended triggers and responses are listed in **Table 3.1**.

### **Table 3.1 Triggers and Response Action**

Trigger	Action
Stripping operations infringe on heritage and/or flora and fauna requirements	Stripping operations in the immediate area cease and the relevant site personnel and authorities are contacted.
Hostile material is identified during the stripping process	Further identification in the immediate area to be undertaken followed by in-pit disposal of all soil that has been recognised as having hostile properties (e.g. sodic soils).
Soil moisture is inappropriate at commencement of stripping activities.	Cease stripping operations. If soil is deemed too wet then activities are to be rescheduled. If soil is deemed dry, apply water and allow infiltration until appropriate soil moisture levels are obtained.
Change of weather during stripping process and topsoil moisture compromised	If too dry - Light watering of the soil before activity is continued. If too wet – Delay operations until drier conditions
	prevail.
Erosion occurrence with the potential for sediment to be transported into waterways	Identify source of sediment. Protect source from point of erosion, then implement sediment controls and inspection regime.
Stockpile height is observed to have surpassed the 2 m limit	Reduce stockpile height.
Seeding and fertiliser application fails to instigate vegetation growth on stockpiles	Consider and assess restrictive factors such as location, recent climate variations, seed amount/type used etc. Reseed using adaptive management.

### 4. Reporting of Performance Criteria

Reporting on the effectiveness of the soil stripping methods and performance against objectives can be conducted through regulatory and corporate reporting. Topsoil management and erosion and sediment control plan performance needs to be reviewed annually. The recommended minimum requirements to be recorded are:

- Monitoring results (including erosion and sedimentation, surface water and air quality);
- Effectiveness of control measures in an objective versus performance criteria analysis;
- Review of disturbance activities and rehabilitation performance;
- Topsoil balance (volume stripped, volume respread, volume stockpiled); and
- A register risks associated with topsoil management that highlights action items.

### Appendix 3

### **Overburden Testing Laboratory Results**

Wet Order     EB1113033     Fage     1 of 26       Clinit     EIN113033     EIN113033     EIN113033       Control     Six SVXLE FINANDIA     Liponetry     Environmes Services       Address     Six SVXLE FINANDIA     Environmes Services     Environmes Services       Address     Six SVXLE FINANDIA     Environmes Services     Environmes Services       Address     Environmes Services     Environmes Services     Environmes Services       Address     Environmes Services     Environmes Services     Environmes Services       Environmes     Environmes Services     Environmes Services     Environmes Services       Relearch     Environmes     Environmes Services     Environmes Services       Relearch     Environmes     Environmes     Environmes     Environmes       Relearch     Environmes     Environmes     Environmes     Enviro	Work Order : EB1119039	RTIFICATE OF ANALYSIS	
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TARINGA     TARINGA       Email     Email     Email     Enail     Enail     Enail     Enail       Email     cashsale@alenvino.com     cashsale@alenvino.com     Enail     Enail     Enail     Enail       Enail     cashsale@alenvino.com     cashsale@alenvino.com     Felephone     :e117.32437218       Enail     Chion Downs     Chion Downs     Chion Downs     Chion Downs       Enail     Conon Downs     Chion Downs     Chion Downs     Chion Downs       Conon Downs     Chion Downs     Chion Downs     Chion Downs     Chion Downs       Conon Downs     Chion Downs     Chion Downs     Chion Downs     Chion Downs       Conon Downs     Chion Downs     Chion Downs     Chion Downs     Chion Downs       Conon Downs     Chion Downs     Chion Downs     Chion Downs     Chion Downs       Conon Downs     Chion Downs     Chion Downs     Chion Downs     Chion Downs       Conon Inner     Image: Chion Special Elgipartice     No. of samples received     Image: State Chion Special Elgipartice       Dist Cartificate of Analysis contains the following information:     Image: Submitted All pages of this report have been chocked and approve release.       Dist Cartificate of Analysis contains the following information:     Image: Submitted Analysis contains the following information:	Address : SUITE 2 / 1 SWANN RD	Address	: 32 Shand Street Stafford QLD Australia 4053
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Enal       Cash safe@atservinc.com       Email       Enal	BRISBANE QUEENSLAND 4068		
Telephone     :-617 33317228       Telephone     :-617 33317218       Project     :-617 33337218       Project     :-617 33337218       Project     :-617 33337218       Project     :-17 33337218       Project     :-17 3337218       CoC number     :       Sample Received     :135EP-2011       Sample Received     :155       Out number     :-        :-       No of sample Received     :55	E-mail : cash.sale@alsenviro.com	E-mail	: Brisbane.Enviro.Services@alsglobal.com
Feasinile       :e17 3220 3311       Feasinile       :e17 3243 7218         Project       :0/ion Downs       :0/ion Downs       :e17 3243 7218         Code number       :       :       :0/ion Downs       :0/ion Downs         Code number       :       :       :13:SEP 2011       :13:SEP 2011         Sampler       :       :       :13:SEP 2011       :13:SEP 2011         Sampler       :       :       :0/ion Downs       :0/ion Downs         Code number       :       :       :13:SEP 2011       :13:SEP 2011         Sampler       :       No. of samples Received       :13:SEP 2011       :13:SEP 2011         Stampler       :       No. of samples received       :55       :00         Oute number       :       No. of samples received       :55       :00         Date sample(s) as submitted. All pages of this report have been checked and approverelease.       :0.0       :0.0       :0.0         Its Certificate of Analysis contains the following information:       :0.0       :0.0       :0.0       :0.0         Its Certificate of Analysis contains the following information:       :0.0       :0.0       :0.0       :0.0       :0.0         Its Certificate of Analysis contains the following information: <th>Telephone : +61 7 3720 9300</th> <td>Telephone</td> <td>: +61 7 3243 7222</td>	Telephone : +61 7 3720 9300	Telephone	: +61 7 3243 7222
Project     : NEPM 1999 Schedule B(3) and AIS OCSS requirement       Co-C number     ::     : No       Co-C number     ::     : Sampler Received     : SSEP-2011       Sampler     : Sampler Received     : SSEP-2011       Sampler     : See Participation     : SSEP-2011       Sampler     : See Participation     : SSEP-2011       Sampler     : See Participation     : SSEP-2011       Sampler     : SSEP-2011     : SSEP-2011       Sampler <td: of="" sampler="" samplereceived<="" td="">     : SSEP-2011</td:>	Facsimile : +61 7 3720 9311	Facsimile	: +61 7 3243 7218
Order number     Image: Construction of samples Received     Image: Construction of samples <t< td=""><th>Project : Orion Downs</th><td>QC Level</td><td>: NEPM 1999 Schedule B(3) and ALS QCS3 requirement</td></t<>	Project : Orion Downs	QC Level	: NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Co-Contuber       :	Order number :		
Sampler       ::       Isue Date       :2-SEP-2011         Site       :       No of samples received       :5         Outo number       :       No of samples received       :5         This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. All pages of this report have been checked and approverelease.       :5         This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. All pages of this report have been checked and approverelease.       :5         This continuents       :1       :1       :2         This continuents       :1       :2       :2         This continuents       :1       :2       :2         This continuents       :1       :2       :2         Analysis contains the following information:       :1       :2       :2         This document       :2       :2       :2       :2         Analysis contains the following information:       :3       :2       :3       :3         This document       :2       :1       :2       :2       :3       :2         Analysis contains the following information:       :3       :3       :3       :3       :3         This document       :3       :3	C-O-C number :	Date Samples Received	: 13-SEP-2011
Step       :       No. of samples received       :55         Curde number       :       No. of samples analysed       :55         This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. All pages of this report have been checked and approverglease.       No. of samples analysed       :55         This Certificate of Analysis contains the following information:       •       •       •       •         • General Comments       •       •       •       •       •       •         • Analytical Results       •       •       •       •       •       •       •       •         • Analytical Results       •	Sampler : Kaylie Hyland	Issue Date	: 29-SEP-2011
No. of samples necked       55         This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. All pages of this report have been checked and approve necked and approve the sample(s) as submitted. All pages of this report have been checked and approve necked and approve the sample(s) as submitted. All pages of this report have been checked and approve the sample(s) as submitted. All pages of this report have been checked and approve the sample(s) as submitted. All pages of this report have been checked and approve the sample(s) as submitted. All pages of this report have been checked and approve the analytical Results.         Inits Gordments       Inits document is sued in accordance with NATA accretited Laboratory 25         Inits document is issued in accordance with NATA accretited on this checument is sued in accordance with NATA accretited for compliance with procedures specified in 21 CFR part 11.       Accretited below. Electronic signing has conditione with more accordance with NATA accretited for compliance with procedures specified in 21 CFR part 11.         Mote Cate       Signatories       Accretitation regions         Mote Cate       Sentior Inorganic Chemist       Brisbane Inorganics         Mote Catak       Myles.Clark       Accretitation Supervisor       Brisbane Inorganics         Mote Catak       Myles.Clark       Accid Supervisor       Brisbane Acid Suphate Soils	Site :		
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Matrix       Nata Accredited Laboratory 825       Signatories       Signatories         Matrix       Nata Accredited Laboratory 825       Signatories       Signatories       Signatories       Signatories       Indicated below. Electronic signing has         Matrix       This document is issued in accordance with NATA       Signatories       Signatories       Indicated below. Electronic signing has         Mote       This document is issued in accordance with NATA       Signatories       Desition       21 CFR Part 11.       Accreditation Category         Mote       Kim McCabe       Position       Senior Inorganic Chemist       Brisbane Inorganics       Brisbane Inorganics         Mote       Myles.Clark       Accreditate Soils Supervisor       Stafford Minerals - AY	<ul><li>This Certificate of Analysis contains the following information:</li><li>General Comments</li><li>Analytical Results</li></ul>		
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This document is issued in accordance with NATA       This document is issued in accordance with NATA       Carried out in compliance with procedures specified in 21 CFR Part 11.         accordance with NATA       accordance with NATA       Signatories       Position       Accreditation Category         accreditation requirements.       Kim McCabe       Position       Accreditation Category       Accreditation Category         Mound Reconnee with NATA       Signatories       Position       Senior Inorganic Chemist       Brisbane Inorganics         Mound Reconnee with Nate       Moles.Clark       Moles.Clark       Acid Sulfrate Soils Supervisor       Brisbane Acid Sulphate Soils         Mound Reconnee with Nate       ISO/IEC 17025.       Myles.Clark       Acid Sulfrate Soils Supervisor       Stafford Minerals - AY	This document h	as been electronically signed by the author	ized signatories indicated below. Electronic signing has
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accreditation requirements.     Kim McCabe     Senior Inorganic Chemist     Brisbane Inorganics       would reconsisted accredited for compliance with ISO/IEC 17025.     Myles.Clark     Senior Inorganic Chemist     Brisbane Inorganics       would reconsisted accredited for compliance with ISO/IEC 17025.     Myles.Clark     Acid Sulfate Soils Supervisor     Brisbane Acid Sulphate Soils Stafford Minerals - AY	accordance with NATA Signatories	Position	Accreditation Category
MORD RECOGNISE         Accredited for compliance with         Myles.Clark         Acid Sulfate Soils Supervisor         Brisbane Acid Sulphate Soils           MORD RECOGNISE         Accredited for compliance with         Myles.Clark         Acid Sulfate Soils Supervisor         Brisbane Acid Sulphate Soils           Accredition         ISO/IEC 17025.         Myles.Clark         Acid Sulfate Soils Supervisor         Stafford Minerals - AY	accreditation requirements. Kim McCabe	Senior Inorganic Chemis	st Brisbane Inorganics
Accretization ISO/IEC 17025. Myles.Clark Acid Sulfate Soils Supervisor Stafford Minerals - AY	WORLD RECOGNISED Accredited for compliance with Myles.Clark	Acid Sulfate Soils Super	visor Brisbane Acid Sulphate Soils
	ACCREDITATION ISO/IEC 17025. Myles.Clark	Acid Sulfate Soils Super	visor Stafford Minerals - AY

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# **General Comments**

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insuffient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society. LOR = Limit of reporting Key:

 $^{A}$  = This result is computed from individual analyte detections at or above the level of reporting

- ASS: EA013 (ANC) Fizz Rating: 0- None; 1- Slight; 2- Moderate; 3- Strong; 4- Very Strong; 5- Lime.
- EA011E (Extended Boil Coal Washery NAG) Testing was discontinued for samples that exceeded pH (ox) of 4.5 as per the method guidelines.
- EG005T (Total Metals) Sample EB1119039 001 (9939) shows poor duplicate results due to sample heterogeneity. Confirmed by visual inspection.
  - EG005T (Total Metals) Sample EB1119039 011 (9949) shows poor duplicate results due to sample heterogeneity. Confirmed by visual inspection.
- EG005T (Total Metals) Sample EB1119039 051 (9988) shows poor duplicate results due to sample heterogeneity. Confirmed by visual inspection. •
- EG005T (Total Metals) The LOR for samples in workorder EB1119039 has been raised due to matrix interference.

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Page	Work Order	Client	Project	



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Ub Matrix: ROCK         Clear sampling date trime         9939         P           Controard         Clear sampling date trime         28-AUG-201115.00         28-AU           Controard         Cas Number         0.1         PH Unit         28-AUG-201115.00         28-AU           Controard         Cas Number         0.1         PH Unit         8.2         28-AU           ANOB: Net Acid Production Potential          0.5         8142504         -72.1         28-AU           ANOB: Net Acid Production Potential          0.5         8142504         -72.1         28-AU           ANOB: Controtivity 25°C          1         PH Unit         8.1         27-4           AND : Controtivity 25°C         0.1         PH Unit         8.1         27-4         24-4           AND : Sciolation Controti         0.1         PSC acc03         7.4         24-4         24-4           AND : Sciolation Content         0.1         PSC acc03         7.4         24-4         24-4           AND : Sciolation Content         0.1         PSC acc03         7.4         24-4         24-4         24-4         24-4         24-4         24-4         24-4         24-4         24-4         24-4         24-4 <th>t sample ID <i>date / time</i> 28-AUG-2011 15:00 28-AUG-201 28-AUG-</th> <th>9940 B-AUG-2011 15:00 EB1119039-002 8.5 -94.4 147 147 8.4 8.4 8.4 8.4 2 4.4 8.4 8.4 8.4 8.4 8.4 8.4 8.4 8.4 8.4</th> <th>9941 28-AUG-2011 15:00 EB1119039-003 8.6 -89.5 -89.5 9.3 9.3 9.1 2</th> <th>9942 28-AUG-2011 15:00 EB1119039-004 8.7 -141 -141 -141 -141 127 -141 -141 -141 -141 -141 -141 -141 -14</th> <th>943 28-AUG-2011 15:00 EB1119039-005 8.4 -105 143 9.1</th>	t sample ID <i>date / time</i> 28-AUG-2011 15:00 28-AUG-201 28-AUG-	9940 B-AUG-2011 15:00 EB1119039-002 8.5 -94.4 147 147 8.4 8.4 8.4 8.4 2 4.4 8.4 8.4 8.4 8.4 8.4 8.4 8.4 8.4 8.4	9941 28-AUG-2011 15:00 EB1119039-003 8.6 -89.5 -89.5 9.3 9.3 9.1 2	9942 28-AUG-2011 15:00 EB1119039-004 8.7 -141 -141 -141 -141 127 -141 -141 -141 -141 -141 -141 -141 -14	943 28-AUG-2011 15:00 EB1119039-005 8.4 -105 143 9.1
Client samping date / time         28-AUC-201115.00	Z8-AUG-2011 15:00         Z           Unit         EB1119039-001         Z           PH Unit         8.2         E           PH Unit         8.2         F           PH Unit         8.2         F           JS/cm         121         F           JS/cm         121         F           PH Unit         8.1         F           PH Unit         7.4         F           PH Unit         8.1         F           PH OLI         7.4         F           PH CaCO3         7.4         F           %         7.4         F           %         7.4         F           %         38.3         F           %         38.3         F           Med/100g         58.8	B-AUG-2011 15:00 EB1119039-002 8.5 -94.4 147 147 8.4 8.4 8.4 8.4 2 4.4 2 4.4 2 4.4 2 4.4 5 6 4.4 5 6 4.4 5 6 5 6 5 6 5 6 5 6 5 6 5 6 5 6 5 6 6 6 6 6 6 6 6 6 6 6 7 6 7	28-AUG-2011 15:00 EB1119039-003 8.6 -89.5 9.3 9.3 89.5 2	28-AUG-2011 15:00 EB1119039-004 8.7 -141 -141 9.1 9.1 14.4 3.3	28-AUG-2011 15:00 EB1119039-005 8.4 -105 143 9.1
ControbutedCAS NumberLORUnitEB111903-001EB1FA002: PH (Solis) $\sim$ $\sim$ $\sim$ $\sim$ EB111903-001EB1FA002: PH (Solis) $\sim$ $\sim$ $\sim$ $\sim$ $\sim$ $\sim$ $\sim$ $\sim$ $\sim$ FA11PAL Kold $\sim$	Unit         EB111903-001           PH Unit         8.2           PH Unit         8.2           IJS/cm         -72.1           JJS/cm         -72.1           JJS/cm         121           JJS/cm         2           JJS/cm         10	EB1119039-002 8.5 -94.4 147 147 8.4 8.4 8.4 9.6 9.6 9.6 4.2 42.1	EB1119039-003 8.6 -89.5 9.3 89.5 9.1 2	EB1119039-004 8.7 -141 127 9.1 9.1 141 141 144 33	EB1119039-005 8.4 -105 143 9.1
EA003: pH (Solis) $=$ <th< th=""><th>pH Unit     8.2       kg H2SO4/t     -72.1       kg H2SO4/t     -72.1       µS/cm     121       µS/cm     121       µS/cm     72.4       kg H2SO4     72.4       µS/cu/t     72.4       PH Unit     8.1       kg H2SO4     72.4       equiv/t     72.4       % CaC03     7.4       % Ca</th><th>8.5 -94.4 8.4 8.4 9.6 9.6 2 2 2 2 564</th><th>8.6 -89.5 9.3 89.5 2</th><th>8.7 -141 -127 9.1 9.1 141 141 143 33</th><th>8.4 -105 143 9.1</th></th<>	pH Unit     8.2       kg H2SO4/t     -72.1       kg H2SO4/t     -72.1       µS/cm     121       µS/cm     121       µS/cm     72.4       kg H2SO4     72.4       µS/cu/t     72.4       PH Unit     8.1       kg H2SO4     72.4       equiv/t     72.4       % CaC03     7.4       % Ca	8.5 -94.4 8.4 8.4 9.6 9.6 2 2 2 2 564	8.6 -89.5 9.3 89.5 2	8.7 -141 -127 9.1 9.1 141 141 143 33	8.4 -105 143 9.1
ph Yalue0.1ph Unit8.29.1 $= 5000$ : Nati Acid Production Potential<	pH Unit     8.2       kg H2SO4/t     -72.1       µS/cm     121       µS/cm     121       µS/cm     121       µB Unit     8.1       µB H Unit     8.1       µB H Unit     7.2.4       µB H Unit     7.2.4       µB H Unit     7.2.4       µB H Unit     7.2.4       µB H Unit     8.1       µB H Unit     7.2.4       µB H Unit     7.2.4       µB H Unit     8.1       µB H Unit     7.4       µB H Unit     7.4       µB H Unit     2       µB H H H H H H H H H H H H H H H H H H H	8.5 -94.4 147 8.4 8.4 9.6 9.6 2 2 2 2 2 2 56 42.1	8.6 	8.7 -141 127 9.1 141 14.4 3	8.4 -105 9.1
E. A003: Nett Acid Production Potential        0.5       kg H2SO4/i      72.1         Net Acid Production Potential        0.5       kg H2SO4/i      72.1         Exercisal Conductivity       Exercisal Conductivity       Exercisal Conductivity       2.7         Exotisal Conductivity       2.8       H       2.7         Exotisal Conductivity       2.8       1.1       kg H         EAO15: Acid Neutralising Capacity        0.1       pH Unit       k1         EAO15: Acid Neutralising Capacity        0.1       pH Unit       k1         ANC as EAD3        0.1       pH Unit       k1       k2         ANC as EAD3        0.1       pH Unit       k1       k2         ANC as EAD3        0.1       pH Unit       x1       k1         ANC as EAD3        0.1       pe equity       7.4       k2         ANC as EAD3       Moisture Content       0.1       pe equity       7.4       k1         ANC as EAD3       Moisture Content (dried @ 103°C)       0.1       meq/1009       2.1       k1         Moisture Content (dried @ 103°C)       0.1       meq/1009       2.2       k1	kg H2SO4/t       -72.1         µS/cm       121         µS/cm       121         PH Unit       8.1         Rg H2SO4       7.2.4         kg H2SO4       72.4         kg H2SO4       72.4         equiv./t       7.4         % CaCO3       7.4	-94.4 147 8.4 9.6 2 2 42.1	-89.5 129 9.3 89.5 2	-141 127 9.1 141 14.4	-105 143 9.1
Net Acid Production Potential $0.5$ $g H2SO4A$ $7.2,1$ $7.2,1$ EX010: Conductivity $25°C$ $1$ $1$ $126$ $121$ $121$ Exertical Conductivity $25°C$ $1$ $1$ $121$ $121$ $121$ Exertical Conductivity $25°C$ $1$ $1$ $121$ $121$ $121$ EX011: Exerting $27$ $121$ $121$ $121$ $121$ $121$ EX01: Exerting $100$ $100$ $100$ $121$ $121$ $121$ EX1: Exerting $100$ $100$ $100$ $121$ $121$ $121$ EX1: Exerting $100$ $100$ $100$ $121$ $121$ EX1: Exerting $100$ $100$ $100$ $100$ $100$ Exchangeable Caterian $0.1$ $0.1$ $0.21$ $100$ Exchangeable Caterian $0.1$ $0.1$ $0.21$ $100$ Exchangeable Caterian $0.1$ $0.01$ $221$ $100$ Exchangeable Caterian $0.1$ $0.01$ $0.01$ $221$ Exchangeable Caterian $0.1$ $0.01$ $0.01$ $0.01$ Exchangeable Caterian $0.01$ $0.01$ $0.01$ $0.01$ Exchangeable Major Caterian <td>kg H2SO4/t     -72.1       µS/cm     121       µS/cm     121       PH Unit     8.1       Rg H2SO4     72.4       equiv./t     72.4       % CaCO3     7.4       % CaCO3<td>-94.4 147 8.4 9.6 9.6 2 2 2 2 2 5 5 4.2 1</td><td>-89.5 129 9.3 89.5 2</td><td>-141 127 9.1 141 14.4 3</td><td>-105 143 9.1</td></td>	kg H2SO4/t     -72.1       µS/cm     121       µS/cm     121       PH Unit     8.1       Rg H2SO4     72.4       equiv./t     72.4       % CaCO3     7.4       % CaCO3 <td>-94.4 147 8.4 9.6 9.6 2 2 2 2 2 5 5 4.2 1</td> <td>-89.5 129 9.3 89.5 2</td> <td>-141 127 9.1 141 14.4 3</td> <td>-105 143 9.1</td>	-94.4 147 8.4 9.6 9.6 2 2 2 2 2 5 5 4.2 1	-89.5 129 9.3 89.5 2	-141 127 9.1 141 14.4 3	-105 143 9.1
EAO10: Conductivity Electrical Conductivity @ $2^{\circ}$ c1JS/cm121Electrical Conductivity @ $2^{\circ}$ c1JS/cm121EAO15: A pl OXElectrical Conductivity @ $2^{\circ}$ c0.1PI Unit8.1EAO15: A cid Neutralising Capacity0.5Kg HS/O47.24ANC as HS/O40.1 $8$ HS/O47.24EAO15: A cid Neutralising Capacity0.1 $8$ Ga(03)7.47ANC as HS/O40.1 $8$ Ga(03)7.47ANC as cacO30.1 $8$ Ga(03)7.47ANC as cacO30.1 $8$ Ga(03)7.47ANC as cacO30.1 $8$ Ga(03)77ANC as cacO30.1 $8$ Ga(03)77ANC as cacO30.1 $8$ Ga(03)77ANC as cacO30.1 $8$ Ga(01)22.110Moisture Content (dried (203°C)0.1 $9$ Ga(01)22.110ANC as cacO30.1 $9$ Ga(01)22.120Cacina Gaebie Magnesium0.1 $9$ Ga(01)22.120Cacina Granting Magnesium0.1 $9$ Ga(01)2020Cacina Gaebie Magnesium0.1 $9$ Ga(01)2020Cacina Gaebie Magnesium0.1 $9$ Ga(01)2020Cacina Gaebie Magnesium0.1 $9$ Ga(01) <td>JS/cm     121       JB/cm     121       PH Unit     8.1       Rd H2SO4     7.2.4       equiv./t     7.2.4       % CaCO3     7.4       % CaCO3</td> <td>147 8.4 9.6 2 2 4.2.1</br></td> <td>129 9.3 89.5 2</td> <td>127 9.1 141 14.4 3</td> <td>143 9.1</td>	JS/cm     121       JB/cm     121       PH Unit     8.1       Rd H2SO4     7.2.4       equiv./t     7.2.4       % CaCO3     7.4       % CaCO3	147 8.4 9.6 	129 9.3 89.5 2	127 9.1 141 14.4 3	143 9.1
Electrical Conductivity @ $2^{\circ}$ C1 $\mu$ Ncm121-Eloctrical Conductivity @ $2^{\circ}$ C0.1 $\mu$ Unt8.1-EA011E-X: pH OX0.1 $\mu$ Unt8.1-EA013E-X: pH OX0.1 $\mu$ Unt8.1-EA013E-X: pH OX0.1 $\mu$ Unt8.1-EA013: Acid Neutratising Capacity0.5 $\mu$ H 20047.4-EA013: Acid Neutratising Capacity0.1 $\mu$ Cacin7.4-ANC as CaCO30.1 $\mu$ Cacin2.4-ANC as Cacos0.1 $\mu$ Cacin2.4-Antur Total as C(LCO)0.1 $\mu$ CacinCacin Exchangeable Kapin0.1 $\mu$ CacinCacin Exchangeable Sodium0.1 $\mu$ CacinCacin Exchangeable Sodium0.1 $\mu$ CacinCacin Exchangeable S	μS/cm     121       μS/cm     8.1       PH Unit     8.1       PH Unit     8.1       R     72.4       equiv./t     72.4       % CaCO3     7.4       %     7.4       %     7.4       %     7.4       %     7.4       %     7.4       %     7.4       %     7.4       %     7.4       %     7.4       %     7.4       %     7.4       %     7.4       %     7.4       %     38.3       %     7.4       %     7.4       %     7.4       %     7.4       %     7.4       %     7.4       %     7.4       %     7.4       %     7.4       %     7.4       % <td>147 8.4 94.4 9.6 2 42.1 56.4</td> <td>129 9.3 89.5 2</td> <td>127 9.1 141 14.4 3</td> <td>143 9.1</td>	147 8.4 94.4 9.6 2 42.1 56.4	129 9.3 89.5 2	127 9.1 141 14.4 3	143 9.1
Edot1E-J: pH OX $\Box$ $\Box$ $D$	PH Unit         8.1           kg H2SO4         8.1           kg H2SO4         72.4           equiv./t         72.4           % CaCO3         7.4           %         38.3           meq/100g         58.8           meq/100g         22.1           meq/100g         0.9           meq/100g         82.8	8.4 94.4 22 42.1	9.3 89.5 2	9.1 141 14.4 3	9.1
ph ( $0X$ ) $0.1$ $ph$ Unit $8.1$ $8.1$ EAO13: Acid Neutralising Capacity $0.5$ $8.9$ H2SO4 $8.1$ $8.1$ ANC as H2SO4 $0.5$ $8.9$ H2SO4 $7.24$ $9.1$ ANC as H2SO4 $0.1$ $8.6$ H2SO4 $7.24$ $9.1$ ANC as H2SO4 $0.1$ $8.6$ H2SO4 $7.24$ $9.1$ ANC as CaCO3 $0.1$ $8.6$ H2SO4 $7.4$ $9.1$ ANC as CaCO3 $0.1$ $0.1$ $8.6$ H2U1 $2.4$ $9.1$ ANC as CaCO3 $0.1$ $0.1$ $8.6$ H2U1 $2.4$ $9.1$ ANC as CaCO3 $0.3$ $1.0$ $8.3$ $3.3$ $7.4$ ANC as CaCO3 $0.1$ $0.1$ $0.1$ $0.1$ $9.2$ ANC as CaCO3 $0.1$ $0.1$ $0.1$ $0.2$ $9.2$ ANC as CaCO3 $0.1$ $0.1$ $0.1$ $0.2$ $9.2$ Antipersolut $0.1$ $0.1$ $0.1$ $0.2$ $9.2$ Antipersolut $0.1$ $0.1$ $0.2$ $0.2$ $0.2$ Antipersolut $0.1$ $0.1$ <td< td=""><td>pH Unit     8.1       kg H2SO4     72.4       equiv./t     72.4       % Gato.3     7.4       % Cato.3     7.4</td><td>8.4 9.6 9.6 4.1 42.1</td><td>9.3 89.5 2</td><td>9.1 141 14.4 3</td><td>9.1</td></td<>	pH Unit     8.1       kg H2SO4     72.4       equiv./t     72.4       % Gato.3     7.4       % Cato.3     7.4	8.4 9.6 9.6 4.1 42.1	9.3 89.5 2	9.1 141 14.4 3	9.1
E-013: Acid Neutralising Capacity         Calon Section Neutralising Capacity         Calon Neutralising Capacity           ANC as H2SO4          0.5         kg H2SO4         72.4           ANC as H2SO4          0.5         kg H2SO4         72.4           ANC as CaCO3          0.1         % CaCO3         7.4           Firz Rating          0.1         % CaCO3         7.4           Firz Rating          0.1         % CaCO3         7.4           Firz Rating          0.1         % CaCO3         7.4           EADS5: Moisture Content          0.1         % CaCO3         38.3           ED07: Exchangeable Cation          0.1         meq/1009         58.8           C Exchangeable Cation          0.1         meq/1009         22.1           C Exchangeable Cation          0.1         meq/1009         22.1           C Exchangeable Potassium          0.1         meq/1009         22.1           C Exchangeable Potassium          0.1         meq/1009         22.1           C Exchangeable Potassium          0.1         meq/1009         22.1     <	Kg H2SO4     72.4       equiv./t     7.2.4       equiv./t     7.4       % CaCO3     7.4       %     38.3       %     38.3       meq/100g     58.8       meq/100g     22.1       meq/100g     0.9       meq/100g     82.8	94.4 9.6 42.1 42.1	89.5 9.1 2	141 14.4 3	
ANC as H2SO4         0.5         kg H2SO4         7.2         4           ANC as H2SO4         0.1         % CaCO3         7.4         1           ANC as CaCO3         0.1         % CaCO3         7.4         1           FIJZ Rating         0.1         % CaCO3         7.4         1           FANC as CaCO3         0.1         % CaCO3         7.4         1           FANC as CaCO3         0.1         % CaCO3         7.4         1           EAG55 Molisture Content         1.0         %         38.3         1         1           EAG55 Molisture Content         1.0         %         38.3         1 <t< td=""><td>kg H2SO4         72.4         72.4           equiv./t         % CaCO3         7.4         7.4           % CaCO3         7.4         7.4         7.4           % CaCO3         7.4         2         7.4           % CaCO3         38.3         38.3         7.4           %         38.3         38.3         7.4           %         38.3         38.3         7.4           meq/100g         58.8         7.4         7.4           meq/100g         58.8         7.0         7.4           meq/100g         22.1         7.0         7.4           meq/100g         23.4         7.0         7.0           meq/100g         82.8         7.0         7.0</td><td>94.4 9.6 42.1 2 42.1</td><td>89.5 9.1 2</td><td>141 14.4 3</td><td></td></t<>	kg H2SO4         72.4         72.4           equiv./t         % CaCO3         7.4         7.4           % CaCO3         7.4         7.4         7.4           % CaCO3         7.4         2         7.4           % CaCO3         38.3         38.3         7.4           %         38.3         38.3         7.4           %         38.3         38.3         7.4           meq/100g         58.8         7.4         7.4           meq/100g         58.8         7.0         7.4           meq/100g         22.1         7.0         7.4           meq/100g         23.4         7.0         7.0           meq/100g         82.8         7.0         7.0	94.4 9.6 42.1 2 42.1	89.5 9.1 2	141 14.4 3	
ANC as CaC03         equiv.ti         equiv.ti         equiv.ti         c         equiv.ti         c	equiv./t         7.4           % CaCO3         7.4           % CaCO3         7.4           Fiz/Unit         2           %         38.3           %         38.3           meq/100g         58.8           meq/100g         22.1           meq/100g         0.9           meq/100g         82.8	9.6 2 42.1 56.4	9.1	14.4 3	106
$\wedge$ ANC as CaCO3 $\dots$ $0.1$ $\%$ CaCO3 $7.4$ $1.4$ Fiz Rating $\square$ $\square$ $\square$ $\square$ $\square$ $\square$ $\square$ $\square$ $\square$ ETZ Rating $\square$ EAG55. Moisture Content (dried @ 103°C) $\square$ <td>% CaCO3         7.4           Fiz Unit         2           Fiz Unit         38.3           %         38.3           %         38.3           meq/100g         58.8           meq/100g         53.3           meq/100g         1.0           meq/100g         0.9           meq/100g         82.8</td> <td>9.6 2 42.1 56.4</td> <td>2. 2</td> <td>3</td> <td></td>	% CaCO3         7.4           Fiz Unit         2           Fiz Unit         38.3           %         38.3           %         38.3           meq/100g         58.8           meq/100g         53.3           meq/100g         1.0           meq/100g         0.9           meq/100g         82.8	9.6 2 42.1 56.4	2. 2	3	
Fizz Rating $-$ 0Fizz Unit2A055: Moisture Content $    -$ A055: Moisture Content (dried @ 103°C) $    -$ Moisture Content (dried @ 103°C) $     -$ A005: Exchangeable Cations $       -$ ED007: Exchangeable Cations $        -$ Exchangeable Cations $          -$ Exchangeable Cation $   -$ </td <td>Fizz Unit         2           %         38.3           %         38.3           meq/100g         58.8           meq/100g         53.3           meq/100g         22.1           meq/100g         0.9           meq/100g         82.8</td> <td>2 42.1 56.4</td> <td>7</td> <td>ę</td> <td>10.8</td>	Fizz Unit         2           %         38.3           %         38.3           meq/100g         58.8           meq/100g         53.3           meq/100g         22.1           meq/100g         0.9           meq/100g         82.8	2 42.1 56.4	7	ę	10.8
FAG55: Moisture Content           ^ MOisture Content (dried @ 103°C)          1.0         %         38.3           ^ MOisture Content (dried @ 103°C)          1.0         %         38.3           FED077: Exchangeable Cations         0.1         meq/1009         58.8         58.8           * Exchangeable Catium         0.1         meq/1009         58.8         58.8           * Exchangeable Potassium         0.1         meq/1009         52.1         58.8           * Exchangeable Potassium         0.1         meq/1009         52.8         58.8           * Cation Exchange Capacity         0.1         meq/1009         52.8         58.8           * Cation Exchange Capacity         0.1         %         6.9         6.9         6.9           * Cation Exchange Capacity         0.1         %         %         6.1         6.9         6.1           * Cation Exchange Capacity         0.1         %	%         38.3           meq/100g         58.8           meq/100g         58.8           meq/100g         22.1           meq/100g         0.9           meq/100g         82.8	42.1			2
$\wedge$ Moisture Content (dried @ 103°C) $-10$ $6$ $38.3$ $38.3$ ED07: Exchangeable Cations $-10$ $meq/100g$ $58.8$ $-10$ $\wedge$ Exchangeable Magnesium $-0.1$ $meq/100g$ $58.8$ $-10$ $\wedge$ Exchangeable Magnesium $-0.1$ $meq/100g$ $58.8$ $-10$ $\wedge$ Exchangeable Potassium $-0.1$ $meq/100g$ $22.1$ $-10$ $\wedge$ Exchangeable Potassium $-0.1$ $meq/100g$ $22.1$ $-10$ $\wedge$ Exchangeable Potassium $-0.1$ $meq/100g$ $-10$ $-10$ $\wedge$ Exchangeable Sodium $-0.1$ $meq/100g$ $-10$ $-10$ $\wedge$ Exchangeable Sodium $-0.1$ $-0.1$ $-10$ $-10$ $\wedge$ Exchangeable Sodium $-0.1$ $-0.1$ $-10$ $-10$ $\wedge$ Exchange Capacity $-10$ $-10$ $-10$ $-10$ $\wedge$ Exchange Capacity <t< td=""><td>%         38.3         8.4           meq/100g         58.8         58.8           meq/100g         52.1         10           meq/100g         1.0         10           meq/100g         0.9         10           meq/100g         82.8         10</td><td>42.1</td><td></td><td></td><td></td></t<>	%         38.3         8.4           meq/100g         58.8         58.8           meq/100g         52.1         10           meq/100g         1.0         10           meq/100g         0.9         10           meq/100g         82.8         10	42.1			
ED007: Exchangeable Cations $\wedge$ Exchangeable Catium0.1meq/100g58.8 $\wedge$ Exchangeable Magnesium0.1meq/100g58.8 $\wedge$ Exchangeable Magnesium0.1meq/100g22.1 $\wedge$ Exchangeable Magnesium0.1meq/100g22.1 $\wedge$ Exchangeable Notassium0.1meq/100g22.1 $\wedge$ Exchangeable Sodium0.1meq/100g22.1 $\wedge$ Cation Exchange Capacity0.1meq/100g82.8 $\wedge$ Cotion Exchange Capacity0.1meq/100g82.8 $\wedge$ Cation Exchange Capacity0.1med/100g82.8 $\wedge$ Cotion Exchange Capacity0.1med/100g $\wedge$ Cotion Exchange Capacity0.1med/100g $\wedge$ Cotion Exchange Capacity0.1med/100g	meq/100g 58.8 meq/100g 22.1 meq/100g 1.0 meq/100g 0.9 meq/100g 82.8	6.4	38.6	33.3	39.1
$^{\bullet}$ Exchangeable Calcium $ 0.1$ $meq/100g$ $58.8$ $58.8$ $^{\bullet}$ Exchangeable Magnesium $ 0.1$ $meq/100g$ $58.8$ $58.8$ $^{\bullet}$ Exchangeable Potassium $ 0.1$ $meq/100g$ $22.1$ $ ^{\bullet}$ Exchangeable Potassium $ 0.1$ $meq/100g$ $22.1$ $ ^{\bullet}$ Exchangeable Sodium $ 0.1$ $meq/100g$ $22.1$ $ ^{\bullet}$ Exchangeable Sodium $ 0.1$ $meq/100g$ $0.9$ $ ^{\bullet}$ Exchangeable Sodium $ 0.1$ $meq/100g$ $0.9$ $ ^{\bullet}$ Exchangeable Sodium $ 0.1$ $meq/100g$ $0.9$ $ ^{\bullet}$ Cation Exchange Capacity $ 0.1$ $   ^{\bullet}$ Cation Exchange Capacity $ 0.1$ $   ^{\bullet}$ Cation Exchange Capacity $      ^{\bullet}$ Sububle Major Cations $        ^{\bullet}$ Colose $          ^{\bullet}$ Colose $          ^{\bullet}$ Colose $                       -$	meq/100g         58.8           meq/100g         22.1           meq/100g         1.0           meq/100g         0.9           meq/100g         82.8	EC 4			
$^{\bullet}$ Exchangeable Magnesium $ 0.1$ $meq/100g$ $22.1$ $21$ $^{\bullet}$ Exchangeable Potassium $ 0.1$ $meq/100g$ $22.1$ $1.0$ $^{\bullet}$ Exchangeable Sodium $ 0.1$ $meq/100g$ $22.1$ $1.0$ $^{\bullet}$ Exchangeable Sodium $ 0.1$ $meq/100g$ $0.9$ $22.1$ $^{\bullet}$ Exchangeable Sodium $ 0.1$ $meq/100g$ $0.9$ $22.1$ $^{\bullet}$ Cation Exchange Capacity $0.1$ $meq/100g$ $82.8$ $82.8$ $^{\bullet}$ Cation Exchange Capacity $0.1$ $meq/100g$ $82.8$ $82.8$ $^{\bullet}$ Cation Exchange Capacity $0.1$ $meq/100g$ $82.8$ $82.8$ $^{\bullet}$ Cation Exchange Capacity $0.01$ $meq/100g$ $82.8$ $82.8$ $^{\bullet}$ Coloride Discrete analyser $0.01$ $meq/100g$ $82.8$ $82.8$ $^{\bullet}$ Coloride $10.01$ $meq/100g$ $82.8$ $82.8$ $82.8$ $^{\bullet}$ Coloride $10.01$ $meq/100g$ $82.8$ $82.8$ $82.8$ $^{\bullet}$ Coloride $10.01$ $meq/100g$ $90.01$ $90.01$ $^{\bullet}$ Coloride $10.01$ $10$ $mg/kg$ $20$ $10.01$ $^{\bullet}$ Coloride $7440-70-2$ $10$ $mg/kg$ $80$ $90$ $^{\bullet}$ Colorid $7440-23-5$ $10$ $mg/kg$ $90$ $90$ $^{\bullet}$ Coloride $7440-03-7$ $10$ $mg/kg$ $90$ $90$ $^{\bullet}$ Coloride $7440-03-7$ $10$ $mg/kg$ $90$ $90$ <td>meq/100g         22.1           meq/100g         1.0           meq/100g         0.9           meq/100g         82.8</td> <td>1.00</td> <td>59.6</td> <td>48.4</td> <td>51.8</td>	meq/100g         22.1           meq/100g         1.0           meq/100g         0.9           meq/100g         82.8	1.00	59.6	48.4	51.8
$^{\bullet}$ Exchangeable Potassium0.1meq/100g1.01.0 $^{\bullet}$ Exchangeable Sodium0.1meq/100g0.90.91.0 $^{\bullet}$ Cation Exchange Capacity0.1meq/100g82.81.01.0 $^{\bullet}$ Cation Exchange Capacity0.1meq/100g82.81.01.0 $^{\bullet}$ Cation Exchange Capacity0.1 $^{\circ}$ meq/100g82.81.01.0 $^{\bullet}$ Cation Exchange Capacity0.01 $^{\circ}$ meq/100g82.81.01.0 $^{\bullet}$ Sufur - Total as S (LECO)0.01 $^{\circ}$ 0.01 $^{\circ}$ 0.011.01.0Sufur - Total as S (LECO)0.01 $^{\circ}$ 0.01 $^{\circ}$ 0.011.01.01.0ChlorideED045G: Chloride Discrete analyser1.0 $^{\circ}$ 0.01 $^{\circ}$ 0.012.01.01.01.01.01.0ChlorideSoluble Major Cations7.440-70-21.0 $^{\circ}$ 0.012.01.0 <td>meq/100g 1.0 0.9 0.9 0.9 82.8</td> <td>16.5</td> <td>12.8</td> <td>10.5</td> <td>15.2</td>	meq/100g 1.0 0.9 0.9 0.9 82.8	16.5	12.8	10.5	15.2
	meq/100g 0.9 82.8	0.5	0.4	0.3	0.4
$^{\circ}$ Catton Exchange Capacity0.1meq/100g82.8IED042T: Total Sulfur by LECO0.0182.81Sulfur - Total as S (LECO)0.01%0.011Sulfur - Total as S (LECO)0.01%0.011ED045G: Chloride Discrete analyser10%0.0111Chloride Discrete analyser16887-00-610mg/kg201Chloride Discrete analyser10mg/kg2012Chloride Discrete analyser10mg/kg302Chloride Discrete analyser7440-70-210mg/kg302Soluthe Major Cations7440-23-510mg/kg3020Solutim7440-03-710mg/kg90202	meq/100g 82.8	1.1	1.4	1.3	1.3
ED042T: Total Sulfur by LECO        0.01       %       0.01         Sulfur - Total as S (LECO)        0.01       %       0.01          ED045G: Chloride Discrete analyser        0.01       %       0.01          ED045G: Soluble Major Cations       16887-00-6       10       mg/kg       20          ED033S: Soluble Major Cations       7440-72       10       mg/kg       80          Catcium       7439-95-4       10       mg/kg       80           Sodium       7440-09-7       10       mg/kg       80            Potassium       7440-09-7       10       mg/kg       90 </td <td></td> <td>74.2</td> <td>74.1</td> <td>60.5</td> <td>68.8</td>		74.2	74.1	60.5	68.8
Sulfur - Total as S (LECO)        0.01       %       0.01       0.01         E045G: Chloride Discrete analyser       E045G: Chloride Discrete analyser       1       %       0.01       1         E1045G: Chloride Discrete analyser       16887-00-6       10       mg/kg       20       1         E1093S: Soluble Major Cations       7440-70-2       10       mg/kg       20       1         Calcium       7430-55-4       10       mg/kg       30       30       30         Magnesium       7440-23-5       10       mg/kg       30       30       30       30         Sodium       7440-03-7       10       mg/kg       10       mg/kg       30					
ED045G: Chloride Discrete analyser           Chloride Discrete analyser           Chloride         16887-00-6         10         mg/kg         20	% 0.01	<0.01	<0.01	<0.01	0.02
Chloride         16887-00-6         10         mg/kg         20         20           ED033S: Soluble Major Cations         7440-70-2         10         mg/kg         80         20           Calcium         7440-70-2         10         mg/kg         80         30         20           Magnesium         7440-23-5         10         mg/kg         30         20         20           Sodium         7440-09-7         10         mg/kg         730         20         20         20					
ED093S: Soluble Major Cations         7440-70-2         10         mg/kg         80 <td>mg/kg 20</td> <td>30</td> <td>30</td> <td>20</td> <td>20</td>	mg/kg 20	30	30	20	20
Calcium         7440-70-2         10         mg/kg         80					
Magnesium         7439-95-4         10         mg/kg         30 <td>mg/kg 80</td> <td>100</td> <td>80</td> <td>70</td> <td>06</td>	mg/kg 80	100	80	70	06
Sodium         7440-23-5         10         mg/kg         90           Potassium         7440-09-7         10         mg/kg         <10	mg/kg <b>30</b>	40	30	30	40
Potassium 7440-09-7 10 mg/kg <10	mg/kg 90	110	100	06	120
	mg/kg <10	<10	<10	<10	<10
EG005T: Total Metals by ICP-AES					
Aluminium 7429-90-5 50 mg/kg <b>38500</b>	mg/kg <b>38500</b>	40200	39800	31600	50800
Antimony 7440-36-0 5 mg/kg <5	mg/kg <5	<5	<5	<5	<5
Arsenic 7440-38-2 5 mg/kg <5	mg/kg <5	<5	<5	<5	<5
Barium 7440-39-3 10 mg/kg <b>420</b>	mg/kg 420	130	30	60	140
Beryllium 7440-41-7 1 mg/kg <2	mg/kg <2	<2	<2	<2	<2
Boron 7440-42-8 50 mg/kg <50	mg/kg <50	<50	<50	<50	<50
Cadmium 7440-43-9 1 mg/kg <1	mg/kg <1	Ý	2	Ý	×1 ۲

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Sub-Matrix: ROCK

Sub-Matrix: ROCK		Clie	nt sample ID	9939	9940	9941	9942	9943
	Cli	ent samplin	g date / time	28-AUG-2011 15:00				
Compound	CAS Number	LOR	Unit	EB1119039-001	EB1119039-002	EB1119039-003	EB1119039-004	EB1119039-005
EG005T: Total Metals by ICP-AES - Continued								
Chromium	7440-47-3	7	mg/kg	89	66	54	48	81
Cobalt	7440-48-4	7	mg/kg	59	40	42	36	27
Copper	7440-50-8	2	mg/kg	50	54	55	44	35
Iron	7439-89-6	50	mg/kg	48000	52200	54400	41600	39500
Lead	7439-92-1	Q	mg/kg	<5	<5	<5	<5	<5
Manganese	7439-96-5	2	mg/kg	1810	880	778	819	693
Molybdenum	7439-98-7	2	mg/kg	4	<2	<2	<2	<2
Nickel	7440-02-0	7	mg/kg	141	144	150	152	174
Selenium	7782-49-2	2	mg/kg	12	8	<5	9	7
Silver	7440-22-4	2	mg/kg	4	<2	<2	<2	<2
Strontium	7440-24-6	7	mg/kg	160	460	1130	1360	575
Tin	7440-31-5	Q	mg/kg	<5	<5	<5	<5	<5
Vanadium	7440-62-2	2	mg/kg	06	68	64	45	73
Zinc	7440-66-6	2	mg/kg	70	82	82	63	60
Titanium	7440-32-6	10	mg/kg	700	730	680	800	360
Thallium	7440-28-0	Q	mg/kg	9	<5	<5	<5	<5
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N (Sol.)		0.1	mg/kg	<0.1	<0.1	<0.1	0.1	<0.1
EK058G: Nitrate as N by Discrete Analyser								
^ Nitrate as N (Sol.)		0.1	mg/kg	0.1	0.2	1.8	14.2	1.5
EK059G: Nitrite plus Nitrate as N (NOx) by I	<b>Discrete Anal</b>	yser						
Nitrite + Nitrate as N (Sol.)		0.1	mg/kg	0.1	0.2	1.8	14.3	1.5



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Page	Work Order	Client	Project	



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ub-Matrix: ROCK		Clie	ent sample ID	9944	9945	9946	9947	9948
	G	ent samplir	ng date / time	28-AUG-2011 15:00				
Compound	CAS Number	LOR	Unit	EB1119039-006	EB1119039-007	EB1119039-008	EB1119039-009	EB1119039-010
EA002 : pH (Soils)								
pH Value		0.1	pH Unit	8.7	8.5	8.7	8.6	8.6
EA009: Nett Acid Production Potential								
Net Acid Production Potential		0.5	kg H2SO4/t	-110	-73.3	-118	-135	-140
EA010: Conductivity								
Electrical Conductivity @ 25°C		1	µS/cm	120	135	129	129	140
EA011E-A: pH OX								
pH (OX)		0.1	pH Unit	9.0	8.6	9.1	8.9	0.6
EA013: Acid Neutralising Capacity								
ANC as H2SO4		0.5	kg H2SO4 equiv./t	110	74.2	118	135	140
ANC as CaCO3		0.1	% CaCO3	11.2	7.6	12.1	13.8	14.3
Fizz Rating		0	Fizz Unit	2	2	2	e	°
EA055: Moisture Content								
^ Moisture Content (dried @ 103°C)		1.0	%	38.8	37.2	30.0	31.8	39.4
ED007: Exchangeable Cations								
Exchangeable Calcium		0.1	meq/100g	50.8	32.2	60.1	54.9	38.7
* Exchangeable Magnesium		0.1	meq/100g	15.0	11.9	14.7	13.4	8.3
* Exchangeable Potassium		0.1	meq/100g	0.4	0.3	0.3	0.3	0.2
* Exchangeable Sodium		0.1	meq/100g	1.2	0.8	1.1	1.0	0.9
Cation Exchange Capacity		0.1	meq/100g	67.4	45.2	76.2	69.6	48.2
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)		0.01	%	<0.01	0.03	<0.01	<0.01	<0.01
ED045G: Chloride Discrete analyser								
Chloride	16887-00-6	10	mg/kg	20	20	20	20	30
ED093S: Soluble Major Cations								
Calcium	7440-70-2	10	mg/kg	70	80	70	70	80
Magnesium	7439-95-4	10	mg/kg	30	30	20	30	30
Sodium	7440-23-5	10	mg/kg	100	110	06	100	120
Potassium	7440-09-7	10	mg/kg	<10	<10	<10	<10	<10
EG005T: Total Metals by ICP-AES								
Aluminium	7429-90-5	50	mg/kg	40400	45000	25600	30200	29700
Antimony	7440-36-0	Q	mg/kg	<2	<2	<2	<5	<5
Arsenic	7440-38-2	5	mg/kg	<5	<5	<5	<5	<5
Barium	7440-39-3	10	mg/kg	80	140	30	50	50
Beryllium	7440-41-7	-	mg/kg	<2	<2	<2	33	<2
Boron	7440-42-8	50	mg/kg	<50	<50	<50	<50	<50
Cadmium	7440-43-9	-	mg/kg	2	₹	₹	×.	4

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1 Sub

Sub-Matrix: ROCK		Clie	nt sample ID	9944	9945	9946	9947	9948
	Cli	ent samplir	ig date / time	28-AUG-2011 15:00				
Compound	CAS Number	LOR	Unit	EB1119039-006	EB1119039-007	EB1119039-008	EB1119039-009	EB1119039-010
EG005T: Total Metals by ICP-AES - Continue	ed							
Chromium	7440-47-3	2	mg/kg	74	75	53	58	68
Cobalt	7440-48-4	7	mg/kg	34	36	34	34	42
Copper	7440-50-8	5	mg/kg	51	35	46	42	56
Iron	7439-89-6	50	mg/kg	45200	41800	41900	42300	51400
Lead	7439-92-1	S	mg/kg	~2	<5	<5	<5	<5
Manganese	7439-96-5	S	mg/kg	684	730	498	774	994
Molybdenum	7439-98-7	2	mg/kg	42	<2	<2	Ŷ	<2
Nickel	7440-02-0	2	mg/kg	148	147	142	142	157
Selenium	7782-49-2	2	mg/kg	11	8	<5	<5	<5
Silver	7440-22-4	2	mg/kg	42	<2	<2	Ŷ	<2
Strontium	7440-24-6	2	mg/kg	540	353	196	302	169
Tin	7440-31-5	5	mg/kg	<5	<5	<5	<5	<5
Vanadium	7440-62-2	5	mg/kg	65	85	48	63	64
Zinc	7440-66-6	S	mg/kg	73	55	64	64	80
Titanium	7440-32-6	10	mg/kg	680	280	640	540	670
Thallium	7440-28-0	5	mg/kg	<5	<5	<5	<5	<5
EG035T: Total Recoverable Mercury by FII	MS							
Mercury	7439-97-6	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N (Sol.)		0.1	mg/kg	<0.1	<0.1	<0.1	0.1	<0.1
EK058G: Nitrate as N by Discrete Analyser								
^ Nitrate as N (Sol.)		0.1	mg/kg	4.8	9.9	16.2	7.9	13.4
EK059G: Nitrite plus Nitrate as N (NOx) by	y Discrete Anal	yser						
Nitrite + Nitrate as N (Sol.)		0.1	mg/kg	4.8	9.6	16.2	8.0	13.4



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Sub-Matrix: ROCK	i	Cile	ent sample IU	9949	9950	9951	9952	9953
	Clie	nt samplin	ng date / time	28-AUG-2011 15:00				
Compound	CAS Number	LOR	Unit	EB1119039-011	EB1119039-012	EB1119039-013	EB1119039-014	EB1119039-015
EA002 : pH (Soils)								
pH Value	-	0.1	pH Unit	8.6	8.4	8.5	8.6	9.4
EA009: Nett Acid Production Potential								
A Net Acid Production Potential		0.5	kg H2SO4/t	-126	-124	-121	-124	-132
EA010: Conductivity								
Electrical Conductivity @ 25°C	-	<del></del>	µS/cm	135	152	140	130	101
EA011E-A: pH OX								
pH (OX)		0.1	pH Unit	8.8	8.9	8.5	9.1	9.5
EA013: Acid Neutralising Capacity								
ANC as H2SO4		0.5	kg H2SO4	126	124	121	124	132
		÷	equiv./t	0.07	9.04	1.01	201	4 0 E
		-		۲.7 ۲	0.71		0.21	13:3 ¢
Fizz Kating		5		0	0	0	0	2
EA055: Moisture Content								
<sup>A</sup> Moisture Content (dried @ 103°C)		1.0	%	36.5	34.2	37.7	32.9	4.4
ED007: Exchangeable Cations								
A Exchangeable Calcium	1	0.1	meq/100g	52.2	53.5	32.0	48.9	33.2
<sup>A</sup> Exchangeable Magnesium		0.1	meq/100g	15.5	14.4	9.6	13.2	7.7
<sup>A</sup> Exchangeable Potassium		0.1	meq/100g	0.5	0.5	0.5	0.8	1.7
A Exchangeable Sodium		0.1	meq/100g	1.1	1.1	0.6	1.2	2.7
A Cation Exchange Capacity		0.1	meq/100g	69.3	69.69	42.6	64.1	45.3
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)		0.01	%	<0.01	<0.01	<0.01	<0.01	<0.01
ED045G: Chloride Discrete analyser								
Chloride	16887-00-6	10	mg/kg	20	20	30	30	<10
ED093S: Soluble Major Cations								
Calcium	7440-70-2	10	mg/kg	70	06	80	20	10
Magnesium	7439-95-4	10	mg/kg	30	40	30	30	10
Sodium	7440-23-5	10	mg/kg	120	110	110	100	80
Potassium	7440-09-7	10	mg/kg	<10	<10	<10	<10	<10
EG005T: Total Metals by ICP-AES								
Aluminium	7429-90-5	50	mg/kg	30700	34600	42300	31500	23900
Antimony	7440-36-0	ŋ	mg/kg	<5	<5	<5	<5	<5
Arsenic	7440-38-2	5	mg/kg	<5	<5	<5	<5	<5
Barium	7440-39-3	10	mg/kg	06	130	300	06	<20
Beryllium	7440-41-7	٦	mg/kg	<2	<2	\$3	<3	<2
Boron	7440-42-8	50	mg/kg	<50	<50	<50	<50	<50
Cadmium	7440-43-9	<del>.</del>	mg/kg	2	₹	~	~	۲. ۲
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Sub-Matrix: ROCK

Sub-Matrix: ROCK		Clie	nt sample ID	9949	9950	9951	9952	9953
	Cli	ent samplin	g date / time	28-AUG-2011 15:00				
Compound	CAS Number	LOR	Unit	EB1119039-011	EB1119039-012	EB1119039-013	EB1119039-014	EB1119039-015
EG005T: Total Metals by ICP-AES - Continue	q							
Chromium	7440-47-3	2	mg/kg	58	68	81	50	18
Cobalt	7440-48-4	7	mg/kg	39	44	51	44	23
Copper	7440-50-8	Ð	mg/kg	48	50	56	53	36
Iron	7439-89-6	50	mg/kg	44500	48800	53800	46900	30700
Lead	7439-92-1	2	mg/kg	<5	<5	<5	<5	<5
Manganese	7439-96-5	Q	mg/kg	836	928	1170	1040	670
Molybdenum	7439-98-7	7	mg/kg	42	<2	<3	<3	<2
Nickel	7440-02-0	7	mg/kg	138	150	161	151	95
Selenium	7782-49-2	Q	mg/kg	<5	<5	11	10	7
Silver	7440-22-4	2	mg/kg	4	42	<3	<3	<2
Strontium	7440-24-6	2	mg/kg	132	128	253	320	681
Tin	7440-31-5	£	mg/kg	<5	<5	<5	129	<5
Vanadium	7440-62-2	Q	mg/kg	55	65	77	48	21
Zinc	7440-66-6	Q	mg/kg	72	79	83	76	60
Titanium	7440-32-6	10	mg/kg	630	069	930	530	240
Thallium	7440-28-0	5	mg/kg	<5	<5	9	9	<5
EG035T: Total Recoverable Mercury by FIM	S							
Mercury	7439-97-6	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N (Sol.)		0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
EK058G: Nitrate as N by Discrete Analyser								
^ Nitrate as N (Sol.)		0.1	mg/kg	<0.1	0.1	<0.1	0.4	0.5
EK059G: Nitrite plus Nitrate as N (NOx) by	<b>Discrete Anal</b>	yser						
Nitrite + Nitrate as N (Sol.)		0.1	mg/kg	<0.1	0.1	<0.1	0.4	0.5



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Sub-Matrix: ROCK		Clie	int sample ID	9954	9993	9955	9956	9957
	Clie	ent samplin	ig date / time	28-AUG-2011 15:00				
Compound	CAS Number	LOR	Unit	EB1119039-016	EB1119039-017	EB1119039-018	EB1119039-019	EB1119039-020
EA002 : pH (Soils)								
pH Value		0.1	pH Unit	9.4	9.3	9.4	9.2	9.3
EA009: Nett Acid Production Potential								
A Net Acid Production Potential		0.5	kg H2SO4/t	-115	-135	-118	-18.6	-24.3
EA010: Conductivity								
Electrical Conductivity @ 25°C		1	µS/cm	105	98	66	150	168
EA011E-A: pH OX								
pH (OX)		0.1	pH Unit	9.3	9.7	9.4	8.3	8.0
EA013: Acid Neutralising Capacity								
ANC as H2SO4		0.5	kg H2SO4 addiv /f	115	135	118	19.2	24.9
^ ANC as CaCO3		0.1	% CaCO3	11.8	13.8	12.1	2.0	2.5
Fizz Rating		0	Fizz Unit	9	e	e	F	-
EA055: Moisture Content								
^ Moisture Content (dried @ 103°C)		1.0	%	5.3	3.2	3.8	19.3	16.1
ED007: Exchangeable Cations								
* Exchangeable Calcium		0.1	meq/100g	30.1	32.7	13.9	13.2	14.3
<sup>A</sup> Exchangeable Magnesium		0.1	meq/100g	7.8	6.0	4.0	14.1	13.4
A Exchangeable Potassium		0.1	meq/100g	1.5	1.7	0.8	0.8	0.8
A Exchangeable Sodium		0.1	meq/100g	2.7	2.8	1.5	2.2	2.0
Cation Exchange Capacity		0.1	meq/100g	42.1	43.3	20.2	30.3	30.6
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)		0.01	%	<0.01	<0.01	<0.01	0.02	0.02
ED045G: Chloride Discrete analyser								
Chloride	16887-00-6	10	mg/kg	<10	<10	<10	10	<10
ED093S: Soluble Major Cations								
Calcium	7440-70-2	10	mg/kg	20	20	20	<10	10
Magnesium	7439-95-4	10	mg/kg	10	20	10	<10	10
Sodium	7440-23-5	10	mg/kg	90	70	80	190	190
Potassium	7440-09-7	10	mg/kg	<10	<10	<10	<10	<10 <
EG005T: Total Metals by ICP-AES								
Aluminium	7429-90-5	50	mg/kg	26800	27200	25000	14800	12000
Antimony	7440-36-0	5	mg/kg	<5	<5	<5	٨IJ	<5
Arsenic	7440-38-2	5	mg/kg	<5	<5	<5	ح <del>5</del>	<5
Barium	7440-39-3	10	mg/kg	<30	<20	<30	60	30
Beryllium	7440-41-7	-	mg/kg	Ŷ	42	Ŷ	2	<b>~</b>
Boron	7440-42-8	50	mg/kg	<50	<50	<50	<50	<50
Cadmium	7440-43-9	1	mg/kg	<1	<1	<2	<1	<1
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Analytical Results								
Sub-Matrix: ROCK		Clie	nt sample ID	9954	9993	9955	9956	9957
	Cli	ent samplin	ig date / time	28-AUG-2011 15:00				
Compound	CAS Number	LOR	Unit	EB1119039-016	EB1119039-017	EB1119039-018	EB1119039-019	EB1119039-020
EG005T: Total Metals by ICP-AES - Continued								
Chromium	7440-47-3	2	mg/kg	23	22	21	12	6
Cobalt	7440-48-4	2	mg/kg	32	30	31	15	17
Copper	7440-50-8	Q	mg/kg	43	43	40	24	6
Iron	7439-89-6	50	mg/kg	36100	36600	34300	15500	9630
Lead	7439-92-1	Q	mg/kg	<5	<5	<5	7	9
Manganese	7439-96-5	Q	mg/kg	1090	1440	1360	290	185
Molybdenum	7439-98-7	7	mg/kg	<3	<2	Ŷ	42	<2
Nickel	7440-02-0	7	mg/kg	127	129	130	18	18
Selenium	7782-49-2	2	mg/kg	10	<5	5	<5	<5
Silver	7440-22-4	7	mg/kg	<3	<2	Ŷ	42	<2
Strontium	7440-24-6	7	mg/kg	726	886	561	27	21
Tin	7440-31-5	Q	mg/kg	<5	<5	<2	<5	<5
Vanadium	7440-62-2	£	mg/kg	25	23	25	23	16
Zinc	7440-66-6	£	mg/kg	66	67	64	71	53
Titanium	7440-32-6	10	mg/kg	300	300	270	130	80
Thallium	7440-28-0	5	mg/kg	<5	<5	<5	<5	<5
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N (Sol.)		0.1	mg/kg	<0.1	<0.1	<0.1	0.1	<0.1
EK058G: Nitrate as N by Discrete Analyser								
^ Nitrate as N (Sol.)		0.1	mg/kg	0.4	0.7	0.4	0.2	<0.1
EK059G: Nitrite plus Nitrate as N (NOx) by E	<b>Discrete Anal</b>	yser						
Nitrite + Nitrate as N (Sol.)		0.1	mg/kg	0.4	0.7	0.4	0.3	<0.1

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Sub-Matrix: ROCK		Cli	ent sample ID	9958	9959	0966	9961	9962
	Clie	ent sampli	ing date / time	28-AUG-2011 15:00				
Compound	CAS Number	LOR	Unit	EB1119039-021	EB1119039-022	EB1119039-023	EB1119039-024	EB1119039-025
EA002 : pH (Soils)								
pH Value		0.1	pH Unit	9.4	9.6	9.7	9.7	9.7
EA009: Nett Acid Production Potential								
A Net Acid Production Potential		0.5	kg H2SO4/t	-42.3	-84.0	-24.0	-28.8	-25.7
EA010: Conductivity								
Electrical Conductivity @ 25°C		-	hS/cm	166	151	154	149	163
EA011E-A: pH OX								
pH (OX)		0.1	pH Unit	8.8	9.1	8.5	8.5	8.4
EA013: Acid Neutralising Capacity								
ANC as H2SO4		0.5	kg H2SO4 equiv /f	42.9	84.6	24.9	29.4	26.6
^ ANC as CaCO3		0.1	% CaCO3	4.4	8.6	2.5	3.0	2.7
Fizz Rating		0	Fizz Unit	2	2	~	2	۲
EA055: Moisture Content								
^ Moisture Content (dried @ 103°C)		1.0	%	15.5	15.5	11.8	17.9	12.3
ED007: Exchangeable Cations								
A Exchangeable Calcium		0.1	meq/100g	27.3	26.3	21.3	26.9	22.0
<sup>A</sup> Exchangeable Magnesium		0.1	meq/100g	11.7	11.5	17.2	14.7	15.8
A Exchangeable Potassium		0.1	meq/100g	0.7	0.7	0.6	0.8	0.5
A Exchangeable Sodium		0.1	meq/100g	1.8	1.8	2.3	2.3	2.2
A Cation Exchange Capacity		0.1	meq/100g	41.5	40.2	41.5	44.8	40.6
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)		0.01	%	0.02	0.02	0.03	0.02	0.03
ED045G: Chloride Discrete analyser								
Chloride	16887-00-6	10	mg/kg	<10	<10	<10	<10	<10
ED093S: Soluble Major Cations								
Calcium	7440-70-2	10	mg/kg	10	<10	<10	<10	10
Magnesium	7439-95-4	10	mg/kg	10	<10	<10	<10	<10
Sodium	7440-23-5	10	mg/kg	180	170	160	170	180
Potassium	7440-09-7	10	mg/kg	<10	<10	<10	<10	<10
EG005T: Total Metals by ICP-AES								
Aluminium	7429-90-5	50	mg/kg	11800	12100	6710	8400	7520
Antimony	7440-36-0	5	mg/kg	<5	^55	<25 <	<b>~</b> 5	<5
Arsenic	7440-38-2	5	mg/kg	<5	<5	<2	<5	<5
Barium	7440-39-3	10	mg/kg	30	30	20	30	20
Beryllium	7440-41-7	-	mg/kg	1	4	-	-	-
Boron	7440-42-8	50	mg/kg	<50	<50	<50	<50	<50
Cadmium	7440-43-9	-	mg/kg	<1	<1	<1	<1	<1
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Sub-Matrix: ROCK		Clie	ent sample ID	9958	9959	0966	9961	9962
	CI	ent samplir	ng date / time	28-AUG-2011 15:00				
Compound	CAS Number	LOR	Unit	EB1119039-021	EB1119039-022	EB1119039-023	EB1119039-024	EB1119039-025
EG005T: Total Metals by ICP-AES - Continue	ġ							
Chromium	7440-47-3	2	mg/kg	8	7	S	7	9
Cobalt	7440-48-4	7	mg/kg	16	15	4	4	4
Copper	7440-50-8	Ð	mg/kg	7	2	<5	9	<5
Iron	7439-89-6	50	mg/kg	9680	9530	11100	12300	12100
Lead	7439-92-1	വ	mg/kg	9	9	8	10	8
Manganese	7439-96-5	2	mg/kg	201	153	180	191	183
Molybdenum	7439-98-7	7	mg/kg	<2	<2	<2	<2	<2
Nickel	7440-02-0	7	mg/kg	16	14	7	10	10
Selenium	7782-49-2	2	mg/kg	<5	<5	<5	<5	<5
Silver	7440-22-4	2	mg/kg	<2	<2	<2	<2	<2
Strontium	7440-24-6	2	mg/kg	22	24	42	99	67
Tin	7440-31-5	2	mg/kg	<5	<22 <	<5	<5	<5
Vanadium	7440-62-2	2	mg/kg	15	14	11	11	10
Zinc	7440-66-6	5	mg/kg	56	50	37	39	38
Titanium	7440-32-6	10	mg/kg	70	70	60	80	60
Thallium	7440-28-0	Ð	mg/kg	<5	<5	<5	<5	<5
EG035T: Total Recoverable Mercury by FIN	VS							
Mercury	7439-97-6	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N (Sol.)		0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
EK058G: Nitrate as N by Discrete Analyser								
^ Nitrate as N (Sol.)		0.1	mg/kg	<0.1	<0.1	0.3	0.4	0.4
EK059G: Nitrite plus Nitrate as N (NOx) by	Discrete Ana	lyser						
Nitrite + Nitrate as N (Sol.)		0.1	mg/kg	<0.1	<0.1	0.3	0.4	0.4

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sub-Matrix: ROCK		Ü	ient sample ID	9963	9964	9965	9966	9967
	Cli	ent sampl	ling date / time	28-AUG-2011 15:00				
Compound	CAS Number	LOR	Unit	EB1119039-026	EB1119039-027	EB1119039-028	EB1119039-029	EB1119039-030
EA002 : pH (Soils)								
pH Value	-	0.1	pH Unit	9.7	9.7	9.7	9.6	9.8
EA009: Nett Acid Production Potential								
Net Acid Production Potential		0.5	kg H2SO4/t	-232	-222	-226	-26.6	-19.5
EA010: Conductivity								
Electrical Conductivity @ 25°C		-	µS/cm	139	137	132	137	115
EA011E-A: pH OX								
pH (OX)		0.1	pH Unit	10.1	10.5	10.1	8.8	8.6
EA013: Acid Neutralising Capacity								
ANC as H2SO4		0.5	kg H2SO4 enuiv /t	232	222	226	26.6	19.5
^ ANC as CaCO3		0.1	% CaCO3	23.6	22.6	23.1	2.7	2.0
Fizz Rating		0	Fizz Unit	4	4	4	-	-
EA055: Moisture Content								
<ul> <li>Moisture Content (dried @ 103°C)</li> </ul>	-	1.0	%	4.9	6.2	6.2	11.5	11.0
ED007: Exchangeable Cations								
* Exchangeable Calcium		0.1	meq/100g	31.6	29.6	33.6	17.4	12.2
* Exchangeable Magnesium		0.1	meq/100g	10.4	11.2	10.7	11.8	8.3
A Exchangeable Potassium	-	0.1	meq/100g	0.6	0.6	0.5	0.7	0.7
A Exchangeable Sodium		0.1	meq/100g	1.6	1.5	1.5	1.7	1.4
Cation Exchange Capacity		0.1	meq/100g	44.3	42.8	46.4	31.8	22.6
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)		0.01	%	<0.01	<0.01	<0.01	<0.01	<0.01
ED045G: Chloride Discrete analyser								
Chloride	16887-00-6	10	mg/kg	<10	<10	<10	<10	10
ED093S: Soluble Major Cations								
Calcium	7440-70-2	10	mg/kg	10	<10	<10	<10	<10
Magnesium	7439-95-4	10	mg/kg	<10	<10	<10	<10	<10
Sodium	7440-23-5	10	mg/kg	140	140	130	160	130
Potassium	7440-09-7	10	mg/kg	<10	<10	<10	<10	<10
EG005T: Total Metals by ICP-AES								
Aluminium	7429-90-5	50	mg/kg	10500	6480	5010	10600	6500
Antimony	7440-36-0	5	mg/kg	<5	<5	<5	<5	<5
Arsenic	7440-38-2	5	mg/kg	<5	<5	<5	9	<5
Barium	7440-39-3	10	mg/kg	40	40	30	50	30
Beryllium	7440-41-7	-	mg/kg	1	1	<1	3	3
Boron	7440-42-8	50	mg/kg	<50	<50	<50	<50	<50
Cadmium	7440-43-9	-	mg/kg	<u>۲</u>	۸ <u>۲</u>	۸ <u>۲</u>	<2	
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Sub-Matrix: ROCK

Sub-Matrix: ROCK		Clie	nt sample ID	9963	9964	9965	9966	9967
	Cli	ent samplir	ig date / time	28-AUG-2011 15:00				
Compound	CAS Number	LOR	Unit	EB1119039-026	EB1119039-027	EB1119039-028	EB1119039-029	EB1119039-030
EG005T: Total Metals by ICP-AES - Continue	ē							
Chromium	7440-47-3	2	mg/kg	6	9	5	11	14
Cobalt	7440-48-4	2	mg/kg	10	9	4	18	12
Copper	7440-50-8	S	mg/kg	14	6	7	14	37
Iron	7439-89-6	50	mg/kg	15000	11000	7280	42600	18000
Lead	7439-92-1	2	mg/kg	8	œ	10	17	18
Manganese	7439-96-5	Ð	mg/kg	824	816	855	393	170
Molybdenum	7439-98-7	2	mg/kg	<2	42	42	\$3	<2
Nickel	7440-02-0	2	mg/kg	28	6	9	28	20
Selenium	7782-49-2	2	mg/kg	<5	<5	<5	5	<5
Silver	7440-22-4	2	mg/kg	<2	42	42	Ŷ	<2
Strontium	7440-24-6	2	mg/kg	233	136	98	40	25
Tin	7440-31-5	2	mg/kg	<5	<5	<5	<5	<5
Vanadium	7440-62-2	2	mg/kg	14	13	80	35	40
Zinc	7440-66-6	5	mg/kg	48	43	32	92	57
Titanium	7440-32-6	10	mg/kg	130	70	70	130	80
Thallium	7440-28-0	5	mg/kg	<5	<5	<5	<5	<5
EG035T: Total Recoverable Mercury by FIM	VS							
Mercury	7439-97-6	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N (Sol.)		0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
EK058G: Nitrate as N by Discrete Analyser								
A Nitrate as N (Sol.)		0.1	mg/kg	0.5	0.3	0.3	1.9	1.2
EK059G: Nitrite plus Nitrate as N (NOx) by	Discrete Anal	yser						
Nitrite + Nitrate as N (Sol.)		0.1	mg/kg	0.5	0.3	0.3	1.9	1.2



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Sub-Matrix: ROCK		Client sam	ole ID	9968	6966	9970	9971	9972	
	Client s	ampling date	/ time	28-AUG-2011 15:00					
Compound	CAS Number L	DR U	nit	EB1119039-031	EB1119039-032	EB1119039-033	EB1119039-034	EB1119039-035	
EA002 : pH (Soils)									
pH Value	0	.1 pH l	Unit	9.8	9.8	9.9	9.9	6.6	
EA009: Nett Acid Production Potential									
<ul> <li>Net Acid Production Potential</li> </ul>	0	.5 kg H2	SO4/t	-7.6	-9.7	-69.3	-28.2	-38.3	
EA010: Conductivity									
Electrical Conductivity @ 25°C		1 µS/	,cm	116	133	115	143	149	
EA011E-A: pH OX									
pH (OX)	0	.1 pH l	Unit	8.2	7.8	8.2	8.2	9.6	
EA013: Acid Neutralising Capacity									
ANC as H2SO4		.5 kg H2	SO4	7.6	9.7	69.3	28.2	38.6	
		edn	iv./t						
ANC as CaCO3		.1 % Ca	CO3	0.8	1.0	7.1	2.9	3.9	
Fizz Rating		0 Fizz	Unit	1	0	2	2	2	
EA055: Moisture Content									
<ul> <li>Moisture Content (dried @ 103°C)</li> </ul>		0.	9	10.7	8.1	10.6	10.7	10.7	
ED007: Exchangeable Cations									
A Exchangeable Calcium		.1 meq/	100g	10.6	21.9	21.2	31.0	27.7	
* Exchangeable Magnesium		.1 meq/	100g	9.4	13.0	14.5	14.6	15.7	
A Exchangeable Potassium		.1 meq/	100g	0.9	1.0	1.0	1.0	0.6	
A Exchangeable Sodium	0	.1 meq/	100g	1.6	2.0	2.2	2.1	2.3	
Cation Exchange Capacity		.1 meq/	100g	22.6	37.9	38.9	48.7	46.4	
ED042T: Total Sulfur by LECO									
Sulfur - Total as S (LECO)	0	01 %	9	<0.01	<0.01	<0.01	<0.01	0.01	
ED045G: Chloride Discrete analyser									
Chloride	16887-00-6	0 mg	/kg	<10	<10	<10	<10	<10	
ED093S: Soluble Major Cations									
Calcium	7440-70-2	0 mg	/kg	<10	<10	<10	<10	<10	
Magnesium	7439-95-4	0 D	/kg	<10	<10	<10	<10	<10	
Sodium	7440-23-5	0 D	/kg	130	140	130	150	160	
Potassium	7440-09-7	0 D	/kg	<10	<10	<10	<10	<10	
EG005T: Total Metals by ICP-AES									
Aluminium	7429-90-5	0 mg	/kg	5230	11100	9480	10500	6680	
Antimony	7440-36-0	5 mg	/kg	<5	<25 <	<5	<5	<5	
Arsenic	7440-38-2	5 mg	/kg	<5	9	5	9	6	
Barium	7440-39-3	0 D	/kg	30	30	40	40	50	
Beryllium	7440-41-7	1 mg	/kg	2	1	1	-	1	
Boron	7440-42-8	.0 mg	/kg	<50	<50	<50	<50	<50	
Cadmium	7440-43-9	1 mg	/kg	۲,	ŕ	<1	۲. ۲	<1 1	
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Sub-Matrix: ROCK		Clie	ent sample ID	9968	6966	0266	9971	9972
	Cli	ent samplir	ng date / time	28-AUG-2011 15:00				
Compound	CAS Number	LOR	Unit	EB1119039-031	EB1119039-032	EB1119039-033	EB1119039-034	EB1119039-035
EG005T: Total Metals by ICP-AES - Continue	ed							
Chromium	7440-47-3	2	mg/kg	9	21	7	13	9
Cobalt	7440-48-4	7	mg/kg	4	13	12	10	8
Copper	7440-50-8	5	mg/kg	44	21	31	17	11
Iron	7439-89-6	50	mg/kg	11000	13400	8700	10700	5760
Lead	7439-92-1	S	mg/kg	16	12	16	14	18
Manganese	7439-96-5	5	mg/kg	107	348	114	172	343
Molybdenum	7439-98-7	2	mg/kg	42	<2	<2	2	<2
Nickel	7440-02-0	2	mg/kg	9	22	21	18	10
Selenium	7782-49-2	2	mg/kg	<5	<5	<5	<5	<ul><li>5</li></ul>
Silver	7440-22-4	2	mg/kg	4	<2	<2	<2	<2
Strontium	7440-24-6	2	mg/kg	25	27	38	35	50
Tin	7440-31-5	5	mg/kg	<5	<5	<5	<5	<5
Vanadium	7440-62-2	5	mg/kg	19	23	15	17	10
Zinc	7440-66-6	S	mg/kg	30	62	71	55	51
Titanium	7440-32-6	10	mg/kg	60	220	80	170	100
Thallium	7440-28-0	5	mg/kg	<5	<5	<5	<5	<5
EG035T: Total Recoverable Mercury by FII	MS							
Mercury	7439-97-6	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N (Sol.)		0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
EK058G: Nitrate as N by Discrete Analyse								
^ Nitrate as N (Sol.)		0.1	mg/kg	1.4	4.4	0.7	5.7	0.9
EK059G: Nitrite plus Nitrate as N (NOx) by	y Discrete Anal	yser						
Nitrite + Nitrate as N (Sol.)		0.1	mg/kg	1.4	4.4	0.7	5.7	0.9

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Sub-Matrix: ROCK		Cilent	it sample IU	9973	9974 28 ALLO 2011 15:00	9975	9976 28 ALIC 2011 15:00	9977 28 ALEC 2011 15:00
			ן ממוב / הוווכ	00.01 102-004-02	00.01 102-004-02	00.01 1102-004-02	00.01 102-004-02	00.01 102-004-02
Compound	CAS Number	LOR	Unit	EB1119039-036	EB1119039-037	EB1119039-038	EB1119039-039	EB1119039-040
EA002 : pH (Soils)								
pH Value		0.1	pH Unit	9.9	9.9	9.7	9.7	9.7
EA009: Nett Acid Production Potential								
<ul> <li>Net Acid Production Potential</li> </ul>		0.5	kg H2SO4/t	-53.4	-44.5	-99.4	-115	-131
EA010: Conductivity								
Electrical Conductivity @ 25°C		-	µS/cm	152	146	141	143	131
EA011E-A: pH OX								
pH (OX)		0.1	pH Unit	9.4	10.0	9.6	9.2	9.6
EA013: Acid Neutralising Capacity								
ANC as H2SO4	-	0.5	kg H2SO4	54.0	44.8	100	116	132
			equiv./t					
^ ANC as CaCO3		0.1	% CaCO3	5.5	4.6	10.2	11.9	13.4
Fizz Rating		0	Fizz Unit	2	2	3	3	3
EA055: Moisture Content								
^ Moisture Content (dried @ 103°C)		1.0	%	10.5	10.6	13.5	11.8	12.0
ED007: Exchangeable Cations								
* Exchangeable Calcium	-	0.1	meq/100g	26.9	30.0	24.7	25.0	24.3
Exchangeable Magnesium		0.1	meq/100g	14.7	14.7	7.1	9.9	6.1
* Exchangeable Potassium		0.1	meq/100g	0.5	0.6	0.4	0.4	0.4
* Exchangeable Sodium		0.1	meq/100g	2.2	2.2	1.6	1.4	1.4
Cation Exchange Capacity		0.1	meq/100g	44.3	47.4	33.9	33.5	32.2
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)		0.01	%	0.02	0.01	0.02	0.03	0.02
ED045G: Chloride Discrete analyser								
Chloride	16887-00-6	10	mg/kg	<10	<10	<10	<10	<10
ED093S: Soluble Major Cations								
Calcium	7440-70-2	10	mg/kg	<10	<10	<10	<10	<10
Magnesium	7439-95-4	10	mg/kg	<10	<10	<10	<10	<10
Sodium	7440-23-5	10	mg/kg	160	160	150	150	140
Potassium	7440-09-7	10	mg/kg	<10	<10	<10	<10	<10
EG005T: Total Metals by ICP-AES								
Aluminium	7429-90-5	50	mg/kg	6260	6330	10300	8900	7880
Antimony	7440-36-0	5	mg/kg	<5	<5	<5	<5	<5
Arsenic	7440-38-2	5	mg/kg	11	6	10	12	ø
Barium	7440-39-3	10	mg/kg	40	40	40	30	30
Beryllium	7440-41-7	<del>.</del>	mg/kg	₽	₽	2	2	÷
Boron	7440-42-8	50	mg/kg	<50	<50	<50	<50	<50
Cadmium	7440-43-9	<del>.                                    </del>	mg/kg	₽	Ŷ	۲. ۲	<u>۲</u>	Ŷ
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Sub-Matrix: ROCK		Clie	nt sample ID	9973	9974	9975	9266	9977
	Cli	ent samplin	ig date / time	28-AUG-2011 15:00				
Compound	CAS Number	LOR	Unit	EB1119039-036	EB1119039-037	EB1119039-038	EB1119039-039	EB1119039-040
EG005T: Total Metals by ICP-AES - Continue	q							
Chromium	7440-47-3	2	mg/kg	5	5	8	10	12
Cobalt	7440-48-4	2	mg/kg	œ	8	13	24	13
Copper	7440-50-8	5	mg/kg	6	10	9	9	5
Iron	7439-89-6	50	mg/kg	0609	6760	18200	15500	13900
Lead	7439-92-1	2	mg/kg	13	13	10	13	6
Manganese	7439-96-5	2	mg/kg	644	465	566	737	907
Molybdenum	7439-98-7	2	mg/kg	<2	<2	<2	2	<2
Nickel	7440-02-0	2	mg/kg	10	10	13	18	12
Selenium	7782-49-2	2	mg/kg	<5	<5	<5	<5	<5
Silver	7440-22-4	2	mg/kg	42	<2	<2	<2	<2
Strontium	7440-24-6	2	mg/kg	55	52	60	70	79
Tin	7440-31-5	2	mg/kg	<5	<5	<5	<5	<5
Vanadium	7440-62-2	2	mg/kg	6	10	14	13	12
Zinc	7440-66-6	5	mg/kg	49	58	34	31	46
Titanium	7440-32-6	10	mg/kg	100	80	100	110	06
Thallium	7440-28-0	2	mg/kg	<5	<5	<5	<5	<5
EG035T: Total Recoverable Mercury by FIN	ß							
Mercury	7439-97-6	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N (Sol.)		0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
EK058G: Nitrate as N by Discrete Analyser								
^ Nitrate as N (Sol.)		0.1	mg/kg	1.2	1.3	0.1	0.2	0.2
EK059G: Nitrite plus Nitrate as N (NOx) by	<b>Discrete Anal</b>	yser						
Nitrite + Nitrate as N (Sol.)		0.1	mg/kg	1.2	1.3	0.1	0.2	0.2
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## Analytical Results

			14 19 19					
Sub-Matrix: ROCK		Clie	ent sample ID	9978	6266	0866	9981	9982
	Č	ent sampli	ng date / time	28-AUG-2011 15:00				
Compound	CAS Number	LOR	Unit	EB1119039-041	EB1119039-042	EB1119039-043	EB1119039-044	EB1119039-045
EA002 : pH (Soils)								
pH Value		0.1	pH Unit	9.8	9.8	9.8	9.6	9.6
EA009: Nett Acid Production Potential								
A Net Acid Production Potential		0.5	kg H2SO4/t	-11.7	-11.2	-10.0	-10.2	-13.1
EA010: Conductivity								
Electrical Conductivity @ 25°C		-	hS/cm	118	139	132	110	123
EA011E-A: pH OX								
pH (OX)		0.1	pH Unit	7.3	7.4	7.2	6.3	7.2
EA013: Acid Neutralising Capacity								
ANC as H2SO4		0.5	kg H2SO4 equiv./t	12.3	11.8	10.6	14.5	14.3
^ ANC as CaCO3		0.1	% CaCO3	1.2	1.2	1.1	1.5	1.4
Fizz Rating		0	Fizz Unit	-	-	-	-	£
EA055: Moisture Content								
<ul> <li>Moisture Content (dried @ 103°C)</li> </ul>		1.0	%	11.7	10.2	11.1	10.2	8.7
ED007: Exchangeable Cations								
A Exchangeable Calcium	1	0.1	meq/100g	20.2	23.3	21.0	25.4	25.2
A Exchangeable Magnesium		0.1	meq/100g	13.6	12.0	13.6	13.2	13.4
A Exchangeable Potassium	-	0.1	meq/100g	1.0	1.0	1.0	0.8	0.9
A Exchangeable Sodium		0.1	meq/100g	2.8	2.4	2.5	2.2	2.4
Cation Exchange Capacity		0.1	meq/100g	37.6	38.7	38.0	41.6	41.8
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)		0.01	%	0.02	0.02	0.02	0.14	0.04
ED045G: Chloride Discrete analyser								
Chloride	16887-00-6	10	mg/kg	10	10	<10	<10	<10
ED093S: Soluble Major Cations								
Calcium	7440-70-2	10	mg/kg	<10	<10	<10	<10	<10
Magnesium	7439-95-4	10	mg/kg	<10	<10	<10	<10	<10
Sodium	7440-23-5	10	mg/kg	130	150	140	120	130
Potassium	7440-09-7	10	mg/kg	<10	<10	<10	<10	<10
EG005T: Total Metals by ICP-AES								
Aluminium	7429-90-5	50	mg/kg	7270	8280	7860	4780	6440
Antimony	7440-36-0	5	mg/kg	<5	<5	<5	<5	<5
Arsenic	7440-38-2	5	mg/kg	<5	ح£ 2	<5	<5	<5 5
Barium	7440-39-3	10	mg/kg	30	30	30	50	60
Beryllium	7440-41-7	-	mg/kg	2	2	2	2	2
Boron	7440-42-8	50	mg/kg	<50	<50	<50	<50	<50
Cadmium	7440-43-9	~	mg/kg	<1	₹	4	4	4

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Sub-Matrix: ROCK

Sub-Matrix: ROCK		Clie	ent sample ID	9978	6266	0866	9981	9982
	Cli	ent samplir	ng date / time	28-AUG-2011 15:00				
Compound	CAS Number	LOR	Unit	EB1119039-041	EB1119039-042	EB1119039-043	EB1119039-044	EB1119039-045
EG005T: Total Metals by ICP-AES - Continue	pa							
Chromium	7440-47-3	2	mg/kg	5	7	9	5	9
Cobalt	7440-48-4	7	mg/kg	17	22	22	4	4
Copper	7440-50-8	Ð	mg/kg	20	19	18	16	17
Iron	7439-89-6	50	mg/kg	11700	13400	12600	4950	5100
Lead	7439-92-1	5	mg/kg	18	19	19	23	33
Manganese	7439-96-5	2ı	mg/kg	61	100	65	60	88
Molybdenum	7439-98-7	7	mg/kg	<2	<2	<2	<2	<2
Nickel	7440-02-0	7	mg/kg	15	18	18	9	7
Selenium	7782-49-2	2J	mg/kg	<5	<5	<5	<5	<5
Silver	7440-22-4	2	mg/kg	<2	42	<2	<2	<2
Strontium	7440-24-6	2	mg/kg	49	47	50	62	66
Tin	7440-31-5	5	mg/kg	<5	<5 5	<5	<5	<5
Vanadium	7440-62-2	2	mg/kg	11	14	13	24	22
Zinc	7440-66-6	2	mg/kg	68	60	62	54	61
Titanium	7440-32-6	10	mg/kg	40	60	60	220	210
Thallium	7440-28-0	5	mg/kg	<5	<5	<5	<5	<5
EG035T: Total Recoverable Mercury by FIM	MS							
Mercury	7439-97-6	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N (Sol.)		0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
EK058G: Nitrate as N by Discrete Analyser								
^ Nitrate as N (Sol.)		0.1	mg/kg	0.5	1.2	9.0	0.7	0.6
EK059G: Nitrite plus Nitrate as N (NOx) by	y Discrete Anal	lyser						
Nitrite + Nitrate as N (Sol.)		0.1	mg/kg	0.5	1.2	0.6	0.7	0.6



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sub-Matrix: ROCK		CI	ient sample ID	9983	9984	9985	9986	9987
	Cli	ent sampli	ing date / time	28-AUG-2011 15:00				
Compound	CAS Number	LOR	Unit	EB1119039-046	EB1119039-047	EB1119039-048	EB1119039-049	EB1119039-050
EA002 : pH (Soils)								
pH Value		0.1	pH Unit	9.7	9.6	9.6	9.5	9.4
EA009: Nett Acid Production Potential								
A Net Acid Production Potential		0.5	kg H2SO4/t	-18.4	-17.6	-30.4	-19.5	-21.4
EA010: Conductivity								
Electrical Conductivity @ 25°C		~	µS/cm	135	137	126	122	112
EA011E-A: pH OX								
pH (OX)		0.1	pH Unit	7.8	7.3	8.4	7.8	7.6
EA013: Acid Neutralising Capacity								
ANC as H2SO4	-	0.5	kg H2SO4	19.3	18.2	31.3	22.9	22.9
			equiv./t					
^ ANC as CaCO3	1	0.1	% CaCO3	2.0	1.9	3.2	2.3	2.3
Fizz Rating		0	Fizz Unit	-	1	2	-	7
EA055: Moisture Content								
<ul> <li>Moisture Content (dried @ 103°C)</li> </ul>		1.0	%	9.7	8.9	<1.0	8.8	8.5
ED007: Exchangeable Cations								
* Exchangeable Calcium	-	0.1	meq/100g	35.9	22.6	26.4	25.9	24.4
* Exchangeable Magnesium		0.1	meq/100g	14.7	12.7	10.0	9.9	8.8
* Exchangeable Potassium	-	0.1	meq/100g	1.0	0.8	0.9	1.0	0.8
* Exchangeable Sodium		0.1	meq/100g	3.0	2.4	1.7	1.7	1.6
Cation Exchange Capacity		0.1	meq/100g	54.6	38.6	39.0	38.5	35.5
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)		0.01	%	0.03	0.02	0.03	0.11	0.05
ED045G: Chloride Discrete analyser								
Chloride	16887-00-6	10	mg/kg	<10	<10	<10	<10	<10
ED093S: Soluble Major Cations								
Calcium	7440-70-2	10	mg/kg	<10	<10	<10	<10	<10
Magnesium	7439-95-4	10	mg/kg	<10	<10	<10	<10	<10
Sodium	7440-23-5	10	mg/kg	150	140	120	120	110
Potassium	7440-09-7	10	mg/kg	<10	<10	<10	<10	<10
EG005T: Total Metals by ICP-AES								
Aluminium	7429-90-5	50	mg/kg	5240	7170	5760	2090	6210
Antimony	7440-36-0	5	mg/kg	<5	<5	<5	<5	<5
Arsenic	7440-38-2	5	mg/kg	<5	<5	6	6	5
Barium	7440-39-3	10	mg/kg	40	50	40	100	40
Beryllium	7440-41-7	-	mg/kg	2	2	-	+	2
Boron	7440-42-8	50	mg/kg	<50	<50	<50	<50	<50
Cadmium	7440-43-9	-	mg/kg	<b>^</b>	<u>۲</u>	2	۲. ۲	
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## Analytical Results

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Sub-Matrix: ROCK		Clie	nt sample ID	9983	9984	9985	9986	9987
	Cli	ent samplin	g date / time	28-AUG-2011 15:00				
Compound	CAS Number	LOR	Unit	EB1119039-046	EB1119039-047	EB1119039-048	EB1119039-049	EB1119039-050
EG005T: Total Metals by ICP-AES - Continue	ed							
Chromium	7440-47-3	2	mg/kg	4	9	5	9	9
Cobalt	7440-48-4	2	mg/kg	7	9	5	9	4
Copper	7440-50-8	5	mg/kg	14	16	18	23	24
Iron	7439-89-6	50	mg/kg	5960	8310	11200	15800	9760
Lead	7439-92-1	S	mg/kg	20	33	18	24	19
Manganese	7439-96-5	Ð	mg/kg	61	130	263	250	230
Molybdenum	7439-98-7	2	mg/kg	<2	<2	<2	<2	<2
Nickel	7440-02-0	2	mg/kg	ø	8	11	12	12
Selenium	7782-49-2	2	mg/kg	<5	<5	<5	<5	<5
Silver	7440-22-4	2	mg/kg	<2	<2	42	42	<2
Strontium	7440-24-6	2	mg/kg	63	64	57	55	58
Tin	7440-31-5	£	mg/kg	<5	<5	<5	<5	<5
Vanadium	7440-62-2	Ð	mg/kg	12	17	14	20	36
Zinc	7440-66-6	S	mg/kg	99	51	70	69	45
Titanium	7440-32-6	10	mg/kg	110	190	100	140	240
Thallium	7440-28-0	Ð	mg/kg	<5	<5	<5	<5	<5
EG035T: Total Recoverable Mercury by FII	MS							
Mercury	7439-97-6	0.1	mg/kg	<0.1	<0.1	0.1	0.2	0.1
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N (Sol.)		0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
EK058G: Nitrate as N by Discrete Analyse								
^ Nitrate as N (Sol.)		0.1	mg/kg	0.6	0.5	0.7	1.4	0.2
EK059G: Nitrite plus Nitrate as N (NOx) by	y Discrete Anal	lyser						
Nitrite + Nitrate as N (Sol.)		0.1	mg/kg	0.6	0.5	0.7	1.4	0.2

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Sub-Matrix: ROCK		Cli	ent sample ID	9988	6866	0666	9991	9992
	Clie	nt sampli	ng date / time	28-AUG-2011 15:00				
Compound	CAS Number	LOR	Unit	EB1119039-051	EB1119039-052	EB1119039-053	EB1119039-054	EB1119039-055
EA002 : pH (Soils)								
pH Value		0.1	pH Unit	9.4	9.2	8.0	7.6	7.8
EA009: Nett Acid Production Potential								
Net Acid Production Potential		0.5	kg H2SO4/t	-41.4	-8.4	4.2	6:9	0.7
EA010: Conductivity								
Electrical Conductivity @ 25°C		+	µS/cm	121	95	51	64	31
EA011-B: Dissolved Major Anions								
Sulfur as S	63705-05-5	-	mg/L				70	40
Chloride	16887-00-6	-	mg/L				<1	<1 -
EA011-C: Dissolved Major Cations								
Calcium	7440-70-2	-	mg/L				28	14
Magnesium	7439-95-4	<del>.</del>	mg/L				12	5
Sodium	7440-23-5	-	mg/L				4	3
Potassium	7440-09-7	٢	mg/L				2	14
EA011-D: Calculated Components								
Calculated Acid Component		0.1	kg H2SO4/t				21.4	12.4
Calculated Neutralisng Component		0.1	kg H2SO4/t				12.6	7.7
Calculated NAG Acidity		0.1	kg H2SO4/t				8.7	4.6
EA011E-A: pH OX								
pH (OX)		0.1	pH Unit	7.8	7.6	5.5	2.6	3.8
pH -2 (ext)		0.1	pH Unit				3.3	5.2
EA013: Acid Neutralising Capacity								
ANC as H2SO4		0.5	kg H2SO4	42.9	10.6	7.1	12.1	9.7
		ť	equiv./t			ľ		10
TILL Poting		5	// CaCCO	ţ c	-	···	<u>i</u> +	2 -
EA 055. Moisture Content		,		4			-	2
A Moisture Content (dried @ 103°C)		1.0	%	9.2	11.6	12.1	23.2	17.8
ED007: Exchanceable Cations								
<ul> <li>Exchangeable Calcium</li> </ul>	-	0.1	meq/100g	27.2	12.4	8.3	5.5	3.2
* Exchangeable Magnesium		0.1	meq/100g	11.0	9.8	6.1	3.7	2.2
* Exchangeable Potassium		0.1	meq/100g	0.7	0.8	0.3	0.1	<0.1
Exchangeable Sodium		0.1	meq/100g	1.7	1.5	0.9	0.7	0.6
Cation Exchange Capacity		0.1	meq/100g	40.6	24.5	15.6	10.0	6.1
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)		0.01	%	0.05	0.07	0.37	0.62	0.34
ED045G: Chloride Discrete analyser								

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ub-Matrix: ROCK		Cli	ent sample ID	9988	9989	0666	9991	9992
	Cli	ent sampli	ng date / time	28-AUG-2011 15:00				
Sompound	CAS Number	LOR	Unit	EB1119039-051	EB1119039-052	EB1119039-053	EB1119039-054	EB1119039-055
ED045G: Chloride Discrete analyser - Contin	nued							
Chloride	16887-00-6	10	mg/kg	10	10	10	20	10
ED093S: Soluble Major Cations								
Calcium	7440-70-2	10	mg/kg	<10	<10	<10	<10	<10
Aagnesium	7439-95-4	10	mg/kg	<10	<10	<10	<10	<10
Sodium	7440-23-5	10	mg/kg	120	100	60	80	40
otassium	7440-09-7	10	mg/kg	<10	<10	<10	<10	<10
EG005T: Total Metals by ICP-AES								
Numinium	7429-90-5	50	mg/kg	4580	4220	2100	840	780
Antimony	7440-36-0	2	mg/kg	<5	<5	<5	<5	<5
Arsenic	7440-38-2	2	mg/kg	<5	<5	<5	<5	<5
3arium	7440-39-3	10	mg/kg	30	30	30	10	<10
3eryllium	7440-41-7	-	mg/kg	2	2	S	9	e
Soron	7440-42-8	50	mg/kg	<50	<50	<50	<50	60
Sadmium	7440-43-9	-	mg/kg	۲.	4	₹.	₽	×1
Shromium	7440-47-3	7	mg/kg	9	3	2	2	2
Sobalt	7440-48-4	2	mg/kg	4	<2	~2	4	4
Copper	7440-50-8	Ð	mg/kg	14	44	58	20	11
ron	7439-89-6	50	mg/kg	11600	4640	13300	16900	1440
ead	7439-92-1	£	mg/kg	19	20	19	5	7
<i>A</i> anganese	7439-96-5	£	mg/kg	295	35	47	153	8
Aolybdenum	7439-98-7	7	mg/kg	<2	<2	<2	<2	<2
Vickel	7440-02-0	2	mg/kg	14	9	5	13	10
selenium	7782-49-2	2	mg/kg	<5	<5	<5	<5	<5
Silver	7440-22-4	7	mg/kg	<2	<2	<2	<2	<2
strontium	7440-24-6	7	mg/kg	56	41	27	22	21
lin	7440-31-5	വ	mg/kg	<5	<5	<5	<5	<5
/anadium	7440-62-2	Q	mg/kg	58	20	45	51	15
linc	7440-66-6	£	mg/kg	46	14	9	<5	9
Titanium	7440-32-6	10	mg/kg	450	40	40	270	320
rhallium	7440-28-0	5	mg/kg	<5	<5	<5	<5	<5
EG035T: Total Recoverable Mercury by FIM	AS N							
Mercury	7439-97-6	0.1	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1
EK057G: Nitrite as N by Discrete Analyser								
vitrite as N (Sol.)		0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N (Sol.)		0.1	mg/kg	0.3	0.3	0.2	0.1	0.1
EK059G: Nitrite plus Nitrate as N (NOx) by	/ Discrete Ana	yser						



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: 25 of	: EB11	END	: Orion	
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Sub-Matrix: ROCK		Clie	ent sample ID	9988	9989	0666	9991	9992
	Cli	ent samplin	ng date / time	28-AUG-2011 15:00				
Compound	CAS Number	LOR	Unit	EB1119039-051	EB1119039-052	EB1119039-053	EB1119039-054	EB1119039-055
EK059G: Nitrite plus Nitrate as N (NOx) b	y Discrete Anal	lyser - Con	ntinued					
Nitrite + Nitrate as N (Sol.)	-	0.1	mg/kg	0.3	0.3	0.2	0.1	0.1



Work Order	ıl Division				
Work Order		CERTIFIC	<b>ATE OF ANALYSIS</b>		
	: EB1222679		Page	: 1 of 17	
Client	ENDOCOAL LTD		Laboratory	: Environmental Divi	sion Brisbane
Contact	: MR BRUCE OGILVIE		Contact	: Customer Services	
vddress	: SUITE 2 / 1 SWANN RD		Address	: 32 Shand Street S	afford QLD Australia 4053
	TARINGA RRISRANF OLIFENSLAN	JD 4068			
E-mail	: cash.sale@alsenviro.com		E-mail	: Brisbane.Enviro.Se	:rvices@alsglobal.com
elephone	: +61 7 3720 9300		Telephone	: +61 7 3243 7222	)
acsimile	: +61 7 3720 9311		Facsimile	: +61 7 3243 7218	
roject	: Orion Downs - Meteor Do	wns South OBA	QC Level	: NEPM 1999 Sche	dule B(3) and ALS QCS3 requirement
Order number	::				
C-O-C number			Date Samples Received	: 08-AUG-2012	
ampler	: Cameron Tomko		Issue Date	: 12-SEP-2012	
			No of samples received	. 32	
tuote number			No. of samples analysed	. 32	
his report sug elease.	ersedes any previous report(s) wi	ith this reference. Results apply	to the sample(s) as submitted.	All pages of this	eport have been checked and approved
<ul><li>his Certificate c</li><li>General</li><li>Analytic</li></ul>	f Analysis contains the following inform Comments al Results	nation:			
<	NATA Accredited Laboratory 825	<i>Signatories</i> This document has been el	ectronically signed by the auth	orized signatories ir	dicated below. Electronic signing has t
ATA IN	Accredited for compliance with	carried out in compliance with pro	ocedures specified in 21 CFR Part 11		
TIT	ISO/IEC 17025.	Signatories	Position		Accreditation Category
		Jonathon Angell	Inorganic Coordinator		Brisbane Inorganics
anomotor a noon		Kim McCabe	Senior Inorganic Chen	ist	Brisbane Inorganics
ACCREDITATION		Kim McCabe	Senior Inorganic Cherr	ist	Stafford Minerals - AY
		Matt Frost SATISH TRIVEDI	Senior Organic Chemi 2 IC Acid Sulfate Soils	st Sunervisor	Brisbane Inorganics Brisbane Acid Sulnhate Soils
		Address 32 Shand Street Stafford QLD Aus Environmental Division Brisbane ABN 84 00	tralia 4053   PHONE +61-7-3243 7222   Facsimile +( 09 936 029 Part of the ALS Group A Campbell Brothe	1-7-3243 7218 rs Limited Company	

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Page Work Order	: 2 of 17 : EB1222679
Client	: ENDOCOAL LTD
Project	: Orion Downs - Meteor Downs South OBA
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## **General Comments**

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society. LOR = Limit of reporting Key:

 $^{\Lambda}$  = This result is computed from individual analyte detections at or above the level of reporting

- ASS: EA013 (ANC) Fizz Rating: 0- None; 1- Slight; 2- Moderate; 3- Strong; 4- Very Strong; 5- Lime.
- EA011E (Extended Boil Coal Washery NAG) Testing was discontinued for samples that which equal or exceedes pH (ox) of 4.5 as per the method guidelines.
- EG005T (Total Metals): Sample EB122265-001 shows poor duplicate results due to sample heterogeneity. Confirmed by visual inspection. •
- EG005T (Total Metals): Sample EB122679-001 (117332) shows poor matrix spike recovery due to matrixinterference. Confirmed by visual inspection. •

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Aatrix: SOI	
-Matrix: SOI	
nh-Matrix: SOI	
Sub-Matrix: SOI	

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Sub-Matrix: SOIL (Matrix: SOIL)		Clie	ent sample ID	117332	117333	117334	117335	117336
	Clie	ent samplii	ng date / time	02-AUG-2012 15:00				
Compound	CAS Number	LOR	Unit	EB1222679-001	EB1222679-002	EB1222679-003	EB1222679-004	EB1222679-005
EA002 : pH (Soils)								
pH Value		0.1	pH Unit	7.8	8.9	9.0	9.2	9.4
EA009: Nett Acid Production Potential								
Net Acid Production Potential		0.5	kg H2SO4/t	-76.1	-143	-108	-104	-121
EA010: Conductivity							-	
Electrical Conductivity @ 25°C		1	µS/cm	243	149	95	95	97
EA011E-A: pH OX								
pH (OX)		0.1	pH Unit	8.1	9.6	9.6	9.6	10.1
EA013: Acid Neutralising Capacity							-	
ANC as H2SO4		0.5	kg H2SO4 equiv./t	76.1	143	108	104	122
ANC as CaCO3		0.1	% CaCO3	7.8	14.6	11.0	10.6	12.4
Fizz Rating		0	Fizz Unit	2	3	3	3	3
EA055: Moisture Content				-			-	
Moisture Content (dried @ 103°C)		1.0	%	20.6	14.4	14.4	25.5	16.9
ED007: Exchangeable Cations								
Exchangeable Calcium		0.1	meq/100g	47.0	60.5	57.0	50.7	39.4
Exchangeable Magnesium		0.1	meq/100g	28.5	21.6	24.9	26.9	9.5
Exchangeable Potassium		0.1	meq/100g	0.7	0.3	0.3	0.2	1.2
Exchangeable Sodium		0.1	meq/100g	1.2	1.2	1.1	1.2	1.9
Cation Exchange Capacity		0.1	meq/100g	77.4	83.7	83.3	79.1	51.9
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)		0.01	%	<0.01	<0.01	<0.01	<0.01	0.02
ED045G: Chloride Discrete analyser							-	
Chloride	16887-00-6	10	mg/kg	160	80	20	20	<10
ED093S: Soluble Major Cations								
Calcium	7440-70-2	10	mg/kg	80	40	30	30	20
Magnesium	7439-95-4	10	mg/kg	40	20	10	20	20
Sodium	7440-23-5	10	mg/kg	110	110	80	06	80
Potassium	7440-09-7	10	mg/kg	<10	<10	<10	<10	<10
EG005T: Total Metals by ICP-AES								
Aluminium	7429-90-5	50	mg/kg	43400	34600	37000	40900	32300
Antimony	7440-36-0	5	mg/kg	<5	<5	<5	<5	<5
Arsenic	7440-38-2	5	mg/kg	<5	<5	<5	<5	<5
	-		-					



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Sub-Matrix: SOIL (Matrix: SOIL)

sub-Matrix: SOIL (Matrix: SOIL)		Clie	ent sample ID	117332	117333	117334	117335	117336
	Cli	ent samplin	ng date / time	02-AUG-2012 15:00				
Compound	CAS Number	LOR	Unit	EB1222679-001	EB122679-002	EB1222679-003	EB1222679-004	EB1222679-005
EG005T: Total Metals by ICP-AES - Continued	-	-						
Barium	7440-39-3	10	mg/kg	480	180	100	06	60
Beryllium	7440-41-7	+	mg/kg	1	7	-	1	1
Boron	7440-42-8	50	mg/kg	<50	<50	<50	<50	<50
Cadmium	7440-43-9	-	mg/kg	4	4	۲.	۲.	
Chromium	7440-47-3	2	mg/kg	100	69	76	93	64
Cobalt	7440-48-4	2	mg/kg	52	37	40	42	38
Copper	7440-50-8	5	mg/kg	52	52	53	67	81
Iron	7439-89-6	50	mg/kg	58100	73300	70400	73900	64600
Lead	7439-92-1	£	mg/kg	g	<5	<5	<5	<5
Manganese	7439-96-5	ъ	mg/kg	1450	762	565	731	823
Molybdenum	7439-98-7	2	mg/kg	42	<2	<2	<2	<2
Nickel	7440-02-0	2	mg/kg	116	151	154	174	147
Selenium	7782-49-2	5	mg/kg	<5	<5	<5	<5	<5
Silver	7440-22-4	2	mg/kg	<2	~2	<2	~2	<2
Strontium	7440-24-6	2	mg/kg	128	129	179	374	503
Tin	7440-31-5	ъ	mg/kg	<5	<5	\2 \	<5	<5
Vanadium	7440-62-2	£	mg/kg	103	77	73	76	50
Zinc	7440-66-6	Ð	mg/kg	50	54	58	76	65
Titanium	7440-32-6	10	mg/kg	460	230	220	300	580
Thallium	7440-28-0	5	mg/kg	<5	<5	<5	<5	<5
EG035T: Total Recoverable Mercury by FIM	S						•	
Mercury	7439-97-6	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N (Sol.)		0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N (Sol.)		0.1	mg/kg	0.8	0.4	0.2	<0.1	<0.1
EK059G: Nitrite plus Nitrate as N (NOx) by	<b>Discrete Anal</b>	yser						
Nitrite + Nitrate as N (Sol.)		0.1	mg/kg	0.8	0.4	0.2	<0.1	<0.1



Page Work Order	5 of 17 EB1722670
Client	ENDOCOAL LTD
Project :	Orion Downs - Meteor Downs South OBA
Analytical Results	



Sub-Matrix: SOIL (Matrix: SOIL)		Clie	ent sample ID	117337	117338	117339	117340	117341
	Cli	ent samplir	ng date / time	02-AUG-2012 15:00	02-AUG-2012 15:00	02-AUG-2012 15:00	02-AUG-2012 15:00	03-AUG-2012 15:00
Compound	CAS Number	LOR	Unit	EB1222679-006	EB1222679-007	EB1222679-008	EB1222679-009	EB1222679-010
EA002 : pH (Soils)								
pH Value		0.1	pH Unit	9.6	9.8	9.8	9.8	9.8
EA009: Nett Acid Production Potential								
Net Acid Production Potential		0.5	kg H2SO4/t	-101	-122	-134	-113	-136
EA010: Conductivity								
Electrical Conductivity @ 25°C		-	µS/cm	104	145	199	184	182
EA011E-A: pH OX								
pH (OX)	-	0.1	pH Unit	10.2	10.3	10.1	9.8	10.3
EA013: Acid Neutralising Capacity		-						
ANC as H2SO4		0.5	kg H2SO4 equiv./t	102	123	135	114	136
ANC as CaCO3		0.1	% CaCO3	10.4	12.5	13.7	11.7	13.9
Fizz Rating		0	Fizz Unit	с	3	з	3	з
EA055: Moisture Content		-						
Moisture Content (dried @ 103°C)		1.0	%	7.5	11.4	20.6	24.0	14.5
ED007: Exchangeable Cations								
Exchangeable Calcium		0.1	meq/100g	29.5	32.8	41.4	45.2	37.6
Exchangeable Magnesium		0.1	meq/100g	7.1	7.3	12.7	13.3	9.4
Exchangeable Potassium		0.1	meq/100g	2.2	1.5	0.3	0.8	1.4
Exchangeable Sodium	1	0.1	meq/100g	6.1	5.5	4.4	5.1	4.8
Cation Exchange Capacity		0.1	meq/100g	45.0	47.1	58.9	64.4	53.1
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)		0.01	%	0.02	0.03	0.04	0.04	<0.01
ED045G: Chloride Discrete analyser								
Chloride	16887-00-6	10	mg/kg	<10	<10	<10	<10	<10
ED093S: Soluble Major Cations								
Calcium	7440-70-2	10	mg/kg	10	<10	<10	<10	<10
Magnesium	7439-95-4	10	mg/kg	<10	<10	<10	<10	<10
Sodium	7440-23-5	10	mg/kg	100	170	260	250	220
Potassium	7440-09-7	10	mg/kg	<10	<10	<10	<10	<10
EG005T: Total Metals by ICP-AES		-						
Aluminium	7429-90-5	50	mg/kg	32700	33000	39400	41900	35900
Antimony	7440-36-0	5	mg/kg	<2 <2	<5	<2>	<5	<5
Arsenic	7440-38-2	5	mg/kg	<5	<5	<5	<5	<5
	-	-	-					

: 6 of 17	: EB1222679	: ENDOCOAL LTD	: Orion Downs - Meteor Downs South OBA	
Page	Work Order	Client	Project	



Sub-Matrix: SOIL (Matrix: SOIL)

Sub-Matrix: SOIL (Matrix: SOIL)		Clie	nt sample ID	117337	117338	117339	117340	117341
	Clie	ent samplin	g date / time	02-AUG-2012 15:00	02-AUG-2012 15:00	02-AUG-2012 15:00	02-AUG-2012 15:00	03-AUG-2012 15:00
Compound	CAS Number	LOR	Unit	EB1222679-006	EB1222679-007	EB1222679-008	EB1222679-009	EB1222679-010
EG005T: Total Metals by ICP-AES - Continue	ed							
Barium	7440-39-3	10	mg/kg	50	30	20	30	06
Beryllium	7440-41-7	~	mg/kg	7	-	£	Ý	۴
Boron	7440-42-8	50	mg/kg	<50	<50	<50	<50	<50
Cadmium	7440-43-9	-	mg/kg	4	4	4	~	<1
Chromium	7440-47-3	2	mg/kg	58	68	107	126	80
Cobalt	7440-48-4	2	mg/kg	36	40	51	52	40
Copper	7440-50-8	5	mg/kg	72	74	72	74	99
Iron	7439-89-6	50	mg/kg	65400	69400	76000	83700	20900
Lead	7439-92-1	5	mg/kg	<5	<5	<5	<5	<5
Manganese	7439-96-5	5	mg/kg	739	783	809	761	1050
Molybdenum	7439-98-7	2	mg/kg	42	42	~2	<2	<2
Nickel	7440-02-0	2	mg/kg	146	161	187	191	151
Selenium	7782-49-2	5	mg/kg	<5	<5	<5	<5	<5
Silver	7440-22-4	2	mg/kg	<2	<2	<2	<2	<2
Strontium	7440-24-6	2	mg/kg	323	238	98	174	399
Tin	7440-31-5	5	mg/kg	<5	<5	<5	<5	<5
Vanadium	7440-62-2	5	mg/kg	30	51	116	112	71
Zinc	7440-66-6	5	mg/kg	63	70	91	66	76
Titanium	7440-32-6	10	mg/kg	960	1010	1000	970	930
Thallium	7440-28-0	5	mg/kg	<5	<5	<5	<5	<5
EG035T: Total Recoverable Mercury by FIN	MS	-						
Mercury	7439-97-6	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
EK057G: Nitrite as N by Discrete Analyser						-		
Nitrite as N (Sol.)		0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
EK058G: Nitrate as N by Discrete Analyser						-		
Nitrate as N (Sol.)		0.1	mg/kg	<0.1	<0.1	0.2	0.2	0.1
EK059G: Nitrite plus Nitrate as N (NOx) by	y Discrete Anal	/ser						
Nitrite + Nitrate as N (Sol.)		0.1	mg/kg	<0.1	<0.1	0.2	0.2	0.1



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Work Order	EB1222679
Client	ENDOCOAL LTD
Project :	Orion Downs - Meteor Downs South OBA
Analytical Results	



Sub-Matrix: SOIL (Matrix: SOIL)		Clie	ent sample ID	117342	117343	117344	117345	117346
	Clie	ent sampli	ng date / time	03-AUG-2012 15:00	04-AUG-2012 15:00	04-AUG-2012 15:00	04-AUG-2012 15:00	05-AUG-2012 15:00
Compound	CAS Number	LOR	Unit	EB1222679-011	EB1222679-012	EB1222679-013	EB1222679-014	EB1222679-015
EA002 : pH (Soils)								
pH Value		0.1	pH Unit	9.6	8.9	8.5	8.9	8.6
EA009: Nett Acid Production Potential							-	
Net Acid Production Potential		0.5	kg H2SO4/t	-108	-119	-124	-74.9	-18.5
EA010: Conductivity								
Electrical Conductivity @ 25°C		-	µS/cm	131	276	388	331	352
EA011E-A: pH OX								
pH (OX)		0.1	pH Unit	10.1	10.2	10.2	10.0	7.9
EA013: Acid Neutralising Capacity								
ANC as H2SO4		0.5	kg H2SO4 equiv./t	109	120	124	74.9	22.2
ANC as CaCO3		0.1	% CaCO3	11.1	12.2	12.7	7.6	2.3
Fizz Rating		0	Fizz Unit	Э	3	ъ	2	1
EA055: Moisture Content					-	-		
Moisture Content (dried @ 103°C)		1.0	%	7.9				
ED007: Exchangeable Cations						-		
Exchangeable Calcium		0.1	meq/100g	29.8	31.8	43.3	37.1	31.7
Exchangeable Magnesium		0.1	meq/100g	8.2	9.3	9.3	10.1	10.9
Exchangeable Potassium		0.1	meq/100g	1.7	0.2	0.2	1.1	1.2
Exchangeable Sodium		0.1	meq/100g	4.8	3.1	3.7	4.7	4.3
Cation Exchange Capacity	-	0.1	meq/100g	44.5	44.5	56.5	53.0	48.1
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)		0.01	%	0.02	0.02	<0.01	<0.01	0.12
ED045G: Chloride Discrete analyser								
Chloride	16887-00-6	10	mg/kg	<10	20	30	20	10
ED093S: Soluble Major Cations								
Calcium	7440-70-2	10	mg/kg	<10	20	30	10	10
Magnesium	7439-95-4	10	mg/kg	<10	<10	10	<10	<10
Sodium	7440-23-5	10	mg/kg	150	280	390	330	330
Potassium	7440-09-7	10	mg/kg	<10	<10	<10	10	30
EG005T: Total Metals by ICP-AES								
Aluminium	7429-90-5	50	mg/kg	33300	34100	31500	27900	19600
Antimony	7440-36-0	5	mg/kg	<5	<5	<5	<5	<5
Arsenic	7440-38-2	5	mg/kg	<5	<5	<5	7	7
	-		-	64				

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Work Order	EB1222679
Client :	ENDOCOAL LTD
Project :	Orion Downs - Meteor Downs South OBA
Analytical Results	



Sub-Matrix: SOIL (Matrix: SOIL)		Clie	nt sample ID	117342	117343	117344	117345	117346
	Clie	ent samplin	g date / time	03-AUG-2012 15:00	04-AUG-2012 15:00	04-AUG-2012 15:00	04-AUG-2012 15:00	05-AUG-2012 15:00
Compound	AS Number	LOR	Unit	EB1222679-011	EB1222679-012	EB1222679-013	EB1222679-014	EB1222679-015
EG005T: Total Metals by ICP-AES - Continued								
Barium	7440-39-3	10	mg/kg	60	80	100	1820	06
Beryllium	7440-41-7	~	mg/kg	Ŷ	Ý	Ý	£	2
Boron	7440-42-8	50	mg/kg	<50	<50	<50	<50	<50
Cadmium	7440-43-9	۲	mg/kg	4	4	4	-1	<b>^</b>
Chromium	7440-47-3	2	mg/kg	53	69	101	71	26
Cobalt	7440-48-4	7	mg/kg	37	36	38	27	9
Copper	7440-50-8	5	mg/kg	64	58	57	45	14
Iron	7439-89-6	50	mg/kg	66300	63400	67100	46800	23200
Lead	7439-92-1	5	mg/kg	<5	<5	<5	5	10
Manganese	7439-96-5	5	mg/kg	749	839	879	523	104
Molybdenum	7439-98-7	2	mg/kg	<2	<2	<2	<2	<2
Nickel	7440-02-0	2	mg/kg	148	148	145	106	21
Selenium	7782-49-2	5	mg/kg	<5	<5	<5	<5	<5
Silver	7440-22-4	2	mg/kg	<2	<2	<2	<2	<2
Strontium	7440-24-6	2	mg/kg	633	164	105	329	70
Tin	7440-31-5	5	mg/kg	<5	<5	<5	<5	<5
Vanadium	7440-62-2	5	mg/kg	34	44	83	45	33
Zinc	7440-66-6	5	mg/kg	66	68	71	63	55
Titanium	7440-32-6	10	mg/kg	860	1250	920	740	160
Thallium	7440-28-0	5	mg/kg	<5	<5	<5	<5	<5
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N (Sol.)	-	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N (Sol.)		0.1	mg/kg	<0.1	0.1	0.2	0.2	0.1
EK059G: Nitrite plus Nitrate as N (NOx) by D	iscrete Anal	/ser						
Nitrite + Nitrate as N (Sol.)		0.1	mg/kg	<0.1	0.1	0.2	0.2	0.1

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Page	Work Order	Client	Project	



trix:
S
SOIL
Sub-Matrix:

ub-Matrix: SOIL (Matrix: SOIL)		Clie	ent sample ID	117347	117348	117349	117350	117351
	Clie	nt samplii	ng date / time	05-AUG-2012 15:00				
Jompound	CAS Number	LOR	Unit	EB1222679-016	EB1222679-017	EB1222679-018	EB1222679-019	EB1222679-020
EA002 : pH (Soils)								
pH Value		0.1	pH Unit	9.2	9.3	9.5	9.2	9.4
EA009: Nett Acid Production Potential								
Net Acid Production Potential		0.5	kg H2SO4/t	-10.2	-39.5	-36.8	-17.5	-9.0
EA010: Conductivity								
Electrical Conductivity @ 25°C		~	µS/cm	227	245	220	221	198
EA011E-A: pH OX								
pH (OX)		0.1	pH Unit	7.5	10.9	10.8	10.3	7.9
EA013: Acid Neutralising Capacity				-			-	
ANC as H2SO4		0.5	kg H2SO4 equiv./t	13.0	39.8	37.1	17.8	9.3
ANC as CaCO3		0.1	% CaCO3	1.3	4.0	3.8	1.8	0.9
Fizz Rating		0	Fizz Unit	£	2	2	+	£
ED007: Exchangeable Cations				-	_		-	
Exchangeable Calcium		0.1	meq/100g	21.2	31.0	27.8	22.0	17.5
Exchangeable Magnesium		0.1	meq/100g	10.0	8.4	7.3	4.4	6.5
Exchangeable Potassium		0.1	meq/100g	1.1	0.7	0.6	9.0	0.6
Exchangeable Sodium	1	0.1	meq/100g	3.9	3.2	3.1	2.4	3.9
Cation Exchange Capacity		0.1	meq/100g	36.2	43.4	38.8	29.4	28.6
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)		0.01	%	60.0	0.01	0.01	0.01	0.01
ED045G: Chloride Discrete analyser								
Chloride	16887-00-6	10	mg/kg	<10	<10	<10	20	<10
ED093S: Soluble Major Cations							-	
Calcium	7440-70-2	10	mg/kg	<10	<10	<10	<10	<10
Magnesium	7439-95-4	10	mg/kg	<10	<10	<10	<10	<10
Sodium	7440-23-5	10	mg/kg	190	240	220	230	200
Potassium	7440-09-7	10	mg/kg	20	10	<10	10	<10
EG005T: Total Metals by ICP-AES								
Aluminium	7429-90-5	50	mg/kg	10800	11500	11100	13900	12400
Antimony	7440-36-0	5	mg/kg	<5	<5	<5	<5	<5
Arsenic	7440-38-2	5	mg/kg	14	9	8	8	<5
Barium	7440-39-3	10	mg/kg	60	60	70	60	70
Beryllium	7440-41-7	-	mg/kg	2	2	-	2	£



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гаде	Work Order	Client	Project	



Sub-Matrix: SOIL (Matrix: SOIL)

sub-Matrix: SOIL (Matrix: SOIL)		Client sample ID	117347	117348	117349	117350	117351
	Client sa	mpling date / time	05-AUG-2012 15:00				
Compound CAS Num	ber LOH	R Unit	EB1222679-016	EB1222679-017	EB1222679-018	EB1222679-019	EB1222679-020
EG005T: Total Metals by ICP-AES - Continued							
Boron 7440-4	2-8 50	mg/kg	<50	<50	<50	<50	<50
Cadmium 7440-4	3-9 1	mg/kg	4	<1	Ý	4	<1
Chromium 7440-4	7-3 2	mg/kg	11	18	17	20	17
Cobalt 7440-4	8-4 2	mg/kg	2	5	15	13	10
Copper 7440-5	0-8 5	mg/kg	6	10	7	9	13
Iron 7439-8	9-6 50	mg/kg	6940	11600	17700	29700	18500
Lead 7439-9	2-1 5	mg/kg	15	13	14	16	16
Manganese 7439-9	6-5 5	mg/kg	<5	391	245	179	63
Molybdenum 7439-9	8-7 2	mg/kg	<2	<2	<2	<2	<2
Nickel 7440-0	2-0 2	mg/kg	9	11	19	12	12
Selenium 7782-4	9-2 5	mg/kg	<5	<5	<5	<5	<5
Silver 7440-2	2-4 2	mg/kg	<2	<2	<2	<2	<2
Strontium 7440-2	4-6 2	mg/kg	57	70	60	36	54
Tin 7440-3	1-5 5	mg/kg	<5	<5	<5	<5	<5
Vanadium 7440-6	2-2 5	mg/kg	15	18	20	26	36
Zinc 7440-6	6-6 5	mg/kg	32	53	55	54	44
Titanium 7440-3	2-6 10	mg/kg	130	120	80	06	120
Thallium 7440-2	8-0 5	mg/kg	<5	<5	<5	<5	<5
EG035T: Total Recoverable Mercury by FIMS							
Mercury 7439-9	7-6 0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
EK057G: Nitrite as N by Discrete Analyser							
Nitrite as N (Sol.)	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
EK058G: Nitrate as N by Discrete Analyser							
Nitrate as N (Sol.)	0.1	mg/kg	0.2	0.2	0.4	0.1	0.2
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete	Analyser						
Nitrite + Nitrate as N (Sol.)	0.1	mg/kg	0.2	0.2	0.4	0.1	0.2



: 11 of 17	: EB1222679	: ENDOCOAL LTD	: Orion Downs - Meteor Downs South OBA	
Page	Work Order	Client	Project	



Analytical Results								
Sub-Matrix: SOIL (Matrix: SOIL)		Clier	rt sample ID	117352	117353	117354	117355	117356
	Clier	t samplin	g date / time	05-AUG-2012 15:00				
Compound	CAS Number	LOR	Unit	EB1222679-021	EB1222679-022	EB1222679-023	EB1222679-024	EB1222679-025
EA002 : pH (Soils)								
pH Value		0.1	pH Unit	9.4	9.2	9.2	9.3	8.8
EA009: Nett Acid Production Potential								
Net Acid Production Potential	-	0.5	kg H2SO4/t	-58.5	-20.3	-14.0	-20.6	-191
EA010: Conductivity								
Electrical Conductivity @ 25°C		-	µS/cm	264	260	276	283	266
EA011E-A: pH OX								
pH (OX)	-	0.1	pH Unit	11.0	10.2	7.6	8.6	8.7
EA013: Acid Neutralising Capacity	-				-			
ANC as H2SO4		0.5	kg H2SO4 equiv./t	58.8	20.3	14.0	21.5	192
ANC as CaCO3		0.1	% CaCO3	6.0	2.1	1.4	2.2	19.6
Fizz Rating		0	Fizz Unit	2	-	-	Ţ	e
ED007: Exchangeable Cations					-			
Exchangeable Calcium		0.1	meq/100g	30.2	27.0	25.9	27.4	26.4
Exchangeable Magnesium	1	0.1	meq/100g	5.3	4.9	6.8	6.4	2.5
Exchangeable Potassium		0.1	meq/100g	0.6	9.0	1.0	0.9	0.4
Exchangeable Sodium		0.1	meq/100g	3.6	4.0	5.6	5.7	1.8
Cation Exchange Capacity		0.1	meq/100g	39.7	36.6	39.3	40.5	31.1
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)		0.01	%	0.01	<0.01	<0.01	0.03	0.03
ED045G: Chloride Discrete analyser								
Chloride	16887-00-6	10	mg/kg	<10	<10	<10	<10	<10
ED093S: Soluble Major Cations								
Calcium	7440-70-2	10	mg/kg	<10	<10	<10	<10	20
Magnesium	7439-95-4	10	mg/kg	<10	<10	<10	<10	<10
Sodium	7440-23-5	10	mg/kg	260	270	270	270	270
Potassium	7440-09-7	10	mg/kg	10	10	10	10	30
EG005T: Total Metals by ICP-AES								
Aluminium	7429-90-5	50	mg/kg	11100	11800	12700	12900	14200
Antimony	7440-36-0	5	mg/kg	<5	<5	<5	<5	<5
Arsenic	7440-38-2	5	mg/kg	7	Q	√5	10	10
Barium	7440-39-3	10	mg/kg	70	50	80	06	70
Beryllium	7440-41-7	~	mg/kg	2	-	2	2	2

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Page	Work Order	Client	Project	



(Matrix: SOIL)
SOIL
Sub-Matrix:

ub-Matrix: SOIL (Matrix: SOIL)		Client sam	ple ID	117352	117353	117354	117355	117356
	Client s	ampling date	/ time	05-AUG-2012 15:00				
Compound CAS Nu	mber L(	DR U	Init	EB1222679-021	EB1222679-022	EB1222679-023	EB1222679-024	EB1222679-025
EG005T: Total Metals by ICP-AES - Continued								
<b>Boron</b> 7440	-42-8 5	0 0	g/kg	<50	<50	<50	<50	<50
Cadmium 7440	-43-9	1 mg	g/kg	~	4	~	4	+
Chromium 7440	-47-3	2 mg	g/kg	21	15	16	10	14
<b>Cobalt</b> 7440	-48-4	2 mg	g/kg	8	6	3	8	10
<b>Copper</b> 7440	-50-8	2 mg	g/kg	6	<5	13	19	12
<b>Iron</b> 7439	-89-6 5	0 mg	g/kg	25900	28600	17400	39700	150000
<b>Lead</b> 7439	-92-1	2 mg	g/kg	14	12	14	18	7
Manganese 7439	-96-5	2 mg	g/kg	436	146	64	666	3480
Molybdenum 7439	-98-7	2 mg	g/kg	<2	<2	<2	<2	<2
Nickel 7440	-02-0	2 mg	g/kg	6	11	9	12	10
Selenium 7782	-49-2	2 mG	g/kg	<5	<5	<5	<5	<5
Silver 7440	-22-4	2 mg	g/kg	<2	<2	<2	<2	<2
Strontium 7440	-24-6	2 mg	g/kg	74	56	78	81	121
<b>Tin</b> 7440	-31-5	2 mg	g/kg	<5	<5	<5	<5	<5
Vanadium 7440	-62-2	2 mg	g/kg	27	25	25	22	57
Zinc 7440	-96-6	2 mG	g/kg	54	64	38	62	30
Titanium 7440	-32-6 1	0 D	g/kg	130	80	120	100	60
Thallium 7440	-28-0	2 mg	j/kg	<5	<5	<5	<5	<5
EG035T: Total Recoverable Mercury by FIMS								
Mercury 7439	-97-6 0	.1 mg	g/kg	<0.1	<0.1	<0.1	0.1	<0.1
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N (Sol.)	0	.1 mg	g/kg	<0.1	<0.1	<0.1	<0.1	<0.1
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N (Sol.)	0	.1 mg	g/kg	0.1	0.1	<0.1	0.2	0.1
EK059G: Nitrite plus Nitrate as N (NOx) by Discret	e Analyse							
Nitrite + Nitrate as N (Sol.)	0	.1 mg	g/kg	0.1	0.1	<0.1	0.2	0.1
			1					



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Analytical Results	



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ub-Matrix: SOIL (Matrix: SOIL)		Clie	nt sample ID	117357	117358	117359	117360	117361
	Clie	nt samplin	ig date / time	05-AUG-2012 15:00				
Compound	CAS Number	LOR	Unit	EB1222679-026	EB1222679-027	EB1222679-028	EB1222679-029	EB1222679-030
EA002 : pH (Soils)								
pH Value		0.1	pH Unit	9.3	8.8	9.4	9.4	9.0
EA009: Nett Acid Production Potential								
Net Acid Production Potential		0.5	kg H2SO4/t	-37.3	-139	-16.4	-111	-32.7
EA010: Conductivity								
Electrical Conductivity @ 25°C		1	µS/cm	310	320	288	301	325
EA011E-A: pH OX						-	-	
pH (OX)		0.1	pH Unit	9.4	8.7	8.5	10.8	9.3
EA013: Acid Neutralising Capacity							-	
ANC as H2SO4		0.5	kg H2SO4 equiv./t	38.2	140	17.3	111	33.6
ANC as CaCO3		0.1	% CaCO3	3.9	14.3	1.8	11.4	3.4
Fizz Rating		0	Fizz Unit	2	r	-	2	2
ED007: Exchangeable Cations					-			
Exchangeable Calcium		0.1	meq/100g	33.6	29.4	29.1	35.1	45.7
Exchangeable Magnesium		0.1	meq/100g	5.9	4.0	5.2	4.4	5.5
Exchangeable Potassium		0.1	meq/100g	1.0	0.7	1.1	0.7	1.2
Exchangeable Sodium		0.1	meq/100g	5.6	2.9	5.4	4.0	4.7
Cation Exchange Capacity		0.1	meq/100g	46.2	37.0	40.7	44.2	57.2
ED042T: Total Sulfur by LECO							-	
Sulfur - Total as S (LECO)		0.01	%	0.03	0.03	0.03	<0.01	0.03
ED045G: Chloride Discrete analyser								
Chloride	16887-00-6	10	mg/kg	10	<10	10	<10	<10
ED093S: Soluble Major Cations								
Calcium	7440-70-2	10	mg/kg	<10	20	<10	<10	<10
Magnesium	7439-95-4	10	mg/kg	<10	<10	<10	<10	<10
Sodium	7440-23-5	10	mg/kg	300	360	280	320	330
Potassium	7440-09-7	10	mg/kg	10	30	20	20	20
EG005T: Total Metals by ICP-AES						-		
Aluminium	7429-90-5	50	mg/kg	13300	14900	12400	9250	13100
Antimony	7440-36-0	5	mg/kg	<5	<5	<5	<5	<5
Arsenic	7440-38-2	5	mg/kg	16	10	13	18	19
Barium	7440-39-3	10	mg/kg	70	70	60	60	60
Beryllium	7440-41-7	-	mg/kg	2	°	Ł	۰ ۲	t
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# Sub-Matrix: SOIL (Matrix: SOIL)

sub-Matrix: SOIL (Matrix: SOIL)	Cli	ent sample ID	117357	117358	117359	117360	117361
0	Client sampli	ng date / time	05-AUG-2012 15:00				
Compound CAS Number	LOR	Unit	EB1222679-026	EB1222679-027	EB1222679-028	EB1222679-029	EB1222679-030
EG005T: Total Metals by ICP-AES - Continued							
Boron 7440-42-8	50	mg/kg	<50	<50	<50	<50	<50
Cadmium 7440-43-9	-	mg/kg	۲.	-	Ŷ		~
Chromium 7440-47-3	2	mg/kg	12	12	12	14	15
Cobalt 7440-48-4	2	mg/kg	8	26	6	8	12
Copper 7440-50-8	5	mg/kg	22	16	26	10	24
Iron 7439-89-6	50	mg/kg	20600	127000	20300	14700	20400
Lead 7439-92-1	5	mg/kg	17	10	18	11	16
Manganese 7439-96-5	5	mg/kg	365	2900	275	657	461
Molybdenum 7439-98-7	2	mg/kg	<2	<2	<2	<2	<2
Nickel 7440-02-0	2	mg/kg	16	19	14	13	20
Selenium 7782-49-2	£	mg/kg	<5	<5	<2	<5	<5
Silver 7440-22-4	2	mg/kg	<2	<2	<2	<2	<2
Strontium 7440-24-6	2	mg/kg	81	91	76	84	72
Tin 7440-31-5	5	mg/kg	<5	<5	<5	<5	<5
Vanadium 7440-62-2	5	mg/kg	21	52	23	16	26
Zinc 7440-66-6	2	mg/kg	69	44	74	47	73
Titanium 7440-32-6	10	mg/kg	100	50	110	80	110
<b>Thallium</b> 7440-28-0	5	mg/kg	<5	<5	<5	<5	<5
EG035T: Total Recoverable Mercury by FIMS						•	
Mercury 7439-97-6	0.1	mg/kg	0.2	0.1	0.1	<0.1	0.1
EK057G: Nitrite as N by Discrete Analyser							
Nitrite as N (Sol.)	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
EK058G: Nitrate as N by Discrete Analyser							
Nitrate as N (Sol.)	0.1	mg/kg	0.2	0.2	0.2	0.2	0.2
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete An	alyser						
Nitrite + Nitrate as N (Sol.)	0.1	mg/kg	0.2	0.2	0.2	0.2	0.2







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ib-Matrix: SOIL (Matrix: SOIL)		Cli	ent sample ID	117362	117363		1	-	
	Cli	ent sampli	ng date / time	06-AUG-2012 15:00	06-AUG-2012 15:00				
punoauio	CAS Number	LOR	Unit	EB1222679-031	EB122679-032		ł		
A002 : pH (Soils)									
oH Value		0.1	pH Unit	8.9	7.6				
A009: Nett Acid Production Potential									
Vet Acid Production Potential		0.5	kg H2SO4/t	-43.3	<0.5				
A010: Conductivity									
Electrical Conductivity @ 25°C	-	-	µS/cm	297	120		-		
A011-B: Dissolved Major Anions									
Sulfur as S	63705-05-5	-	mg/L		19				
Chloride	16887-00-6	-	mg/L		Ÿ				
A011-C: Dissolved Major Cations									
Salcium	7440-70-2	-	mg/L		14				
Magnesium	7439-95-4	٢	mg/L		8				
Sodium	7440-23-5	-	mg/L		4				
otassium	7440-09-7	٢	mg/L		3				
A011-D: Calculated Components									
<b>Calculated Acid Component</b>		0.1	kg H2SO4/t		5.7				
<b>Calculated Neutralisng Component</b>		0.1	kg H2SO4/t	-	8.2				
<b>Calculated NAG Acidity</b>		0.1	kg H2SO4/t		<0.1				
A011E-A: pH OX									
)H (OX)		0.1	pH Unit	9.9	4.2		-		
bH -2 (ext)		0.1	pH Unit	1	5.9			1	
A013: Acid Neutralising Capacity									
ANC as H2SO4		0.5	kg H2SO4 equiv./t	44.2	5.7				
ANC as CaCO3		0.1	% CaCO3	4.5	0.6				
izz Rating	-	0	Fizz Unit	2	-				
D007: Exchangeable Cations									
Exchangeable Calcium	1	0.1	meq/100g	28.6	5.7		1		
Exchangeable Magnesium		0.1	meq/100g	4.0	4.2				
Exchangeable Potassium		0.1	meq/100g	1.0	0.4	-		-	
Exchangeable Sodium		0.1	meq/100g	3.2	1.1		1		
Cation Exchange Capacity		0.1	meq/100g	36.8	11.4		-		
D042T: Total Sulfur by LECO									
Sulfur - Total as S (LECO)		0.01	%	0.03	0.18		-	-	



### Analytical Results

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## Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)		Clie	ent sample ID	117362	117363			
	Cli	ent samplii	ng date / time	06-AUG-2012 15:00	06-AUG-2012 15:00			
Compound	CAS Number	LOR	Unit	EB1222679-031	EB1222679-032	1	ł	1
EK057G: Nitrite as N by Discrete Analyser	r - Continued							
Nitrite as N (Sol.)		0.1	mg/kg	<0.1	<0.1			
EK058G: Nitrate as N by Discrete Analysen	L						-	
Nitrate as N (Sol.)		0.1	mg/kg	0.1	0.1			
EK059G: Nitrite plus Nitrate as N (NOx) by	y Discrete Anal	yser				-	-	
Nitrite + Nitrate as N (Sol.)		0.1	mg/kg	0.1	0.1		-	
	-	-						

### Appendix C

Approved RIDA RPI14/002



Department of State Development, Infrastructure and Planning

### **REGIONAL INTERESTS DEVELOPMENT APPROVAL** (RIDA)

### **RPI14/002 UDMMeteor – Meteor Downs South Coal Mine project** (MDS)

Given under the Regional Planning Interests Act 2014 section 53 on 24 November 2014.

### **Description of the land**

•	Real property description:	Part of Lot 4 on RP617701; Part of Lot1 on SP164068;
		Part of Lot 1 on SP174071; Part of Lot 4 on SP170470 and Part of
		Lot 2 on RP 616045 (The area contained within MLA 70452).
•	Local Government Area:	Central Highlands Regional Council

### **Approved activities**

The approved activities are those resource activities (open cut coal mine and associated infrastructure) as set out in Table 1 below. Definitions of the resource activities are included in Attachment 1.

Area of regional interest	Resource activity	Location	Area of disturbance
Priority agricultural area	<ul> <li>Extraction activities including:</li> <li>Open cut mining pit</li> <li>Spoil dump</li> <li>Water and sediment management systems</li> <li>Haul roads</li> <li>Plant parking areas</li> <li>Temporary workers facilities</li> <li>Fire protection systems</li> </ul>	Part of Lot 4 on RP617701	259.04ha
	<ul> <li>Ancillary mine support activities including:</li> <li>Mine infrastructure area</li> <li>Run of mine (ROM) stockpiles and load out</li> </ul>	Part of Lot 1 on SP164068	68.08ha

### **Table 1: Approved activities**

Area of regional interest	Resource activity	Location	Area of disturbance
	<ul> <li>facilities</li> <li>Coal Handling Preparation Plant, including crushing and screening equipment</li> <li>Water and sediment management systems</li> <li>Haul roads</li> <li>Sewerage treatment plant</li> <li>Fire protection systems</li> </ul>		
	<ul> <li>Extraction activities including:</li> <li>Open cut mining pit</li> <li>Spoil dump</li> <li>Water and sediment management systems</li> <li>Haul roads</li> <li>Plant parking areas</li> <li>Temporary workers facilities</li> <li>Fire protection systems</li> </ul>	Part of Lot 1 on SP174071	50.72ha
	<ul> <li>Ancillary mine support activities including:</li> <li>Water and sediment management systems</li> <li>Haul roads</li> <li>Quarry</li> <li>Security facilities</li> <li>Offices</li> <li>Fire protection systems</li> </ul>	Part of Lot 4 on SP170470	40.29ha
	<ul> <li>Ancillary mine support activities including:</li> <li>Water and sediment management systems</li> <li>Haul roads</li> <li>Fire protection systems</li> </ul>	Part of Lot 2 on RP 616045	8.52 ha

### **General Advice**

This approval does not relieve the applicant of the obligation to obtain all approvals and licenses from all relevant authorities required under any Act.

### **Regional interests conditions**

A person who is the holder of, or is acting under, this RIDA must not contravene a condition of this approval.

Condition number	Condition	Timing for condition
1.	Carry out the approved activities and disturbance of land generally in accordance with:	For the duration of the conduct of the
	a) The approved drawing, <i>Figure AC1 Mine Infrastructure and PALU (undated)</i> (See Attachment 2)	approved activities
	b) The activities identified in Table 1: Approved activities.	
2.	Maintain approved activities generally in accordance with the approved drawing and Table 1: Approved activities.	For the duration of the conduct of the approved activities
3.	<ul> <li>a) Any disturbance of land in accordance with this RIDA is not to impact adversely on other priority agricultural land uses in the PAA.</li> </ul>	While construction is occurring and then for the duration of the
	<ul> <li>b) All complaints received, and resulting actions taken, about the impact of the approved activities on the priority agricultural land uses in the PAA must be recorded. The record must include.</li> </ul>	conduct of the approved activities
	<ul> <li>name, address and contact number of the complainant</li> </ul>	
	ii) time and date of complaint	
	iii) reasons for the complaint	
	iv) investigations undertaken	
	v) conclusions formed	
	vi) actions taken to resolve the complaint	
	vii) any abatement measures implemented	1
	viii) person responsible for resolving the complaint.	
	c) The records of any complaints received and recorded in accordance with this condition must be provided to the chief executive on request.	

### **Attachment 1: Definitions**

Activity	Definition	
Spoil dump	A pile built of accumulated overburden or other waste as it is removed during mining.	
Open cut mining pit	An open pit or trench at the surface from which rock or minerals is extracted. Includes supporting infrastructure such as haul roads, bunding, soil stockpiles, hardstands and water management structures.	
Run of mine stockpile and load out facility	Stockpiles of raw coal and product removed from the pit and includes associated infrastructure required to deposit and transport the product.	
Coal handling processing plant	Infrastructure necessary to support the coal handing processing plant e.g. wash plant, water dam, crushers, conveyor belts, stackers and reclaimers.	
Water and sediment management system         A system of interconnected channels, associated infrastructure dams to manage erosion and sediment run off.		
Sediment dam	The banking of rock and/or earth to create a hold area for water to manage erosion and sediment run off.	
Mine infrastructure area	Mine related infrastructure to support the mine. Includes offices, workshops and associated infrastructure.	
Sewerage treatment plant	A facility that processes the removal of contaminants from wastewater.	
Quarry	Quarrying activities to provide various construction materials, predominantly concrete aggregates, asphalt aggregates and road base products for the development of the Meteor Downs South project.	
Haul road	A road constructed to facilitate the trucking of coal product or overburden.	
Plant parking area	A parking area for the storage of plant and equipment.	
Temporary workers facility	Temporary facilities for mine workers including toilets, drinking water, washing, dining and storage of clothing and personal equipment.	
Fire protection systems	A system to protect human life and property from fire and may include sprinkler and mist systems, fire alarm and evacuation systems, water deluge, and chemical suppression systems.	
Security facilities and offices	Infrastructure necessary to support the security and administrative requirements of the mine.	
Other terms	Definition	
Chief Executive	Chief Executive responsible for administering the Regional Planning Interests Act 2014.	



Attachment 2: - Figure AC1 Mine Infrastructure and PALU (undated)

### Appendix D

Approved RIDA RPI17/008



Department of Infrastructure, Local Government and Planning

Our ref: RPI17/008/U & D Mining OUT17/7863

16 November 2017

U & D Mining Australia Pty Ltd ACN 165 894 806 Att: Mr Marty Costello Level 4, Rowes Building 235 Edward Street BRISBANE QLD 4000 Brisbane.admin@udmining.com.au

### DECISION NOTICE

### RPI17/008/U & D Mining – Meteor Downs South Coal Project (given under the Regional Planning Interests Act 2014 section 51)

The Department of Infrastructure, Local Government and Planning (DILGP) advises that the assessment application (that was properly made on 19 September 2017) for construction and operation of resource activities associated with the Meteor Downs South Coal Project on strategic cropping land has been approved, subject to regional interests conditions. The subject land is described at Attachment 'A'.

### Reasons for the decision

DILGP considers that by imposing conditions, the proposed activity meets the applicable Required Outcome in the Strategic Cropping Area assessment criteria.

The authorised delegate of the Chief Executive considers that by imposing conditions, the impacts from the approved activities in the Strategic Cropping Area will be appropriately managed.

### **Assessing Agencies**

Agency	Area of Regional Interest	Date of assessing agency response	
Department of Natural Resources and Mines	Strategic Cropping Area	30 October 2017	

### Appeals

- The period in which any appeal under Part 5 of the *Regional Planning Interests* Act 2014 must be started is set out in Attachment 1.
- How rights of appeal under Part 5 of the *Regional Planning Interests Act 2014* are to be exercised are set out in Attachment 1.

This decision takes effect when the "appeal period" for the decision ends. The "appeal period" means the period ending on the last day on which an appeal against the decision may be started (see s73 in Attachment 1).

The Regional Interests Development Approval is enclosed.

If you require any further information, please contact Darren Brewer, Manager -Development Assessment and Advisory Team, on 3452 7472 or <u>RPIAct@dilgp.qld.gov.au</u> who will be pleased to assist.

Yours sincerely

Patrick Atkinson Director Development Assessment Division

enc.

Regional Interests Development Approval Attachment 'A'

### Attachment 1 - Extract from the Regional Planning Interests Act 2014

### Part 5 Appeals and declarations

### 71 Definitions for pt 5

### In this part—

affected land owner, for a regional interests decision, means an owner of land (affected land) that may be adversely affected by the resource activity or regulated activity because of—

- (a) the proximity of the affected land to the land the subject of the decision; and
- (b) the impact the activity may have on an area of regional interest.

*court* means the Planning and Environment Court under the Sustainable Planning Act 2009.

regional interests decision means each of the following decisions-

- (a) a decision to grant a regional interests development approval;
- (b) a decision to impose a condition on a regional interests development approval;
- (c) a decision to refuse all or part of an assessment application;
- (d) a decision to make, or refuse to make, a requested amendment to a regional interests development approval.

### 72 Appeal to Planning and Environment Court

The following may appeal (an appeal) against a regional interests decision to the court-

- (a) the applicant;
- (b) if the applicant is not the owner of the land-the owner of the land;
- (c) an affected land owner.

### Note-

See the Sustainable Planning Act 2009, chapter 7, part 1 for provisions about the powers, processes and procedures of the court, including, for example—

- section 457 (Costs);
- section 495 (Appeal by way of hearing anew);
- division 12 (Alternative dispute resolution).

### 73 Appeal period

- (1) An appeal may be started only within 20 business days after-
  - (a) for a person who received a decision notice, or a copy of a decision notice, for the decision—the notice was received; or
  - (b) for an affected land owner for a regional interests decision—notice of the decision was published under section 52.
- (2) However, the court may at any time extend the time for starting the appeal.

### 74 Respondent for appeal

- (1) The chief executive is the respondent for the appeal.
- (2) If the appellant is not the applicant for the decision, the applicant is a corespondent for the appeal.
- (3) If the appellant is not the owner of the land for the decision, the owner of the land may apply to the court to be a co-respondent for the appeal.
- (4) If the appeal is about an assessing agency's response, the assessing agency is a co- respondent for the appeal.
- (5) If the appeal is only about an assessing agency's response, the chief executive may apply to the court to withdraw from the appeal.

### 75 Notice of appeal to other parties

- (1) An appellant must, within 10 business days after starting an appeal, give notice of the appeal to each of the following—
  - (a) a respondent or co-respondent for the appeal;
  - (b) if the appellant is not the owner of land for the regional interests decision the owner of the land.
- (2) The notice must state-
  - (a) the grounds of the appeal; and
  - (b) if the person given the notice is the owner of the land—that the person may apply to the court to be a co-respondent for the appeal.

### 76 Stay of operation of decision

- (1) The starting of an appeal does not stay the operation of the decision appealed against.
- (2) However, the court may stay the operation of the decision to secure the effectiveness of the appeal.
- (3) A stay-
  - (a) may be given on reasonable conditions as the court considers appropriate; and
  - (b) operates until the first of the following happens-
    - (i) the period fixed by the court ends;
    - (ii) the appeal is decided, withdrawn or dismissed; and
  - (c) may be revoked or amended by the court.

### 77 Who must prove case for appeal

- (1) In an appeal by the applicant for a regional interests decision, it is for the appellant to establish the appeal should be upheld.
- (2) In an appeal by either of the following, it is for the applicant for a regional interests decision to establish the appeal should be dismissed—
  - (a) if the applicant is not the owner of the land-the owner of the land;
  - (b) an affected land owner.

### Attachment A

Lot 1 on SP164068 Lot 4 on SP170740 Lot 2 on RP616045 Lot 4 on RP617701 Lot 1 on SP174071
# REGIONAL INTERESTS DEVELOPMENT APPROVAL (RIDA) 16 NOVEMBER 2017

### RPI17/008 U & D Mining Australia Pty Ltd – Meteor Downs South Coal Project.

(Given under the Regional Planning Interests Act 2014 section 53)

#### Description of the land

Real property description:	Mining Lease ML70452 on the following lot/plans:
	Lot 1 on SP164068
	Lot 4 on SP170740
	Lot 4 on RP617701
	Lot 2 on RP616045
	Lot 1 on SP174071
Local Government Area:	Central Highlands Regional Council

#### **Approved activities**

The approved activities are set out in Table 1 of Attachment 1.

Definitions of the resource activities are included in Table 2 of Attachment 1.

This development approval authorises impacts on the Strategic Cropping Area by the approved activities.

#### **General Advice**

It is the applicants' responsibility prior to works commencing on site to ensure all relevant approvals and licenses are obtained from the applicable Local, State, and/or Federal Authorities. This includes but not limited to approvals required under *Nature Conservation Act, 1992; Aboriginal Cultural Heritage Act, 2003 and Environmental Protection and Biodiversity Conservation Act, 1999.* 

#### **Regional interests conditions**

A person who is the holder of, or is acting under, this RIDA must not contravene a condition of this approval.

Condition number	Condition	Timing for condition
1.	<ul> <li>Carry out the approved activities and disturbance of land generally in accordance with:</li> <li>a) The activities identified in Table 1: Approved activities (refer Attachment 1)</li> <li>b) The activities defined in Table 2: Definitions of Activities (refer Attachment 1).</li> <li>c) The approved plans: <ul> <li>'Meteor Downs Strategic Cropping Land', prepared by Northern Resource Consultants, dated 15 November 2017 (refer Attachment 2);</li> <li>'Meteor Downs Strategic Cropping Land Affected by Infrastructure', prepared by Northern Resource Consultants, dated 15 November 2017 (refer Attachment 2);</li> <li>'Mine Infrastructure Area Layout Plan', prepared by Harradynamics, Drawing No. 1550-SK-LA-041, Rev A, dated 11 September 2017 (refer Attachment 2); and</li> <li>'Meteor Downs AB Triple Contractor Laydown Pad and MIA Pad', prepared by Northern Resource Consultants, dated 15 November 2017 (refer Attachment 2);</li> </ul> </li> </ul>	At all times.
2.	Maintain the approved activities generally in accordance with plan 'Meteor Downs Strategic Cropping Land Affected by Infrastructure', prepared by Northern Resource Consultants, dated 15 November 2017 ( <b>refer Attachment 2</b> ) and Table 1: Approved Activities ( <b>refer Attachment 1</b> ).	At all times.
3.	The maximum area of impact on SCL that may occur as a result of this development approval is to be no greater than 29.573 hectares.	At all times.
4.	Provide mitigation for the 29.573 permanently impacted strategic cropping land ('the mitigated SCL land') in accordance with the <i>Regional Planning Interests Act 2014</i> . The applicant is to pay to the strategic cropping land mitigation fund, the sum of money calculated as 30 hectares multiplied by the dollar amount prescribed by the Regional Planning Interests Regulation 2014 at the time of payment. <i>Note:</i> <i>The mitigation value is determined by multiplying each hectare of the mitigated SCL land by the prescribed mitigation value, where:</i> a) the number of hectares is rounded up to the nearest whole <i>hectare; and</i> b) the mitigation value for land in the Central Highlands Isaac subzone in the Western Cropping zone is prescribed in section 16 (1/a)) of the Region Plancing Plancing Interest Plancing 2014	Prior to commencing any approved activities upon the area of approved permanently Impacted strategic cropping land.

5.	A full copy of the regional interests development approval must be kept on-site and available to any person(s) contracted to undertake the approved activity, throughout the construction, operation and restoration period.	At all times.
6.	<ul> <li>a) All complaints received, and resulting actions taken, about the impact of the approved activities on the environmental attributes in the SCA must be recorded. The record must include: <ul> <li>i) name, address and contact number of the complainant</li> <li>ii) time and date of complaint</li> <li>iii) reasons for the complaint</li> <li>iv) investigations undertaken</li> <li>v) conclusions formed</li> <li>vi) actions taken to resolve the complaint</li> <li>vii) person responsible for resolving the complaint.</li> </ul> </li> <li>b) The records of any complaints received and recorded in accordance with this condition must be provided to the chief executive within three business days of receipt of the complaint to <u>RPIAct@dilgp.qld.gov.au</u></li> </ul>	At all times.

### Attachment 1

Constraint State	rices and a starting	(hectares)
Lot 1 on	Haul Road	14.132
SP164068	AB Triple Contractor Compound	2.046
	Groundwater monitoring bores	0.008
	Borefield Maintenance Track	0.127
	MIA Pad	3.450
Lot 2 on RP616045	Haul Road	9.809
Lot 4 on RP617701	Haul Road	0.001
	Lot 1 on SP164068 Lot 2 on RP616045 Lot 4 on RP617701	Lot 1 on SP164068Haul RoadAB Triple Contractor Compound Groundwater monitoring bores Borefield Maintenance Track MIA PadLot 2 on RP616045Lot 4 on RP617701

# Table 1: Approved activities within the Strategic Cropping Area

## Table 2: Definitions

Resource activity	Definition	
Haul Road	The haul road will be utilised to facilitate access to the Meteor Downs South project and allow the movement of coal product from the open cut pit to the Run of Mine prior to offsite transport.	
Borefield	Light vehicle track to provide access to facilitate maintenance of borefield	
Maintenance Track	throughout activities.	
Groundwater monitoring bores	Utilised to conduct environmental monitoring as required under the Meteor Downs South project Environmental Authority.	
AB Triple Contractor	The AB Triple Contractor Compound will house supporting infrastructure for	
Compound	mine site contractors including materials and storage areas.	
Mine Infrastructure Area (MIA) Pad	The MIA pad will house supporting infrastructure for coal product extraction including the workshop, administration, storage and vehicle facilities.	

Attachment 2 (approved plans)