Northern Resource
CONSULTANTS

Meteor Downs South

Strategic Cropping Land Restoration Plan

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prepared for

Endocoal Ltd

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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).

A RIDA is being sought by Endocoal Ltd to undertake resource activities (the Meteor Downs South project) that have potential to disturb SCL. This Restoration Plan is provided in support of a SCA RIDA to demonstrate how permanent impacts 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.

3.2 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).

Areas already approved under RPI14/002 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).

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 Limited 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 pre-activity 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 2. Mean maximum temperatures range from 22.9°C in July to 34.8°C in January as shown in Figure 3.

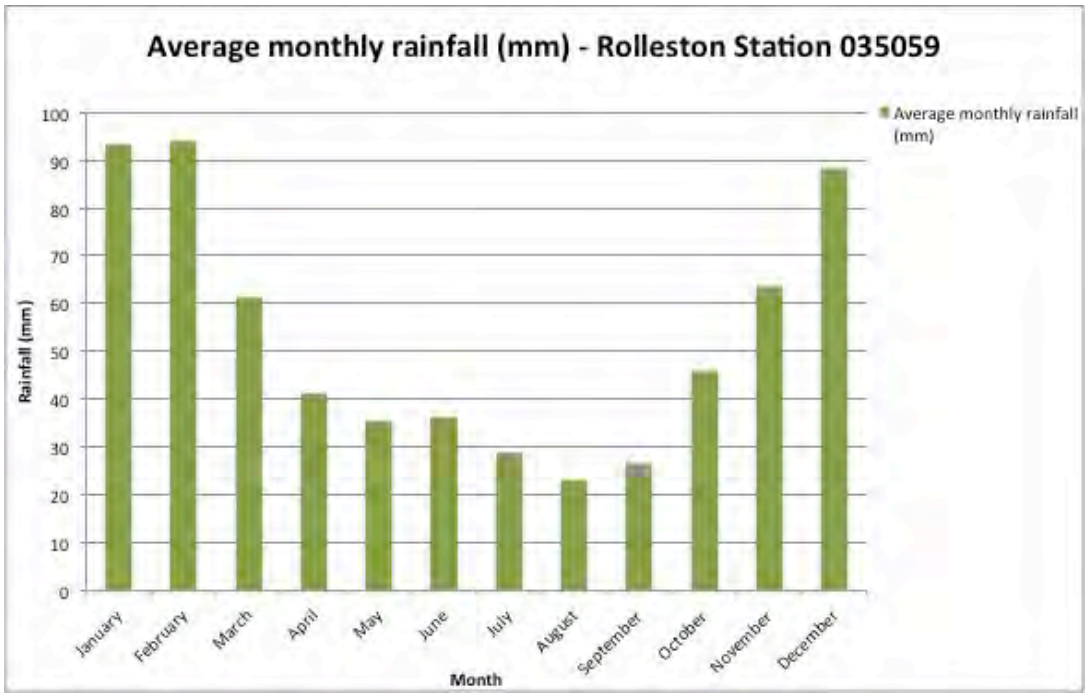


Figure 2: Average monthly rainfall at Rolleston (BOM station 035059).

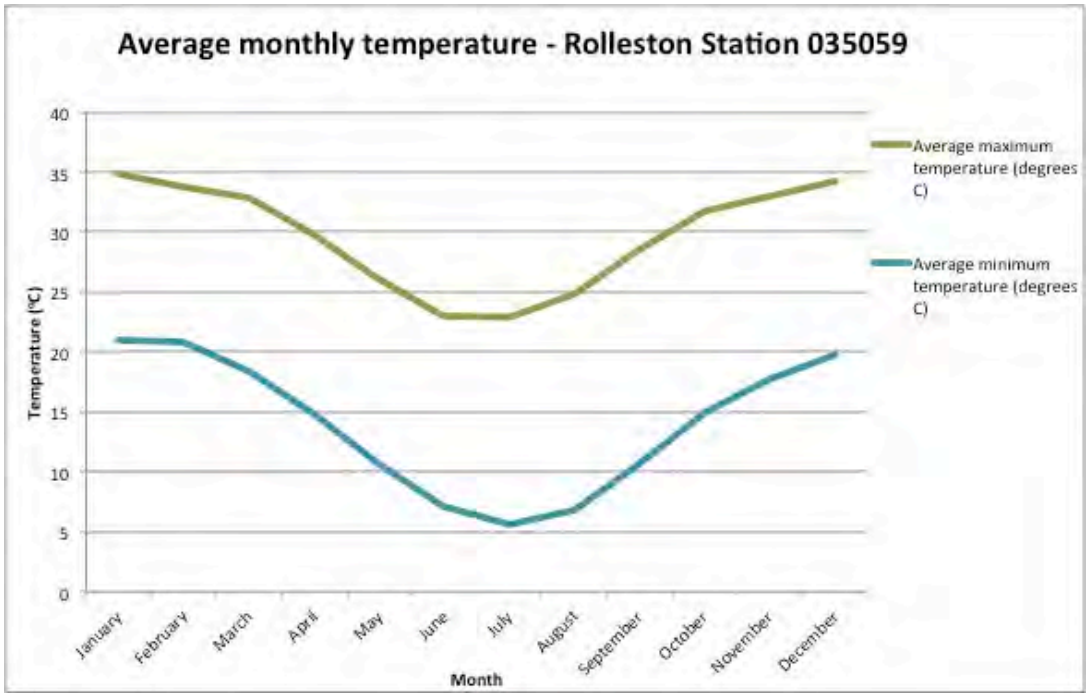


Figure 3: Average monthly temperature at Rolleston BOM station 035059.

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 south-easterly 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.

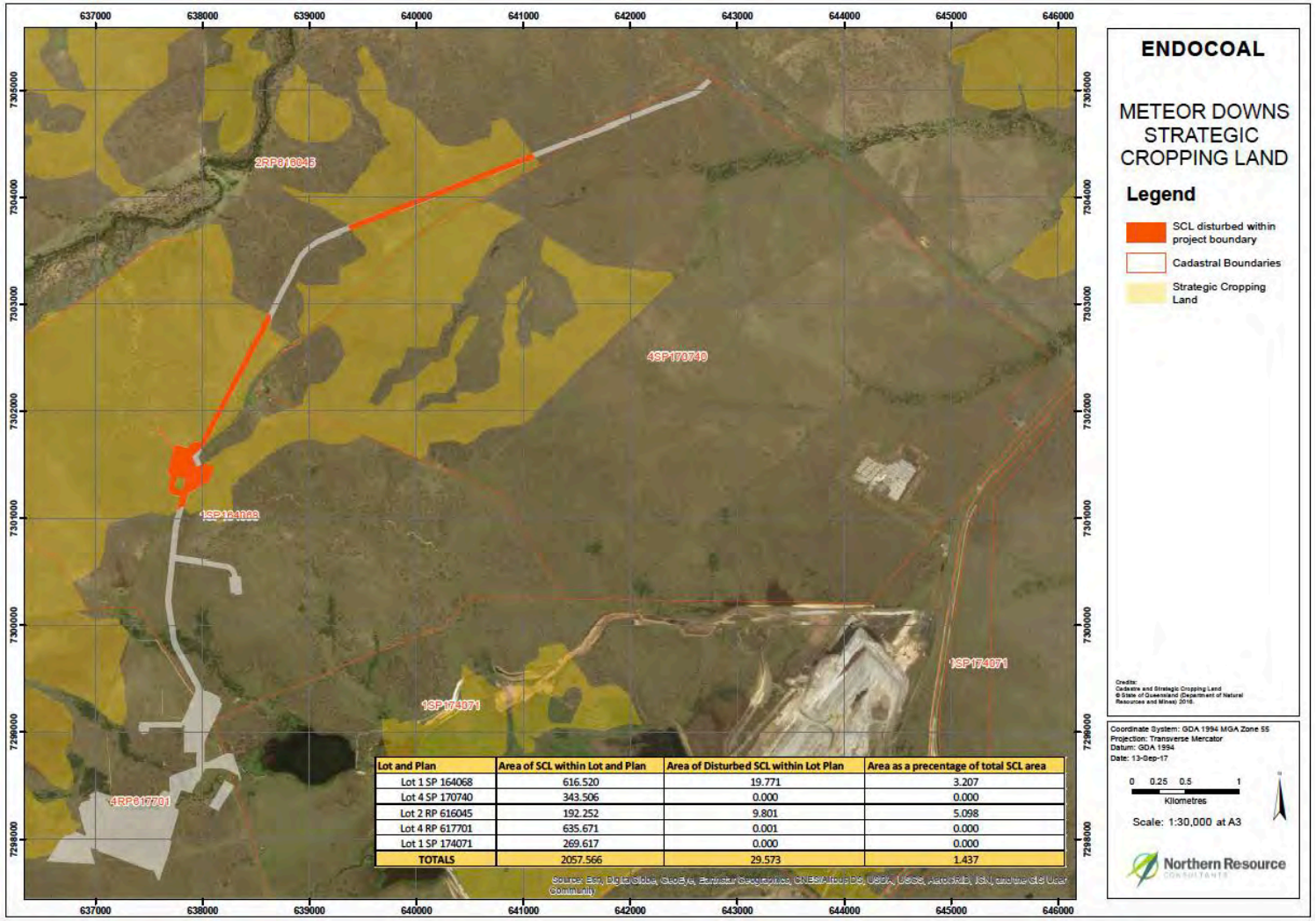
5. Strategic cropping land

5.1 Meteor Downs South trigger map

SCL is identified to occur within the MDS ML and immediate surrounds as detailed in Figure 4. Table 2 also details the extent of mapped SCL in relation to the MDS project (including immediate surrounds).

Table 2: Extent of mapped SCL in relation to the MDS project.

LOT AND PLAN	SCL MAPPED (ha)	OWNER
Lot 1 SP164068	616.52	Xstrata Coal Queensland Pty Ltd (as trustee)
Lot 4 SP170740	343.51	Xstrata Coal Queensland Pty Ltd (as trustee)
Lot 2 RP616045	192.25	Xstrata Coal Queensland Pty Ltd (as trustee)
Lot 4 RP617701	635.67	Xstrata Coal Queensland Pty Ltd (as trustee)
Lot 1 SP174071	269.62	CRA Rolleston Pty Ltd, Sumisho Coal Australia Pty Ltd and Limited and Xstrata Coal Queensland Pty Ltd
Total	**2057.57**	



Lot and Plan	Area of SCL within Lot and Plan	Area of Disturbed SCL within Lot Plan	Area as a precentage of total SCL area
Lot 1 SP 164068	616.520	19.771	3.207
Lot 4 SP 170740	343.506	0.000	0.000
Lot 2 RP 616045	192.252	9.801	5.098
Lot 4 RP 617701	635.671	0.001	0.000
Lot 1 SP 174071	269.617	0.000	0.000
TOTALS	2057.566	29.573	1.437

Figure 4: Strategic Cropping Land proposed to be disturbed by the MDS project.

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 4 and Appendix A. Table 3 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 is 29.57ha.

Table 3: Areas of impacted SCL in relation to the MDS project mine infrastructure.

LOT AND PLAN	IMPACTED SCL (ha)	IMPACTED SCL (%)	OWNER
Lot 1 SP 164068	19.77	3.34	Xstrata Coal Queensland Pty Ltd (as trustee)
Lot 4 SP170740	0.00	0.00	Xstrata Coal Queensland Pty Ltd (as trustee)
Lot 2 RP 616045	9.80	5.10	Xstrata Coal Queensland Pty Ltd (as trustee)
Lot 4 RP 617701	0.001	0.00	Xstrata Coal Queensland Pty Ltd (as trustee)

LOT AND PLAN	IMPACTED SCL (ha)	IMPACTED SCL (%)	OWNER
Lot 1 SP174071	0.00	0.00	CRA Rolleston Pty Ltd, Sumisho Coal Australia Pty Ltd and Limited and Xstrata Coal Queensland Pty Ltd
Total	**29.57**	**1.43**	

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 pre-disturbance 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 4 provides an overview of the land suitability classification scheme as reproduced from GSSE (2013).

Table 4: 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.

ORDERS	CLASS	CLASS DESCRIPTOR	DESCRIPTION
	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 5 provides an overview of land units, associated soil type and limitations to rainfed cropping for SCL trigger mapped areas within the MDS project.

Table 5: Land units and limitations of SCL trigger mapped areas within the MDS project.

LAND UNIT	SOIL TYPE	MAIN LIMITATIONS TO RAINFED CROPPING (DME, 1995)[1,2,3,4]	LAND SUITABILITY FOR RAINFED CROPPING
105	Haplic, self-mulching, Black Veritsol, non-gravelly, fine, fine, moderate	P_3 N_3 E_3	3
107	Haplic, self-mulching, Brown Vertisol, slightly gravelly, fine, fine, moderate	P_2 N_3 E_3	3

LAND UNIT	SOIL TYPE	MAIN LIMITATIONS TO RAINFED CROPPING (DME, 1995)[1,2,3,4]	LAND SUITABILITY FOR RAINFED CROPPING
108	Haplic, self-mulching, Brown Vertisol, non-gravelly, fine, fine, moderate	P_5 N_3 E_3	5
110	Haplic, self-mulching, Brown Vertisol, non-gravelly, fine, fine, deep	P_2 N_3 E_3	3

[1]Limitation class ranked from 1 (most suitable) to 5 (least suitable) in accordance with DME (1995) and Table 4.

[2]P – Plant available water capacity.

[3]N – Soil nutrient levels.

[4]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 6 provides restoration criteria for relevant land units and associated tenures.

Table 6: 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_3 N_3 E_3	Not SCL
107	Lot 1 SP164068 Lot 2 RP616045	3	P_2 N_3 E_3	SCL
108	Lot 1 SP164068 Lot 2 RP616045	5	P_5 N_3 E_3	Not SCL
110	Lot 1 SP164068	3	P_2 N_3 E_3	Not SCL

4. Restoration methods

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

- Lot 1 SP164068
- Lot 2 RP616045.

Associated land units for each tenure are detailed in Table 6 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.

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. Tracking over stripped areas and stockpiled soils following stripping should be avoided to minimise degradation of the soil resource.

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).

Stockpile 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 shall be developed and include details of 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 form 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 Soil replacement

Replacement of soil over stripped areas should 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 topsoil materials over the restoration area should result in an area “left rough” to promote infiltration of water and aeration. Consultation with the land holder should be undertaken to determine required activities to facilitate a return to agricultural activities (e.g. ploughing and target crop requirements).

4.5 Monitoring activities

Table 7 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.

Table 7: 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: - 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).	Annually

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

References

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Appendix summary

Appendix A	Maps
Appendix B	Meteor Downs South Soil, Land, Overburden and Process Waste Study
Appendix C	Approved Regional Interests Development Approval (RIDA)

Appendix A

Maps

SOLJITZ COAL

METEOR DOWNS SITE LOCATION

Legend

- Dual Carriageway
- Principal Road
- Secondary Road
- Railways
- Proposed project area

Coordinate System: GDA 1994 MGA Zone 55
Projection: Transverse Mercator
Datum: GDA 1994
Date: 01-Sep-17

0 5 10 20
Kilometres

N

Scale: 1:1,000,000 at A3

Northern Resource CONSULTANTS

ENDOCOAL

METEOR DOWNS STRATEGIC CROPPING LAND

Legend

- SCL disturbed within project boundary
- Cadastral Boundaries
- Strategic Cropping Land

2RP616045

4SP170740

1SP164068

1SP174071

1SP174071

4RP617701

Lot and Plan	Area of SCL within Lot and Plan	Area of Disturbed SCL within Lot Plan	Area as a precentage of total SCL area
Lot 1 SP 164068	616.520	19.771	3.207
Lot 4 SP 170740	343.506	0.000	0.000
Lot 2 RP 616045	192.252	9.801	5.098
Lot 4 RP 617701	635.671	0.001	0.000
Lot 1 SP 174071	269.617	0.000	0.000
TOTALS	2057.566	29.573	1.437

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

637000 638000 639000 640000 641000 642000 643000 644000 645000 646000

7305000 7304000 7303000 7302000 7301000 7300000 7299000 7298000

Coordinate System: GDA 1994 MGA Zone 55
Projection: Transverse Mercator
Datum: GDA 1994
Date: 13-Sep-17

0 0.25 0.5 1
Kilometres

N

Scale: 1:30,000 at A3

Northern Resource CONSULTANTS

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

GSS ENVIRONMENTAL
Environmental, Land and Project Management Consultants

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

GSS ENVIRONMENTAL
Environmental, Land and Project Management Consultants

GSS ENVIRONMENTAL
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Date of Issue: March 2013

GSSE 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 22nd and the 23rd 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 acid-forming 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^3), and 0.1 to 0.6 m for secondary media (2,469,000 m^3). 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_2SO_4/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).

LEGEND

Project Boundary

0 5 10 15km

Scale 1:300 000

FIGURE 1.1

Project Locality

Version	Date:	Author:	Checked:	Approved:
1	21/02/2013	BS	SHS	MB

GSS ENVIRONMENTAL
Environmental, Land and Project Management Consultants

Project: Meteor Downs South Soils, Land, Overburden and Process Waste Study

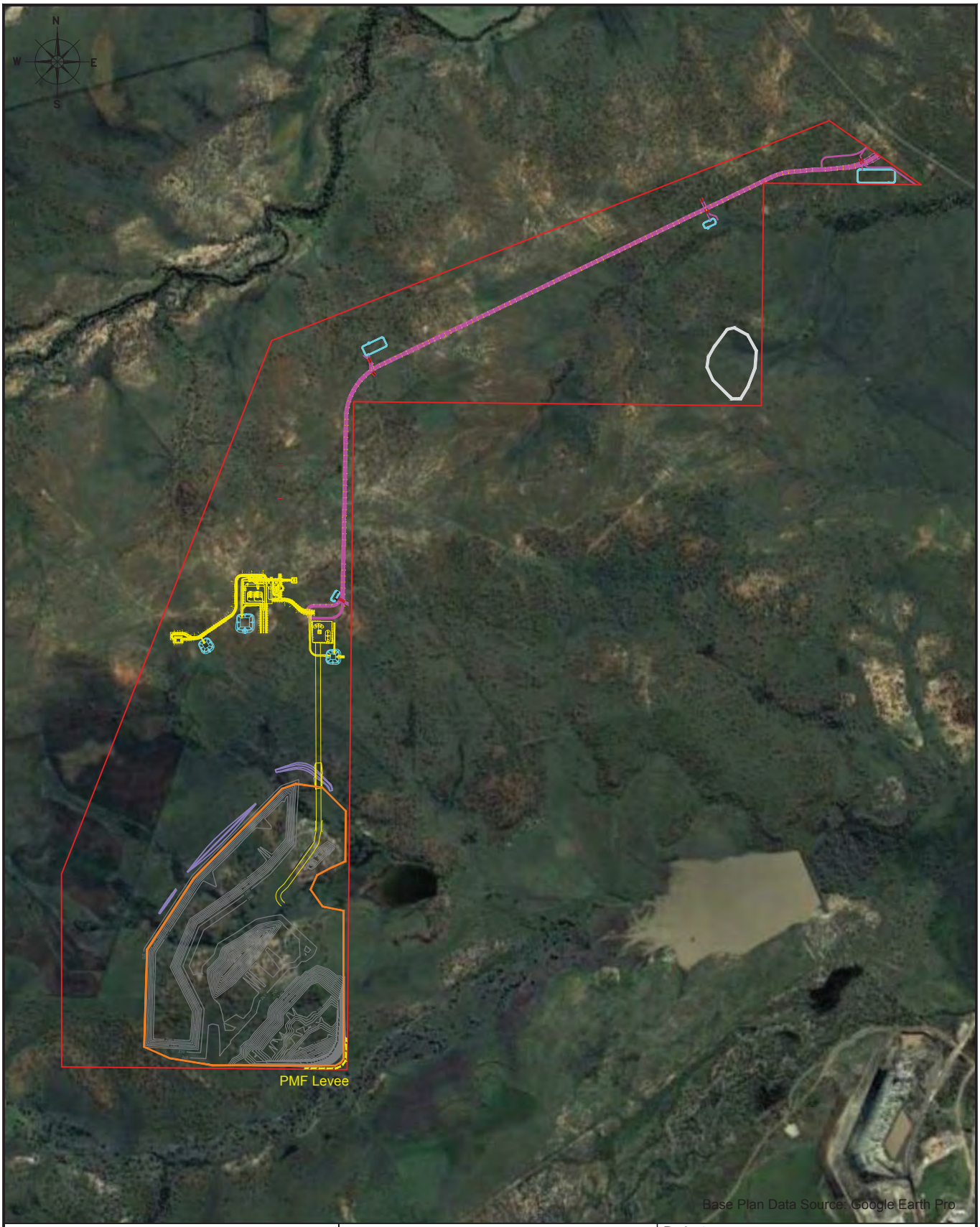
Client: Endocoal Limited

File: Fg1.1_MEM08-001_ProjectLocality_130221

Projection: MGA 94 Zone 55

To be printed A4

V:\MEM08-001\Figures\Final\CAD\Fg1.1_MEM08-001_ProjectLocality_130221.dwg



LEGEND

- Project Boundary Area
- Proposed Infrastructure
- Proposed Out of Pit Spoil Dump and Mining Area
- Proposed Quarry
- Proposed Product Haul Road
- Proposed Sediment Dams
- Contours
- Proposed Trimmed Dumps

0 1km 2km

Scale 1:45 000

Version	Date:	Author:	Checked:	Approved:
2	06/03/2013	BS	SHS	MB

FIGURE 1.2

Project Layout

GSS ENVIRONMENTAL
Environmental, Land and Project Management Consultants

Project: Meteor Downs South Soils, Land, Overburden and Process Waste Study

Client: Endocoal Limited

File: Fg1.2_MEM08-001_ProjectLayout_130306

Projection: MGA 94 Zone 55

V:\MEM08-001\Figures\Final\CAD\Fg1.2_MEM08-001_ProjectLayout_130306.dwg

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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LEGEND

Project Boundary

Geomorphic Domains

Waterford Lowhills Domain

Oxford Undulating Lowlands and Plains Domain

0 1km 2km

Scale 1:45 000

Version	Date:	Author:	Checked:	Approved:
1	21/02/2013	BS	SHS	MB

FIGURE 2.1

Geomorphic Domains

GSS ENVIRONMENTAL
Environmental, Land and Project Management Consultants

Project: Meteor Downs South Soils, Land, Overburden and Process Waste Study

Client: Endocoal Limited

File: Fg2.1_MEM08-001_GeomorphicDomains_130221

Projection: MGA 94 Zone 55

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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.

Table 3-1 Field Survey Observations

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[1]		10	3	5	12
III	Check sites	33	63	12	36	17
	Exclusion sites				10	

[1] 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).

Table 3-2 Laboratory Analysis Parameters

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

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**.

Table 3-3 Soil Map Legend

Map unit/soil family	Soil survey reference site #	Australian Soil Classification	MDS Project area	
			ha	%
Oxford undulating lowlands and 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 Hills				
105, Rugby	2, 7, 9	Haplic, Self-Mulching, Black Vertosol; Slightly-Gravelly, Fine, Fine, Shallow-Moderate, *Minor Haplic, Eutrophic Brown Dermosol; Slightly Gravelly, Fine, Fine, Shallow*	124	8
	Total		**1606**	**100**

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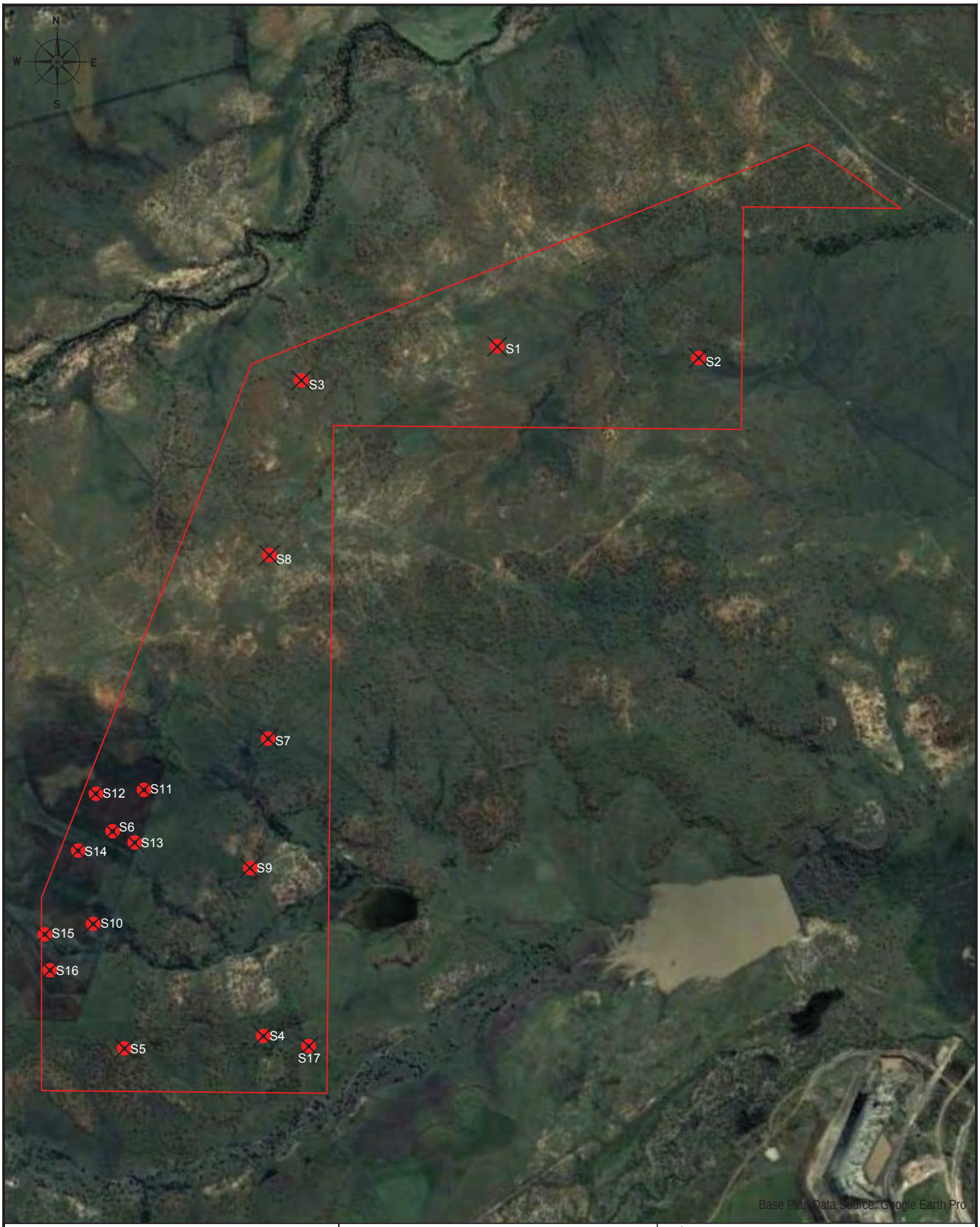

LEGEND

Project Boundary

Sampling Points

0 1km 2km

Scale 1:45 000

Version	Date:	Author:	Checked:	Approved:
1	21/02/2013	BS	SHS	MB

FIGURE 3.1

Sample Sites

GSS ENVIRONMENTAL
Environmental, Land and Project Management Consultants

Project: Meteor Downs South Soils, Land, Overburden and Process Waste Study

Client: Endocoal Limited

File: Fg3.1_MEM08-001_SampleSites_130221

Projection: MGA 94 Zone 55

To be printed A4

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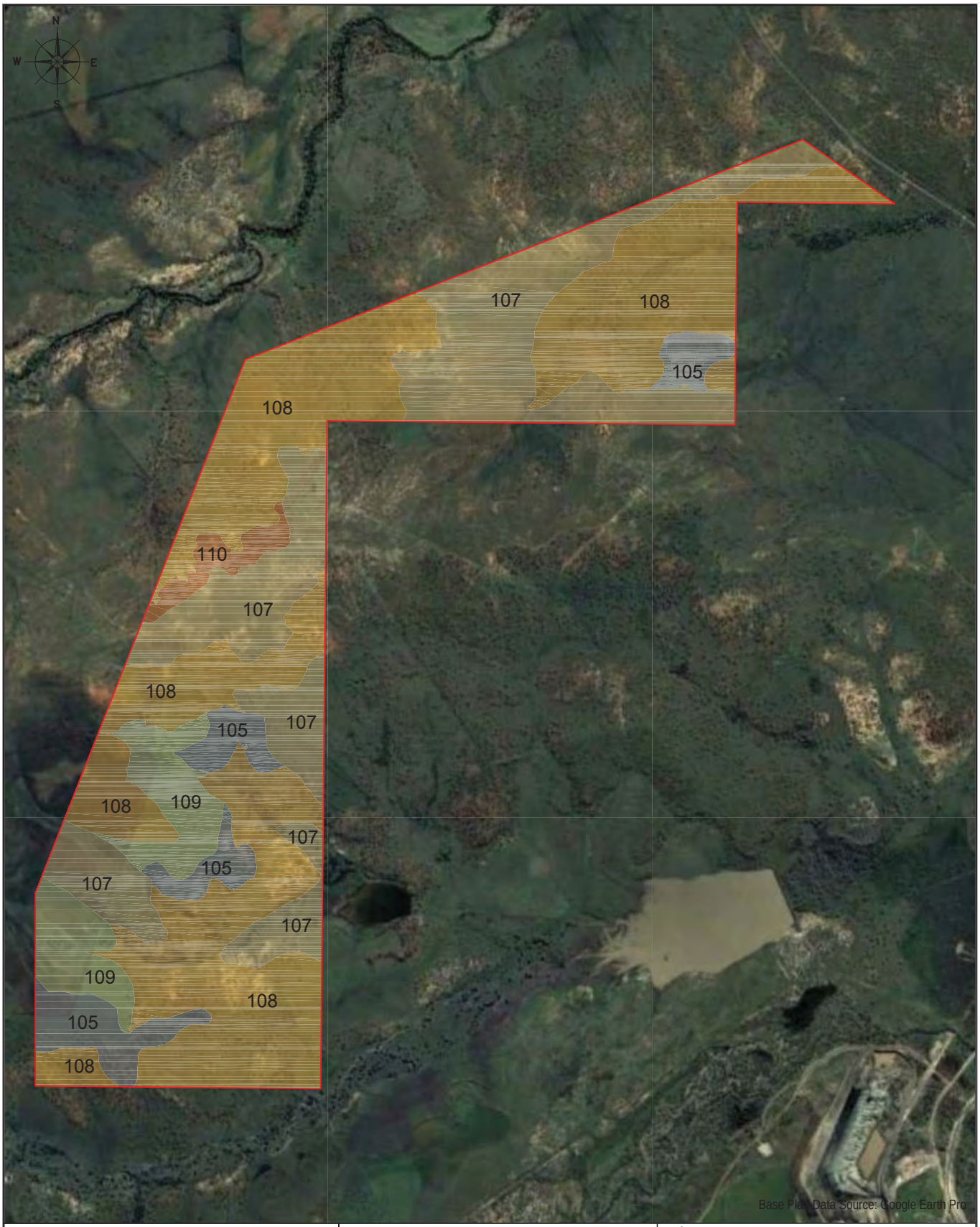

Base Plan Data Source: Google Earth Pro

LEGEND

Project Boundary

Soil Map Units

105 Rugby
107 Rugby
108 Bruce
109 Arcturus
110 May Downs

0 1km 2km

Scale 1:45 000

Version	Date:	Author:	Checked:	Approved:
1	21/02/2013	BS	SHS	MB

FIGURE 3.2

Soils Distribution Map

GSS ENVIRONMENTAL
Environmental, Land and Project Management Consultants

Project: Meteor Downs South Soils, Land, Overburden and Process Waste Study

Client: Endocoal Limited

File: Fg3.2_MEM08-001_SoilDistributionMap_130221

Projection: MGA 94 Zone 55

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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.

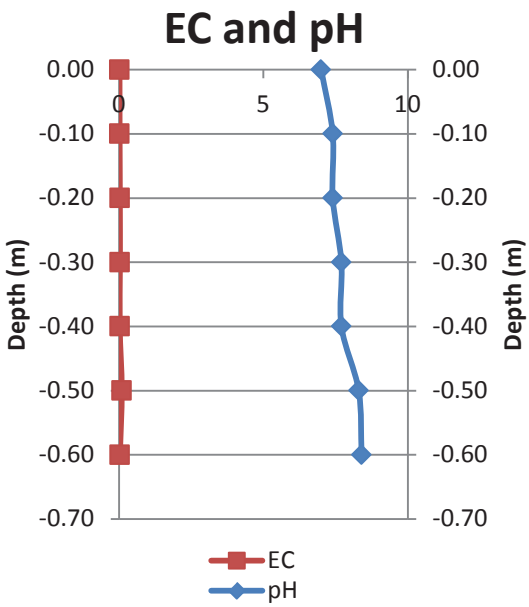
The Rugby 107 soils are recommended for use in rehabilitation and are suitable for stripping and stockpiling. This soil should be managed according to the *Meteor Downs South Topsoil Management Plan*.

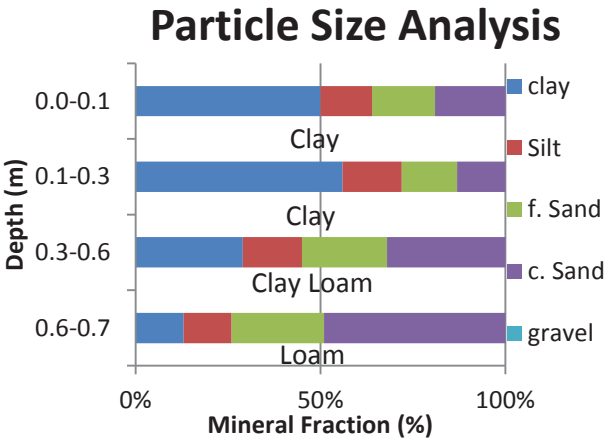
Site Description

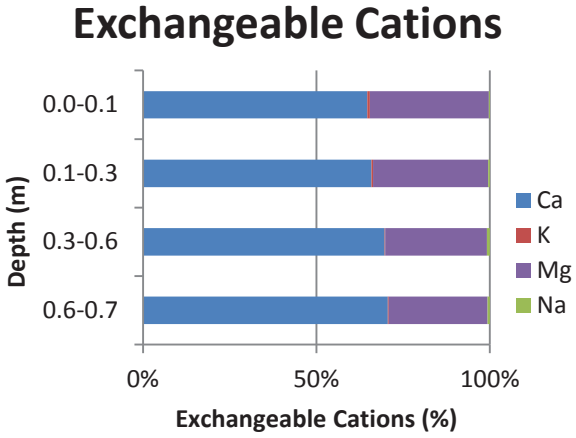
Landscape (Site 1)

ASC Soil Type	Haplic, Self-Mulching, Brown Vertosol; Slightly Gravelly, Fine, Fine, Shallow	
Representative Pit	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 Recommendation	**Primary Media Depth (m)**	**Secondary Media Depth (m)**
	0.0 m - 0.1 m – nil limitations	0.1 m – 0.35 m – nil limitations

Profile







Physical Characteristics		
Horizon	**Depth (m)**	**Description**
A1	0.00 - 0.10	Brown (10YR 3/2) heavy clay with moderate, sub-angular blocky structure of 10 – 20 mm. pH is neutral and salinity is rated very low. Drainage is considered poor with no mottling characteristics. Horizon contains 5% lithic stone materials and boundary distinctness is gradual to B2 horizon.
B2	0.10 – 0.35	Dark Brown (10YR 3/3) heavy clay with strong, sub-angular blocky structure of 10 – 20 mm. pH is mildly alkaline and salinity is rated very low. Drainage is considered poor with no mottling characteristics. Horizon contains 10% lithic stone materials and boundary distinctness is clear to C horizon.
C	0.35 – 0.55	Dark Yellowish Brown (10YR 3/4) clay loam with apedal structure. pH is moderately alkaline and salinity is rated very low. Drainage is considered poor with 20% dark brown mottles. 15% Manganese segregations are noted within horizon with 10% lithic materials and weathered Tertiary basalt.

Analytical Description[1]							
Analyte	**Units**	**A1**		**B2**		**C**	
Depth	m	0.00 – 0.10		0.10 – 0.35		0.35 – 0.55	
Colour[2]	-	Brown		Dark Brown		Dark Yellowish Brown	
pH	-	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 Kjeldahl Nitrogen	mg/kg	1100	Low	-		-	
	%	0.11		-		-	
Total Organic Carbon	%	1.7	Moderate	-		-	
Emerson Aggregate Test	-	5	Slight	5	Slight	5	Slight
Available Water Capacity	%	15.5	N/A	51.4	N/A	33.1	N/A
	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

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

2 Colour analysed on moist sample unless was a bleached layer

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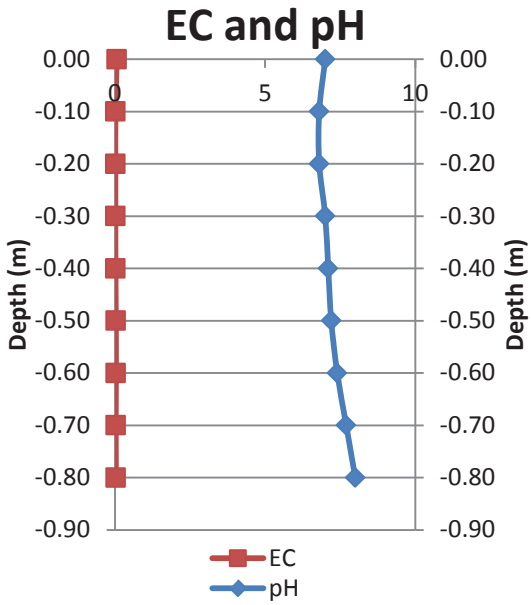
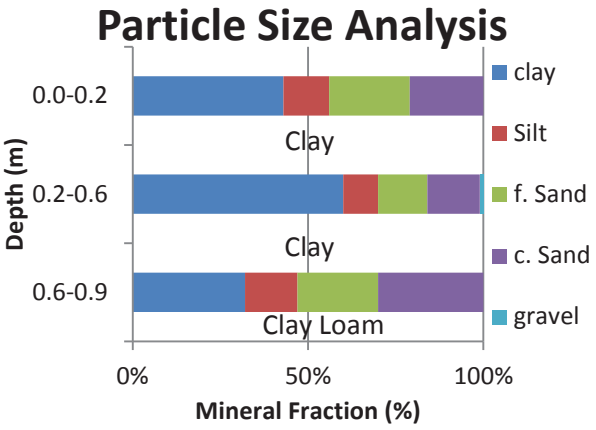
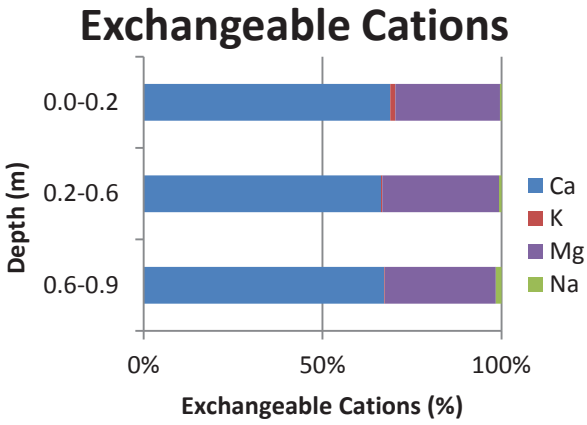
Site Description		
		
Landscape (Site 3)		
ASC Soil Type	Haplic, Self-mulching, Brown Vertosol; Slightly Gravelly, Fine, Fine, Moderate	
Representative Pit	Site 3	
Dominant Geology Association	Tertiary Basalt	
Dominant Slope Association	Gently undulating plains	
Land Use and Vegetation	Native pastures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

Profile







Physical Characteristics		
Horizon	**Depth (m)**	**Description**
A1	0.00 – 0.20	Very Dark Brown (7.5YR 2.5/2) medium clay with moderate, sub-angular blocky structure of 10 – 25 mm. pH is neutral and salinity is rated very low. Drainage is considered poor with no mottling characteristics. No stony materials were noted and boundary distinctness is diffuse to B2 horizon.
B2	0.20 – 0.60	Dark Reddish Brown (5YR 3/3) heavy clay with moderate, sub-angular blocky structure of 10 – 25 mm. pH is neutral and salinity is rated very low. Drainage is considered poor with no mottling characteristics. 10% Manganese segregations were noted within the horizon and boundary distinctness is clear to C horizon.
C	0.60 – 0.70	Brown (7.5YR 5/3) clay loam with weak, sub-angular blocky structure of 10 – 15 mm. pH is mildly alkaline and drainage is considered poor with 20% yellow mottling. Weathered Tertiary basalt was dominant throughout this horizon.
Analytical Description[1]		

Analyte	Units	A1		B2		C	
Depth	m	0.0 - 0.20		0.20 - 0.60		0.60 – 0.70	
Colour[2]	-	Very Dark Brown		Dark Reddish Brown		Brown	
pH	-	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 Kjeldahl Nitrogen	mg/kg	1810	Low	-		-	
	%	0.18		-		-	
Total Organic Carbon	%	1.85	High	-		-	
Emerson Aggregate Test	-	3(1)	Slight	5	Slight	5	Slight
Available Water Capacity	%	33	N/A	47.6	N/A	19.4	N/A
	mm/cm	2.56	N/A	0.92	N/A	1.5	N/A
	mm/layer	25.6	N/A	36.9	N/A	15	N/A

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

2 Colour analysed on moist sample unless was a bleached layer

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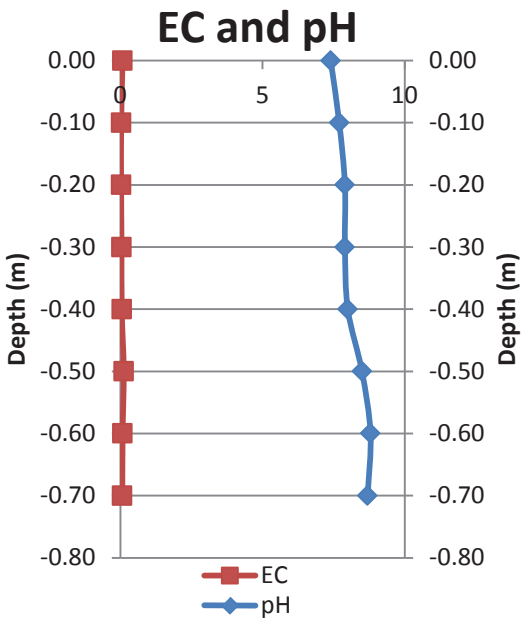
3.2.3.2 Oxford – Bruce Land Unit 108 (Bruce 108) – Haplic, Self-Mulching, Brown Vertosols; Non-Gravelly, Fine, Fine, Moderate

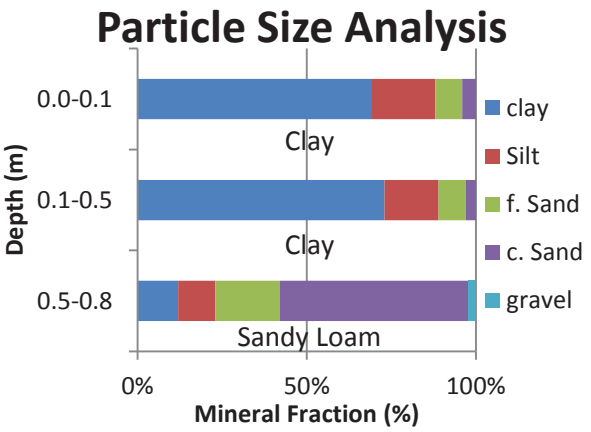
Bruce 108 soils are very dark brown heavy clay topsoil and dark greyish brown subsoil. Profiles are mildly alkaline becoming strongly alkaline with depth, have very low to low salinity and are non sodic throughout. Very high cation exchange capacity is present throughout the profile and comprise primarily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

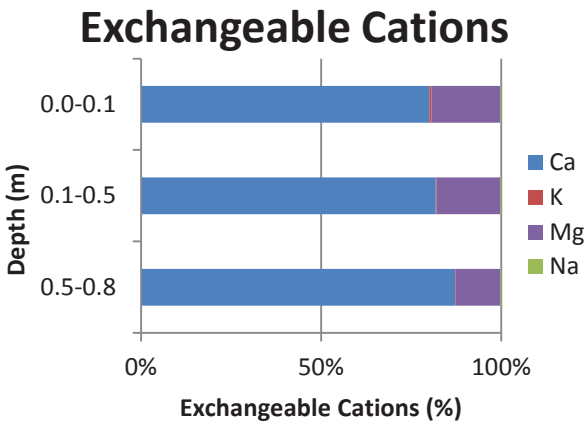
The Bruce 108 soils are recommended for use in rehabilitation and are suitable for stripping and stockpiling. This soil should be managed according to the *Meteor Downs South Topsoil Management Plan*.

<table>
<tr><th colspan="3">Site Description</th></tr>
<tr><td colspan="3"> 
Landscape (Site 12)</td></tr>
<tr><td>ASC Soil Type</td><td colspan="2">Haplic, Self-Mulching, Brown Vertosol; Non-Gravelly, Fine, Fine, Moderate</td></tr>
<tr><td>Representative Pit</td><td colspan="2">Site 12</td></tr>
<tr><td>Dominant Geology Association</td><td colspan="2">Tertiary Basalt</td></tr>
<tr><td>Dominant Slope Association</td><td colspan="2">Gently undulating plains</td></tr>
<tr><td>Land Use and Vegetation</td><td colspan="2">Native pastures and grazing</td></tr>
<tr><td>Land Suitability Class</td><td colspan="2">Beef Cattle Grazing Class 2</td></tr>
<tr><td>Erosion Risk Class</td><td colspan="2">Moderate</td></tr>
<tr><td rowspan="2">Soil Stripping Recommendation</td><td>Primary Media Depth (m)</td><td>Secondary Media Depth (m)</td></tr>
<tr><td>0.0 m – 0.1 m – nil limitations</td><td>0.2 m – 0.6 m – nil limitations</td></tr>
</table>

Profile







Physical Characteristics		
Horizon	**Depth (m)**	**Description**
A1	0.00 – 0.10	Very Dark Grey (10YR 3/1) heavy clay with moderate, sub-angular blocky structure of 10 – 15 mm. pH is mildly alkaline and salinity is rated very low. Drainage is considered poor with no mottling characteristics. No stony materials were noted and boundary distinctness is diffuse to B2 horizon.
B2	0.10 – 0.50	Very Dark Brown (10YR 2/2) heavy clay with moderate, sub-angular blocky structure of <10 mm. pH is moderately alkaline and salinity is rated very low. Drainage is considered poor with no mottling characteristics. No segregations or stony materials were noted within the horizon and boundary distinctness is clear to B3 horizon.
B3	0.50 – 0.60	Dark Brown (10YR 3/3) sandy loam with weak, angular blocky structure of 10 - 20 mm. pH is strongly alkaline and salinity is rated low. Drainage is considered poor with 30% brown and 10% yellow mottling characteristics. 15% feldspar and 30% weathered Tertiary basalt material was noted within the horizon.
Analytical Description[1]		

Analyte	Units	A1		B2		B3	
Depth	m	0.00 - 0.10		0.10 - 0.50		0.50 – 0.60	
Colour[2]	-	Very Dark Grey		Very Dark Brown		Dark Brown	
pH	-	7.4	Mildly Alkaline	7.9	Moderately Alkaline	8.5	Moderately 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 Kjeldahl Nitrogen	mg/kg	910	Low	-		-	
	%	0.09		-		-	
Total Organic Carbon	%	1.21	Moderate	-		-	
Emerson Aggregate Test	-	5	Slight	5	Slight	4	Neg.[3]
Available Water Capacity	%	16.4	N/A	57.2	N/A	26.4	N/A
	mm/cm	1.94	N/A	1.68	N/A	3.12	N/A
	mm/layer	19.4	N/A	67.5	N/A	31.2	N/A

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

2 Colour analysed on moist sample unless was a bleached layer

3 Negligible

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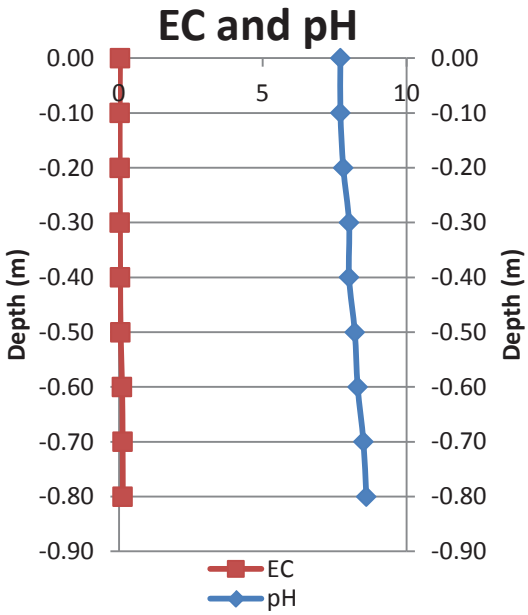
3.2.3.3 Oxford – Arcturus Land Unit 109 (Arcturus 109) – Haplic, Self-Mulching, Grey Vertosols; Non-Gravelly, Fine, Fine, Moderate

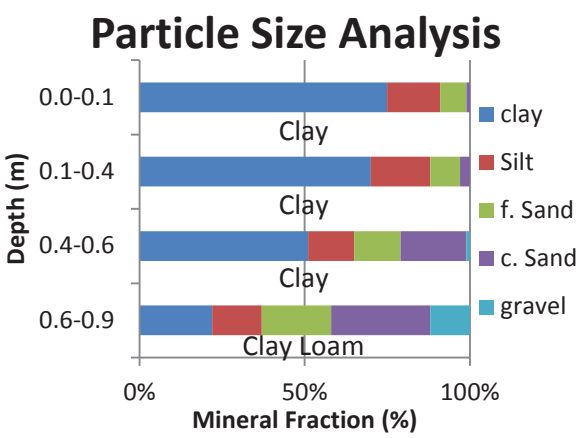
Arcturus 109 soils are very dark grey uniform heavy clays. Profiles are mildly alkaline becoming moderately alkaline with depth, have very low to low salinity and are non sodic throughout. Very high cation exchange capacity is present throughout and comprise primarily of exchangeable calcium and magnesium.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

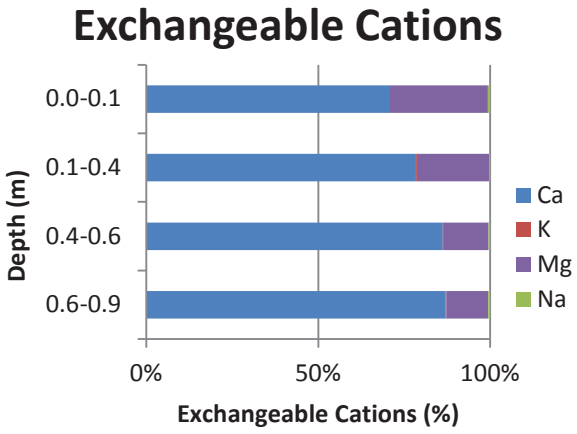
The Arcturus 109 soils are recommended for use in rehabilitation and are suitable for stripping and stockpiling. This soil should be managed according to the *Meteor Downs South Topsoil Management Plan*.

Site Description		
 **Landscape (Site 10)**		
ASC Soil Type	Self-Mulching, Grey Vertosol; Non-Gravelly, Fine, Fine, Moderate	
Representative Pit	Site 10	
Dominant Geology Association	Tertiary Basalt	
Dominant Slope Association	Gently undulating plains	
Land Use and Vegetation	Cropping	
Land Suitability Class	Rainfed Broadacre Cropping Class 2	
Erosion Risk Class	Moderate	
Soil Stripping Recommendation	**Primary Media Depth (m)**	**Secondary Media Depth (m)**
	0.0 m – 0.1 m – nil limitations	0.1 m – 0.6 m – nil limitations

Profile







Physical Characteristics		
Horizon	**Depth (m)**	**Description**
A1	0.00 – 0.10	Very Dark Grey (10YR 3/1) heavy clay with moderate, sub-angular blocky structure of 10 – 15 mm. pH is mildly alkaline and salinity is rated very low. Drainage is considered poor with no mottling characteristics. No stony materials were noted and boundary distinctness is gradual to B2 horizon.
B2	0.10 – 0.50	Very Dark Grey (10YR 3/1) heavy clay with moderate, sub-angular blocky structure of 15 - 20 mm. pH is mildly alkaline and salinity is rated very low. Drainage is considered poor with no mottling characteristics. No segregations or stony materials were noted within the horizon and boundary distinctness is gradual to B3 horizon.
B3	0.50 – 0.60	Brown (10YR 3/2) heavy clay with moderate, angular blocky structure of 15 - 20 mm. pH is moderately alkaline and salinity is rated very low. Drainage is considered poor with 5% yellow brown mottling characteristics. 5% weathered Tertiary basalt material was noted within the horizon.
Analytical Description[1]		

Analyte	Units	A1		B2		B3	
Depth	m	0.00 - 0.10		0.10 - 0.50		0.50 – 0.60	
Colour[2]	-	Very Dark Grey		Very Dark Grey		Brown	
pH	-	7.7	Mildly Alkaline	7.8	Mildly Alkaline	8.2	Moderately 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 Kjeldahl Nitrogen	mg/kg	1220	Low	-		-	
	%	0.12		-		-	
Total Organic Carbon	%	1.72	Moderate	-		-	
Emerson Aggregate Test	-	5	Slight	5	Slight	4	Neg.[3]
Available Water Capacity	%	18.3	N/A	49.3	N/A	32.4	N/A
	mm/cm	2.36	N/A	2.12	N/A	2.09	N/A
	mm/layer	23.6	N/A	63.6	N/A	41.8	N/A

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

2 Colour analysed on moist sample unless was a bleached layer

3 Negligible

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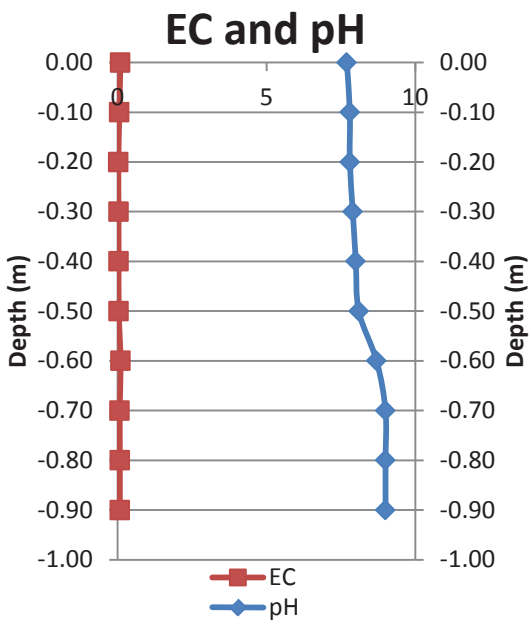
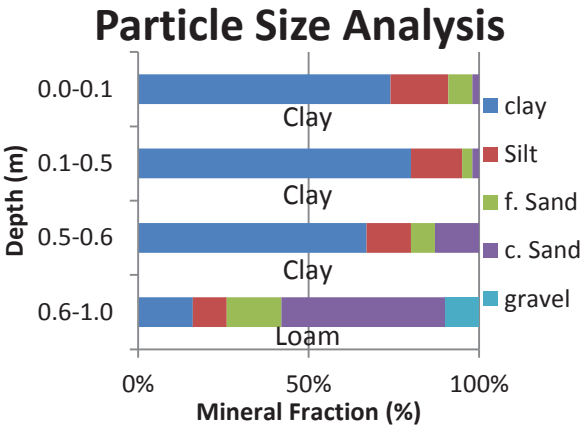
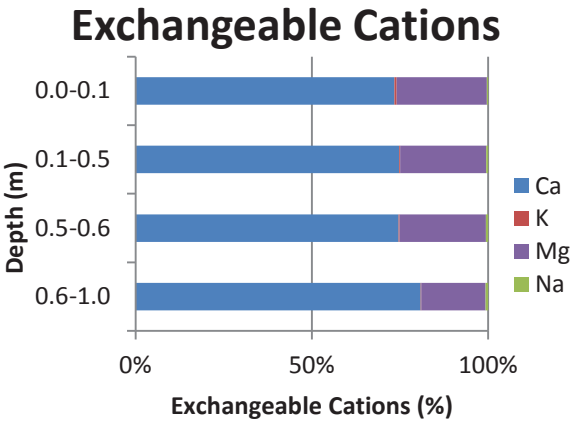
Site Description		
		
Landscape (Site 11)		
ASC Soil Type	Self-Mulching, Grey Vertosol; Non-Gravelly, Fine, Fine, Moderate	
Representative Pit	Site 11	
Dominant Geology Association	Tertiary Basalt	
Dominant Slope Association	Gently undulating plains	
Land Use and Vegetation	Native pastures and grazing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

Profile







Physical Characteristics		
Horizon	**Depth (m)**	**Description**
A1	0.00 – 0.10	Very Dark Grey (10YR 3/1) heavy clay with moderate, angular blocky structure of 10 – 20 mm. pH is mildly alkaline and salinity is rated very low. Drainage is considered poor with no mottling characteristics. No stony materials were noted and boundary distinctness is diffuse to B2 horizon.
B2	0.10 – 0.50	Very Dark Grey (10YR 3/1) heavy clay with moderate, angular blocky structure of 10 – 20 mm. pH is mildly to moderately alkaline and salinity is rated very low. Drainage is considered poor with no mottling characteristics. No segregations or stony materials were noted within the horizon and boundary distinctness is diffuse to B3 horizon.
B3	0.50 – 0.60	Black (10YR 2/1) heavy clay with moderate, angular blocky structure of 10 - 20 mm. pH is moderately alkaline and salinity is rated very low. Drainage is considered poor with no mottling characteristics. 5% manganiferous segregations were noted within the horizon.
Analytical Description[1]		

Analyte	Units	A1		B2		B3	
Depth	m	0.00 - 0.10		0.10 - 0.50		0.50 – 0.60	
Colour[2]	-	Very Dark Grey		Very Dark Grey		Very Dark Grey	
pH	-	7.7	Mildly Alkaline	7.9	Moderately Alkaline	8.1	Moderately 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	-
Total Kjeldahl Nitrogen	mg/kg	820	Low	-		-	
	%	0.08		-		-	
Total Organic Carbon	%	1.20	Moderate	-		-	
Emerson Aggregate Test	-	5	Slight	5	Slight	4	Neg.[3]
Available Water Capacity	%	23	N/A	60	N/A	17	N/A
	mm/cm	2.64	N/A	1.73	N/A	1.95	N/A
	mm/layer	26.4	N/A	69	N/A	19.5	N/A

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

2 Colour analysed on moist sample unless was a bleached layer

3 Negligible

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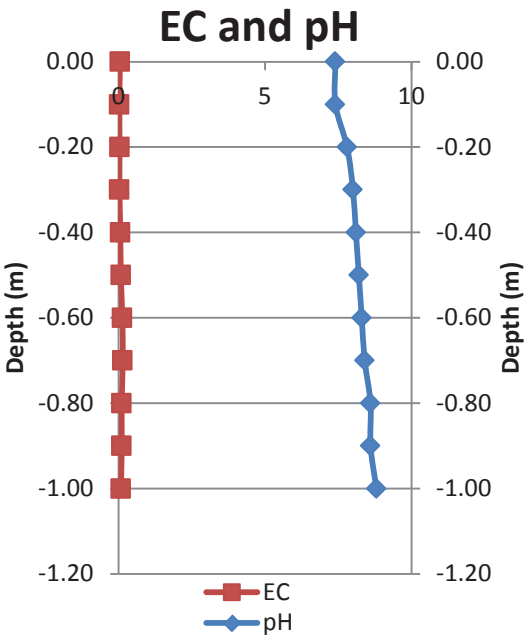
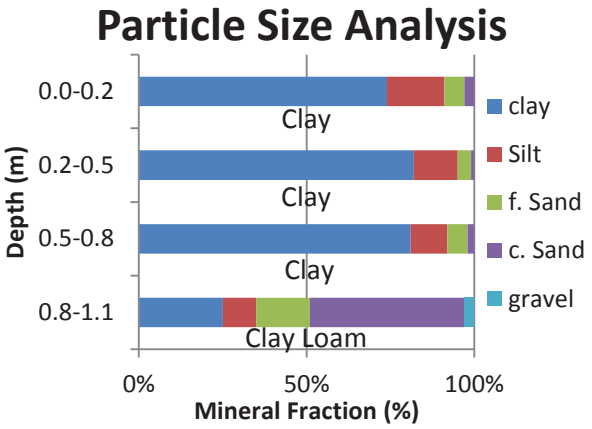
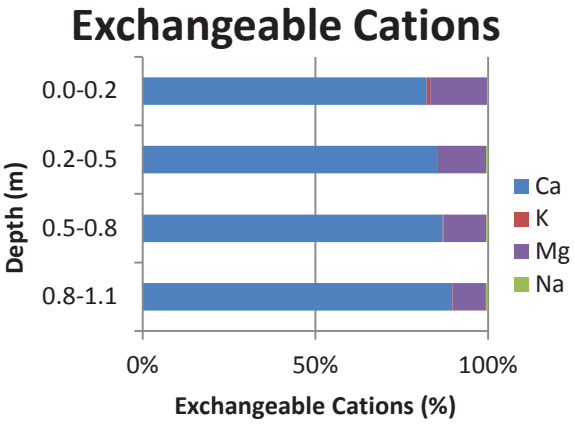
Site Description		
 **Landscape (Site 14)**		
ASC Soil Type	Haplic, Self-Mulching, Grey Vertosol; Non-Gravelly, Fine, Fine, Moderate	
Representative Pit	Site 14	
Dominant Geology Association	Tertiary Basalt	
Dominant Slope Association	Gently undulating plains	
Land Use and Vegetation	Native pastures 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

Profile







Physical Characteristics		
Horizon	**Depth (m)**	**Description**
A1	0.00 – 0.15	Very Dark Grey (10YR 3/1) heavy clay with moderate, angular blocky structure of 10 – 15 mm. pH is mildly alkaline and salinity is rated very low. Drainage is considered poor with no mottling characteristics. No stony materials were noted and boundary distinctness is gradual to B2 horizon.
B2	0.15 – 0.80	Very Dark Grey (10YR 3/1) heavy clay with moderate, angular blocky structure of 15 – 20 mm. pH is moderately alkaline and salinity is rated very low. Drainage is considered poor with no mottling characteristics. No segregations or stony materials were noted within the horizon and boundary distinctness is gradual to B3 horizon.
B3	0.80 – 0.90	Very Dark Grey (10YR 3/1) heavy clay with moderate, angular blocky structure of 20 mm. pH is moderately alkaline and salinity is rated low. Drainage is considered poor with 35% brown and 5% yellow mottling characteristics. 5% calcareous segregations and weathered Tertiary basalt were noted within the horizon.

Analytical Description[1]							
Analyte	**Units**	**A1**		**B2**		**B3**	
Depth	m	0.00 - 0.15		0.15 - 0.80		0.80 – 0.90	
Colour[2]	-	Very Dark Grey		Very Dark Grey		Very Dark Grey	
pH	-	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	-
Total Kjeldahl Nitrogen	mg/kg	1420	Low	-		-	
	%	0.14		-		-	
Total Organic Carbon	%	2.02	High	-		-	
Emerson Aggregate Test	-	5	Slight	5	Slight	5	Slight
Available Water Capacity	%	18.2	N/A	42.8	N/A	39	N/A
	mm/cm	1.75	N/A	0.95	N/A	5.64	N/A
	mm/layer	26.25	N/A	61.8	N/A	56.4	N/A

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

2 Colour analysed on moist sample unless was a bleached layer

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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.

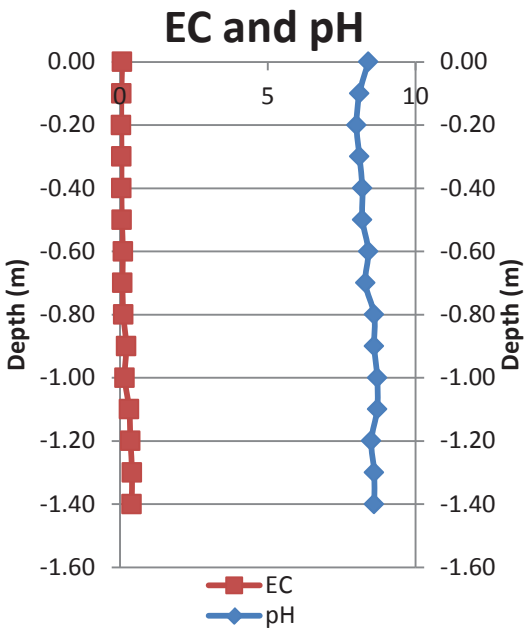
The May Downs 110 soils are recommended for use in rehabilitation and suitable for stripping and stockpiling. This soil should be managed according to the *Meteor Downs South Topsoil Management Plan*.

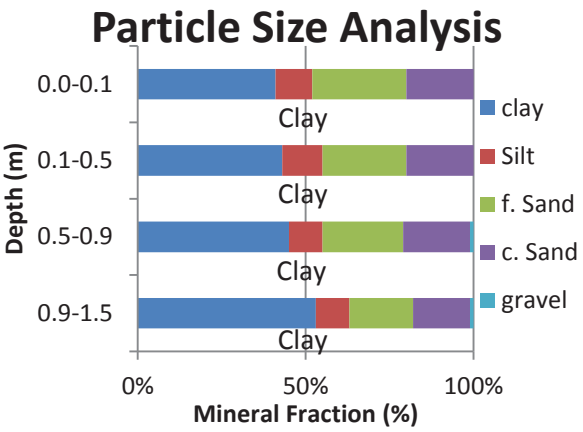
Site Description

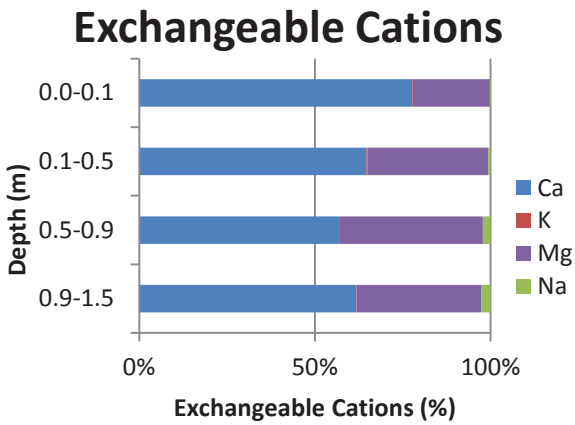
Landscape (Site 8)

ASC Soil Type	Haplic, Self-mulching, Brown Vertosol; Non-Gravelly, Fine, Fine, Deep	
Representative Pit	Site 8	
Dominant Geology Association	Tertiary Basalt	
Dominant Slope Association	Gently undulating plains	
Land Use and Vegetation	Native pastures and grazing	
Land Suitability Class	Rainfed Broadacre Cropping Class 3	
Erosion Risk Class	Moderate	
Soil Stripping Recommendation	**Primary Media Depth (m)**	**Secondary Media Depth (m)**
	0.0 m – 0.1 m – nil limitations	0.1 – 0.6 m – nil limitations

Profile







Physical Characteristics		
Horizon	**Depth (m)**	**Description**
A1	0.00 – 0.10	Brown (10YR 3/2) light - medium clay with moderate, sub-angular blocky structure of 10 – 15 mm. pH is moderately alkaline and salinity is rated very low. Drainage is considered poor with no mottling characteristics. 3% quartz materials were noted and boundary distinctness is diffuse to B21 horizon.
B21	0.10 – 0.50	Dark Brown (10YR 3/3) light - medium clay with moderate, sub-angular blocky structure of 15 – 20 mm. pH is moderately alkaline and salinity is rated very low. Drainage is considered poor with no mottling characteristics. 3% quartz materials were noted and boundary distinctness is diffuse to B22 horizon.
B22	0.50 – 0.90	Dark Brown (10YR 3/3) medium clay with moderate, sub-angular blocky structure of 20 mm. pH is moderately alkaline and salinity is rated very low. Drainage is considered poor with no mottling characteristics. 3% quartz materials were noted and boundary distinctness is clear to B3 horizon.
B3	0.90 –	Brown (10YR 3/2) heavy clay with moderate, sub-angular blocky structure of 20 mm. pH is

	1.40	strongly alkaline and salinity is rated low to medium. Drainage is considered poor with 10% Dark Brown mottling characteristics. 10% calcareous concretions were noted and underlying geology is Tertiary basalt.

Analytical Description[1]

Analyte	Units	A1		B21		B22		B3	
Depth	m	0.0 - 0.10		0.10 - 0.50		0.50 – 0.90		0.90 – 1.40	
Colour[2]	-	Brown		Dark Brown		Dark Brown		Brown	
pH	-	8.4	Moderately Alkaline	8.0	Moderately Alkaline	8.4	Moderately Alkaline	8.7	Strongly Alkaline
Electrical Conductivity	dS/cm	0.075	Very Low	0.045	Very Low	0.062	Very Low	0.211	Low
Cation Exchange Capacity	meq/100g	42.5	Very High	32.8	High	35.9	High	77.6	Very High
Exchangeable Sodium Percent	%	0.24	Non Sodic	0.61	Non Sodic	2.22	Non Sodic	2.57	Non Sodic
Total Phosphorus	mg/kg	291	-	207	-	160	-	265	-
Total Kjeldahl Nitrogen	mg/kg	920	Low	-		-			
	%	0.09		-		-			
Total Organic Carbon	%	1.37	Moderate	-		-			
Emerson Aggregate Test	-	5	Slight	5	Slight	5	Slight	4	Neg.[3]
Available Water Capacity	%	8.1	N/A	24.5	N/A	30.7	N/A	36.7	N/A
	mm/cm	1.14	N/A	0.86	N/A	1.08	N/A	1.03	N/A
	mm/layer	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

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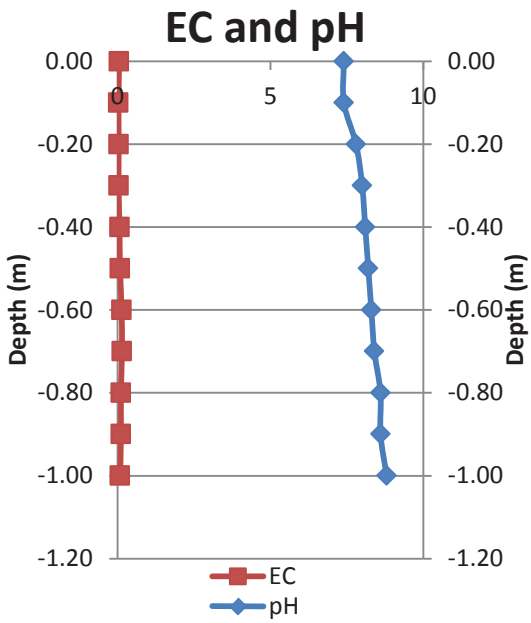
3.2.3.5 Waterford – Rugby Land Unit 105 (Rugby 105) – Haplic, Self-Mulching, Black Vertosol; Slightly-Gravelly, Fine, Fine, Moderate

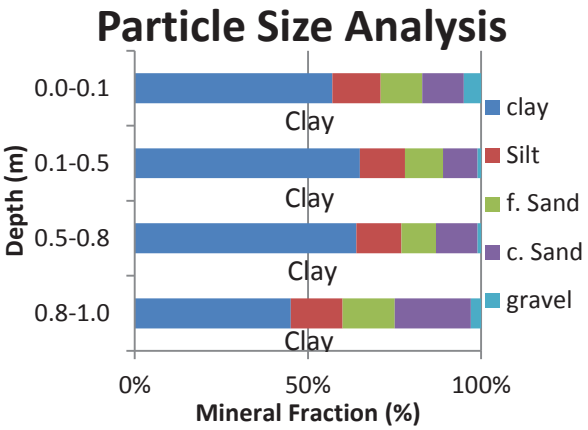
Rugby 105 soils are very dark brown topsoils and black heavy clay subsoils. The soil is neutral becoming strongly alkaline with depth, has very low salinity and is non sodic throughout. Very high cation exchange capacity is present throughout the profile and comprise primarily of exchangeable calcium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

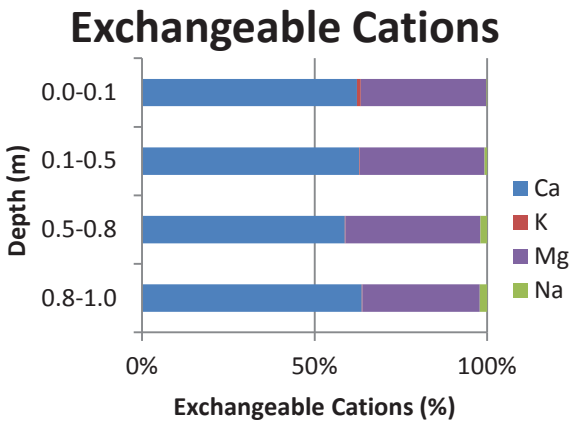
The Rugby 105 soils are recommended for use in rehabilitation and suitable for stripping and stockpiling. This soil should be managed according to the *Meteor Downs South Topsoil Management Plan*.

Site Description		
 **Landscape (Site 2)**		
ASC Soil Type	Haplic, Self-Mulching, Black Vertosol; Non-Gravelly, Fine, Fine, Moderate	
Representative Pit	Site 2	
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 3	
Erosion Risk Class	Low	
Soil Stripping Recommendation	**Primary Media Depth (m)**	**Secondary Media Depth (m)**
	0.0 m – 0.1 m – nil limitations	0.1 m – 0.6 m – nil limitations

Profile







Physical Characteristics		
Horizon	**Depth (m)**	**Description**
A1	0.00 – 0.10	Very Dark Brown (10YR 3/2) heavy clay with moderate, sub-angular blocky structure of 20 mm. pH is neutral and salinity is rated very low. Drainage is considered poor with no mottling characteristics. 10 % stony materials <10 mm were noted and boundary distinctness is clear to B21 horizon.
B21	0.10 – 0.50	Black (10YR 2/1) heavy clay with moderate, sub-angular blocky structure of 20 mm. pH is mildly to moderately alkaline and salinity is rated very low. Drainage is considered poor with no mottling characteristics. No stony material was noted and boundary distinctness is clear to B22 horizon.
B22	0.50 – 0.90	Black (10YR 2/1) heavy clay with moderate, sub-angular blocky structure of 20 mm. pH is moderately alkaline to strongly alkaline and salinity is rated very low. Drainage is considered poor with no mottling characteristics. 5% manganiferous concretions and 5% stony material <20 mm were noted within the horizon.

Analytical Description[1]							
Analyte	**Units**	**A1**		**B21**		**B22**	
Depth	m	0.00 - 0.10		0.10 - 0.50		0.50 – 0.90	
Colour[2]	-	Very Dark Brown		Black		Black	
pH	-	7.3	Neutral	8.1	Moderately 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 Sodic	1.92	Non Sodic
Total Phosphorus	mg/kg	232	-	182	-	185	-
Total Kjeldahl Nitrogen	mg/kg	930	Low	-		-	
	%	0.09		-		-	
Total Organic Carbon	%	1.6	Moderate	-		-	
Emerson Aggregate Test	-	5	Slight	4	Neg.	4	Neg.[3]
Available Water Capacity	%	10	N/A	41	N/A	49	N/A
	mm/cm	1.14	N/A	1.19	N/A	1.42	N/A
	mm/layer	11.4	N/A	47.4	N/A	56.7	N/A

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

2 Colour analysed on moist sample unless was a bleached layer

3 Negligible

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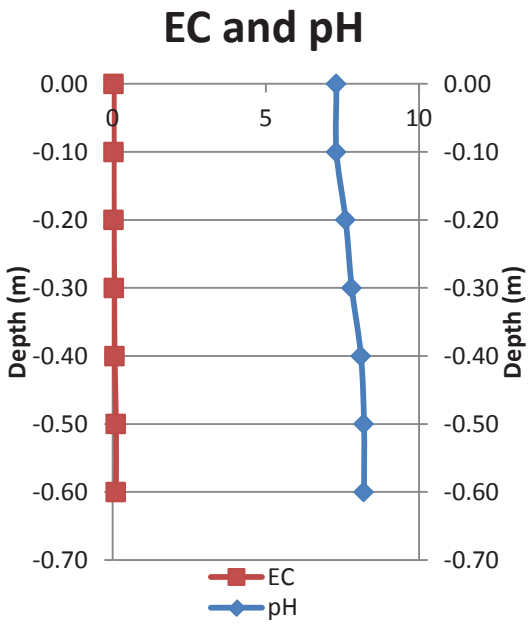
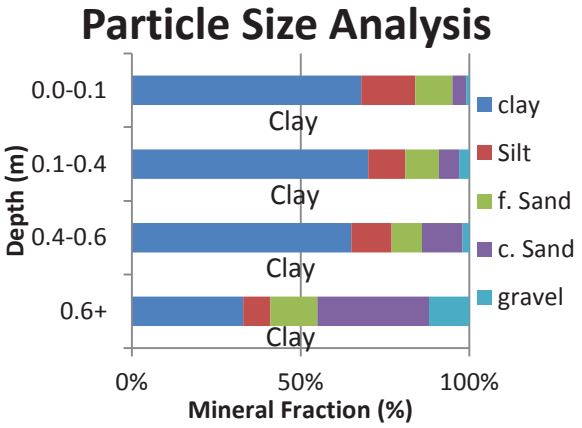
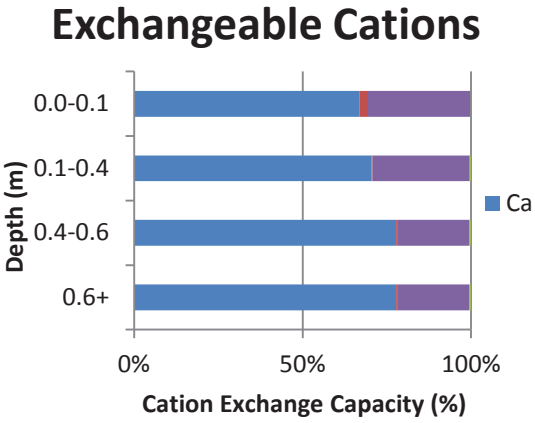
Site Description		
 **Landscape (Site 7)**		
ASC Soil Type	Haplic, Self-Mulching, Black Vertosol; Slightly Gravelly, Fine, Fine, Shallow	
Representative Pit	Site 7	
Dominant Geology Association	Tertiary Basalt	
Dominant Slope Association	Gently undulating plains	
Land Use and Vegetation	Native pastures 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

Profile







Physical Characteristics		
Horizon	**Depth (m)**	**Description**
A1	0.00 – 0.10	Black (10YR 2/1) heavy clay with moderate, sub-angular blocky structure of 10 – 20 mm. pH is neutral and salinity is rated very low. Drainage is considered poor with no mottling characteristics. 10 % stony materials were noted and boundary distinctness is diffuse to B2 horizon.
B2	0.10 – 0.40	Black (10YR 2/1) heavy clay with moderate, sub-angular blocky structure of 10 - 20 mm. pH is mildly alkaline and salinity is rated very low. Drainage is considered poor with no mottling characteristics. 5% stony materials were noted within the horizon and boundary distinctness is clear to C horizon.
C	0.40 – 0.60	Black (10YR 2/1) heavy clay with weak, sub-angular blocky structure of 10 mm. pH is moderately alkaline and salinity is rated low. Drainage is considered poor with 20% dark brown mottling characteristics. 15% manganese concretions, 10% lithic materials and 50% weathered Tertiary basalt material were noted within the horizon.

Analytical Description[1]							
Analyte	**Units**	**A1**		**B2**		**C**	
Depth	m	0.00 - 0.10		0.10 - 0.40		0.40 – 0.60	
Colour[2]	-	Black		Black		Black	
pH	-	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	-
Total Kjeldahl Nitrogen	mg/kg	1310	Low	-		-	
	%	0.13		-		-	
Total Organic Carbon	%	1.62	Moderate	-		-	
Emerson Aggregate Test	-	5	Slight	5	Slight	5	Slight
Available Water Capacity	%	18.6	N/A	53	N/A	28.4	N/A
	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

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

2 Colour analysed on moist sample unless was a bleached layer

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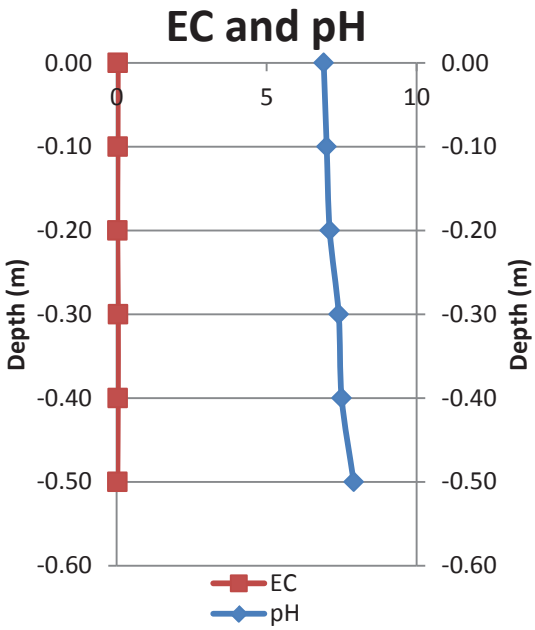
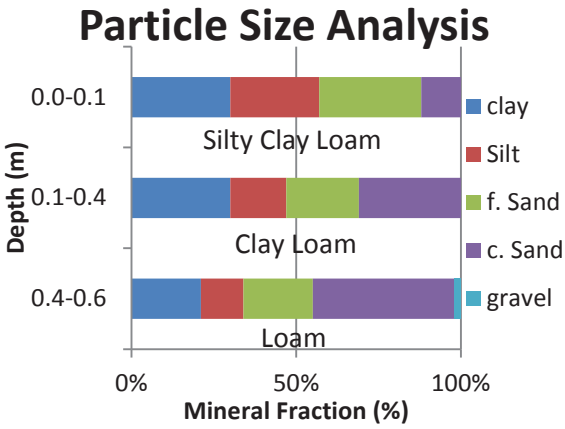
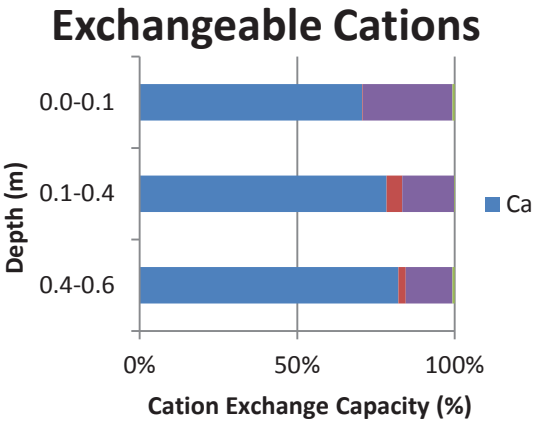
Site Description		
		
Landscape (Site 9)		
ASC Soil Type	Haplic, Eutrophic, Brown Dermosol; Slightly Gravelly, Fine, Fine, Shallow	
Representative Pit	Site 9	
Dominant Geology Association	Tertiary Basalt	
Dominant Slope Association	Gently undulating plains	
Land Use and Vegetation	Native pastures and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

Profile







Physical Characteristics		
Horizon	**Depth (m)**	**Description**
A1	0.00 – 0.10	Very Dark Brown (7.5YR 2.5/2) silty clay loam with moderate, blocky structure of 20 mm. pH is neutral and salinity is rated very low. Drainage is considered moderate with no mottling characteristics. No stony material was noted and boundary distinctness is gradual to B2 horizon.
B2	0.10 – 0.35	Brown (10YR 3/2) clay loam with moderate, blocky structure of 20 mm. pH is neutral to mildly alkaline and salinity is rated very low. Drainage is considered moderate with no mottling characteristics. No stony material was noted and boundary distinctness is clear to C horizon.
C	0.35 – 0.55	Dark Brown (10YR 3/3) loam with weak, blocky structure of <20 mm. pH is mildly to moderately alkaline and salinity is rated very low. Drainage is considered poor with 40% grey mottling characteristics. 10% manganiferous concretions and 30% Tertiary basalt material were noted within the horizon.

Analytical Description[1]							
Analyte	**Units**	**A1**		**B21**		**B22**	
Depth	m	0.00 - 0.10		0.10 - 0.35		0.35 – 0.55	
Colour[2]	-	Very Dark Brown		Brown		Dark Brown	
pH	-	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	-
Total Kjeldahl Nitrogen	mg/kg	2210	Low	-		-	
	%	0.22		-		-	
Total Organic Carbon	%	2.72	High	-		-	
Emerson Aggregate Test	-	3(1)	Slight	3(1)	Slight	5	Slight
Available Water Capacity	%	19	N/A	44	N/A	37	N/A
	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

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

2 Colour analysed on moist sample unless was a bleached layer

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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 inter-seam 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.

LEGEND

Project Boundary

Overburden Sampling Points

0 1km 2km

Scale 1:45 000

Version	Date:	Author:	Checked:	Approved:
1	21/02/2013	BS	SHS	MB

FIGURE 4.1

Overburden Sampling Sites

GSS ENVIRONMENTAL
Environmental, Land and Project Management Consultants

Project: Meteor Downs South Soils, Land, Overburden and Process Waste Study

Client: Endocoal Limited

File: Fg4.1_MEM08-001_OverburdenSamplingSites_130221

Projection: MGA 94 Zone 55

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

Sample ID	Sample Code	Depth from (m)	Depth to (m)	Stratum Lithology	Horizon	Analytes
1	9939	0	-1	Soil	Basalt	Analytes assessed for all collected samples as follows: 1) Soil pH 2) Oxidizing pH 3) Net Acid Production Potential 4) EC 5) Acid Neutralising Capacity (ANC as H2SO4, ANC as CaCO3, Fizz Rating) 6) Moisture Content 7) Exchangeable Cations (Ca, Mg, K, Na, Cation Exchange Capacity) 8) Total Sulfur by LECO 9) Chloride (Discrete Analyser) 10) Soluble Major Cations (Ca, Mg, Na, K) 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 12) Total Recoverable Mercury by FIMS 13) Nitrite as N by Discrete Analyser 14) Nitrate as N by Discrete Analyser 15) Nitrite + Nitrate as N (sol.)
2	9940	-1	-2	Soil		
3	9941	-2	-3	Soil		
4	9942	-3	-5	Soil		
5	9943	-5	-6	Clay		
6	9944	-5	-6	Clay		
7	9945	-6	-7	Clay		
8	9946	-6	-7	Clay		
9	9947	-7	-8	Basalt		
10	9948	-8	-9	Basalt		
11	9949	-11	-12	Basalt		
12	9950	-13	-14	Basalt		
13	9951	-13	-14	Basalt		
14	9952	-13	-14	Basalt		
15	9953	-14.02	-14.24	Basalt		
16	9954	-14.02	-14.24	Basalt		
17	9993	-14.02	-14.24	Basalt		
18	9955	-14.02	-14.24	Basalt		
19	9956	-27.7	-27.76	Claystone	Tertiary	
20	9957	-27.76	-27.82	Claystone		
21	9958	-27.82	-27.88	Claystone		
22	9959	-27.88	-28.73	Claystone		
23	9960	-28.73	-28.79	Siltstone		
24	9961	-28.79	-28.85	Siltstone		
25	9962	-28.85	-28.91	Siltstone		
26	9963	-31.92	-31.98	Sandstone Medium Grained		
27	9964	-31.98	-32.04	Sandstone Medium Grained		
28	9965	-32.04	-32.1	Sandstone Medium Grained		
29	9966	-36.7	-36.76	Conglomerate	Permian	
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		
35	9972	-41.1	-41.16	Sandstone Medium Grained		
36	9973	-41.16	-41.22	Sandstone Medium Grained		

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	Coal Seam Interburden/ Reject Material	Similar Suite as above including the following Analytes: 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)
55	9992	-73.68	-73.74	Sandstone Medium Grained		

Table 4-2 Overburden samples selected for geochemical testing (ORD133HC1)

Sample ID	Sample Code	Depth from (m)	Depth to (m)	Stratum Lithology	Horizon	Analytes
1	117332	0	-1.5	Soil	Basalt	**Analytes assessed for all collected samples as follows:** 1) Soil pH 2) Oxidizing pH 3) Net Acid Production Potential 4) EC 5) Acid Neutralising Capacity (ANC as H2SO4, ANC as CaCO3, Fizz Rating) 6) Moisture Content 7) Exchangeable Cations (Ca, Mg, K, Na, Cation Exchange Capacity) 8) Total Sulfur by LECO 9) Chloride (Discrete Analyser) 10) Soluble Major Cations (Ca, Mg, Na, K) 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 12) Total Recoverable Mercury by FIMS 13) Nitrite as N by Discrete Analyser 14) Nitrate as N by Discrete Analyser 15) Nitrite + Nitrate as N (sol.)
2	117333	-1.5	-3	Sandy Clay		
3	117334	-3	-5	Coarse Sandstone		
4	117335	-5	-8	Very Coarse Sandstone		
5	117336	-8	-13	Basalt		
6	117337	-13	-18	Basalt		
7	117338	-18	-23	Basalt		
8	117339	-23	-28	Basalt		
9	117340	-28	-33	Basalt		
10	117341	-33	-38	Basalt		
11	117342	-38	-39	Basalt		
12	117343	-39	-42.24	Basalt		
13	117344	-42.24	-44.09	Igneous with Siderite		
14	117345	-44.09	-46.33	Igneous		
15	117346	-46.33	-46.76	Carbonaceous Mudstone	Tertiary	
16	117347	-46.76	-47.52	Mudstone		
17	117348	-47.52	-49.6	Fine-Medium Grained Sandstone		
18	117349	-49.6	-54.6	Coarse-grained Sandstone		
19	117350	-54.6	-55.77	Coarse Sandstone		
20	117351	-55.77	-55.95	Claystone	Permian	
21	117352	-55.95	-60.95	Coarse Sandstone		
22	117353	-60.95	-62.1	Coarse Sandstone		
23	117354	-62.1	-62.49	Claystone		
24	117355	-62.49	-66.45	Fine Sandstone		
25	117356	-66.45	-66.56	Siderite		
26	117357	-66.56	-66.81	Fine Sandstone		
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

Sample ID	Sample Code	Depth from (m)	Depth to (m)	Stratum Lithology	Horizon	Analytes
				Siltstone	Interburden/ Reject Material	following Analytes: 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^{o}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:

$$FeS_2 + 15/4\ O_2 + 7/2H_2O \Rightarrow Fe(OH)_3 + 2H_2SO_4$$

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:

$$\text{MPA (kg } H_2SO_4\text{/t)} = \text{(Total \%S)} \times 30.6$$

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:

$$NAPP = MPA - ANC$$

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**.

Table 4-3 Sample Classification of Acid producing potential

Total Oxidisable Sulfur	NAPP	Sample Classification
< 0.1	-	Non-Acid Forming (NAF)
0.1 ≤ *TOS* ≤ 0.2	≤ -20	
0.1 ≤ *TOS* ≤ 0.2	-20 < *NAPP* ≤ 0	Uncertain - Non-Acid Forming (UC-NAF)
0.1 ≤ *TOS* ≤ 0.2	> 0	Uncertain (UC)
>0.20	≤ 0	
0.2 < *TOS* ≤ 1.0	0 > *NAPP* ≤ 20	Uncertain - Potentially Acid Forming (UC-PAF)
> 1.0	> 20	Potentially Acid Forming (PAF)

**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.

Table 4-4 pH Ratings Results

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

4.3.2 Electrical Conductivity

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

Table 4-5 EC Ratings Results

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

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.**

Table 4-6 Reference Ratings for Cation Exchange Capacity

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

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%

Table 4-8 Overburden Ratings Summary for CEC and ESP

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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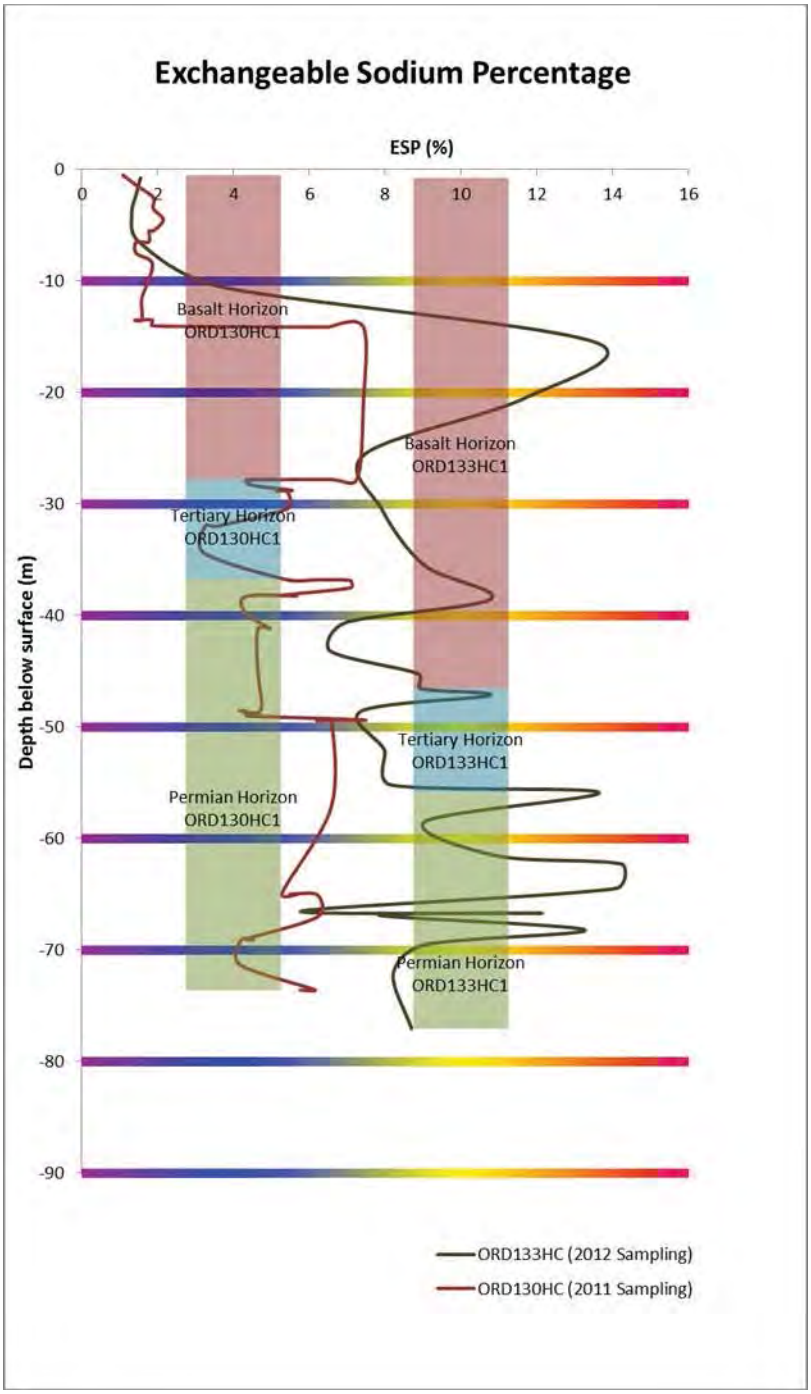

Figure 4-2 Exchangeable Sodium Percentage Depth Profile

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 sub-horizon 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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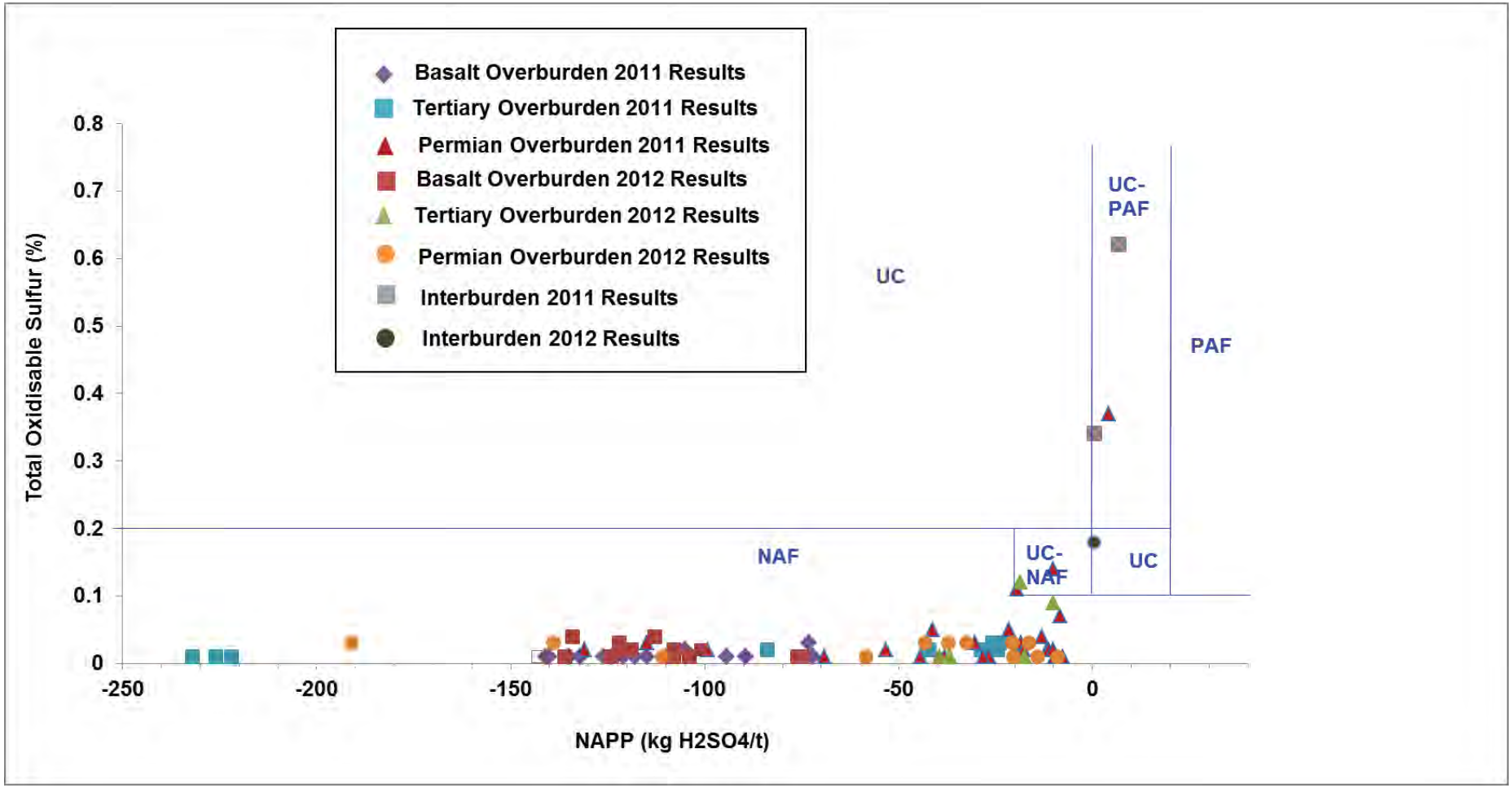

Figure 4-3 Correlation between Overburden TOS and NAPP values, all samples

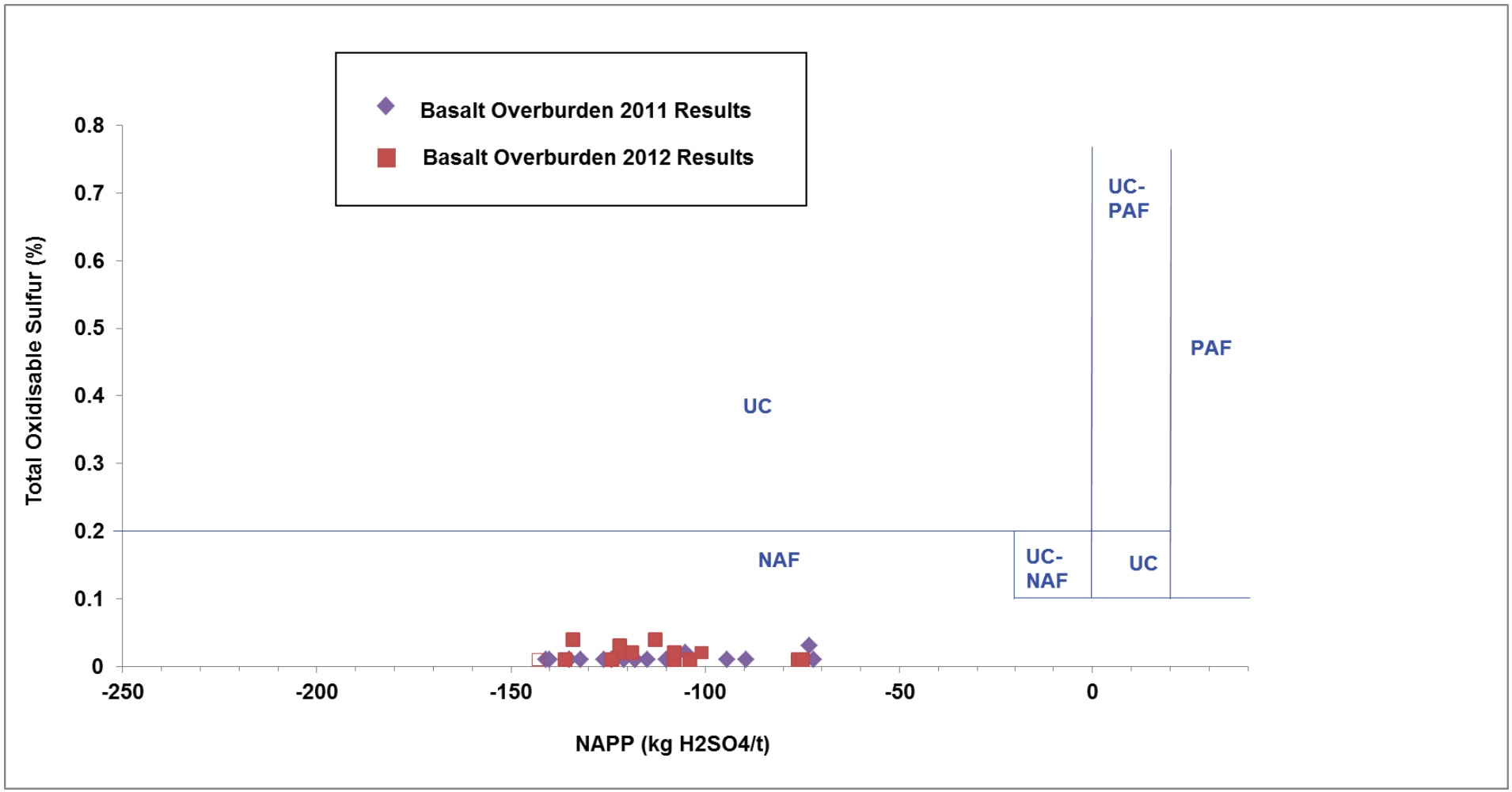

Figure 4-4 Correlation between Overburden TOS and NAPP values, Basalt Overburden Samples

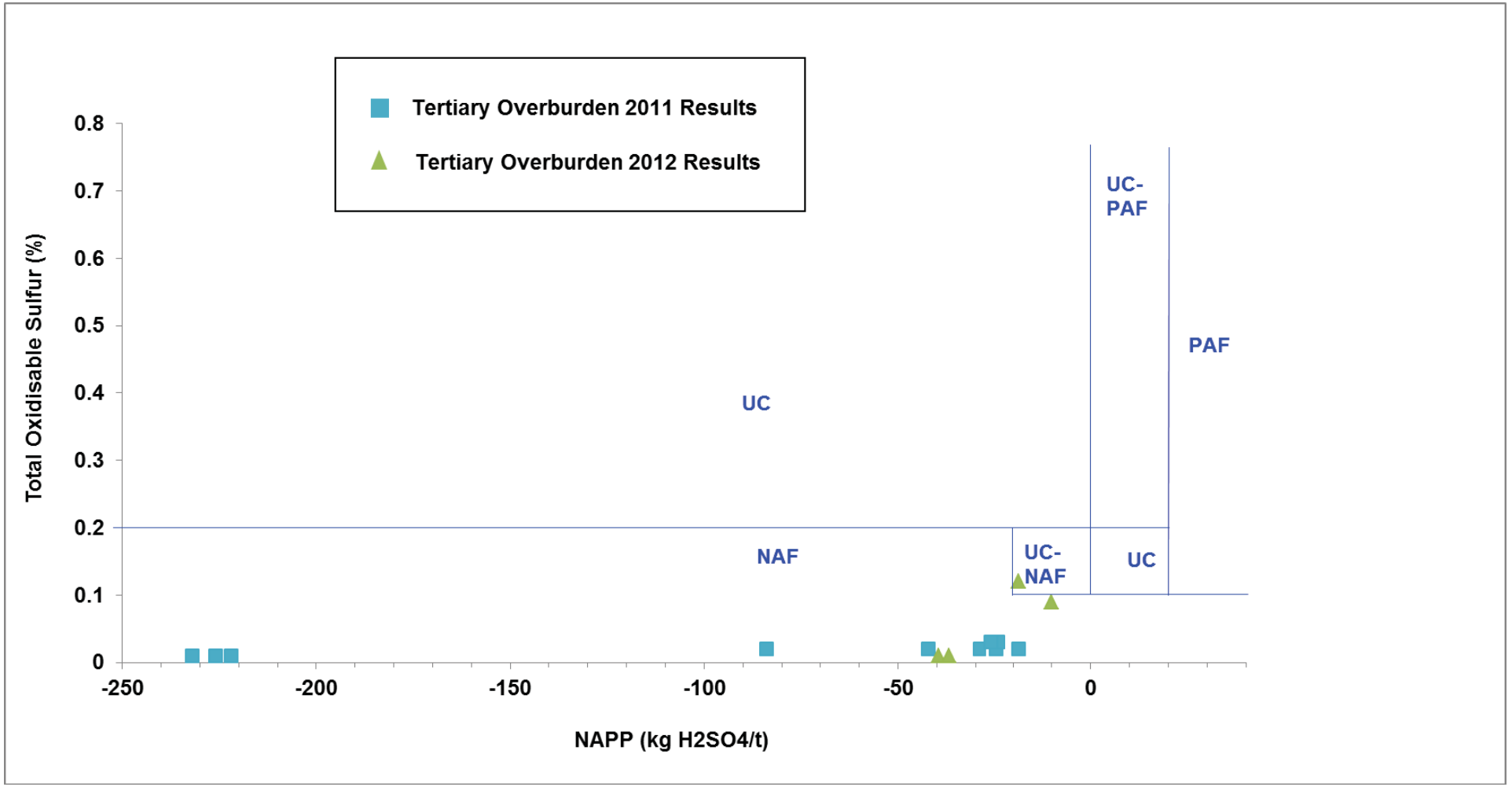

Figure 4-5 Correlation between Overburden TOS and NAPP values, Tertiary Overburden Samples

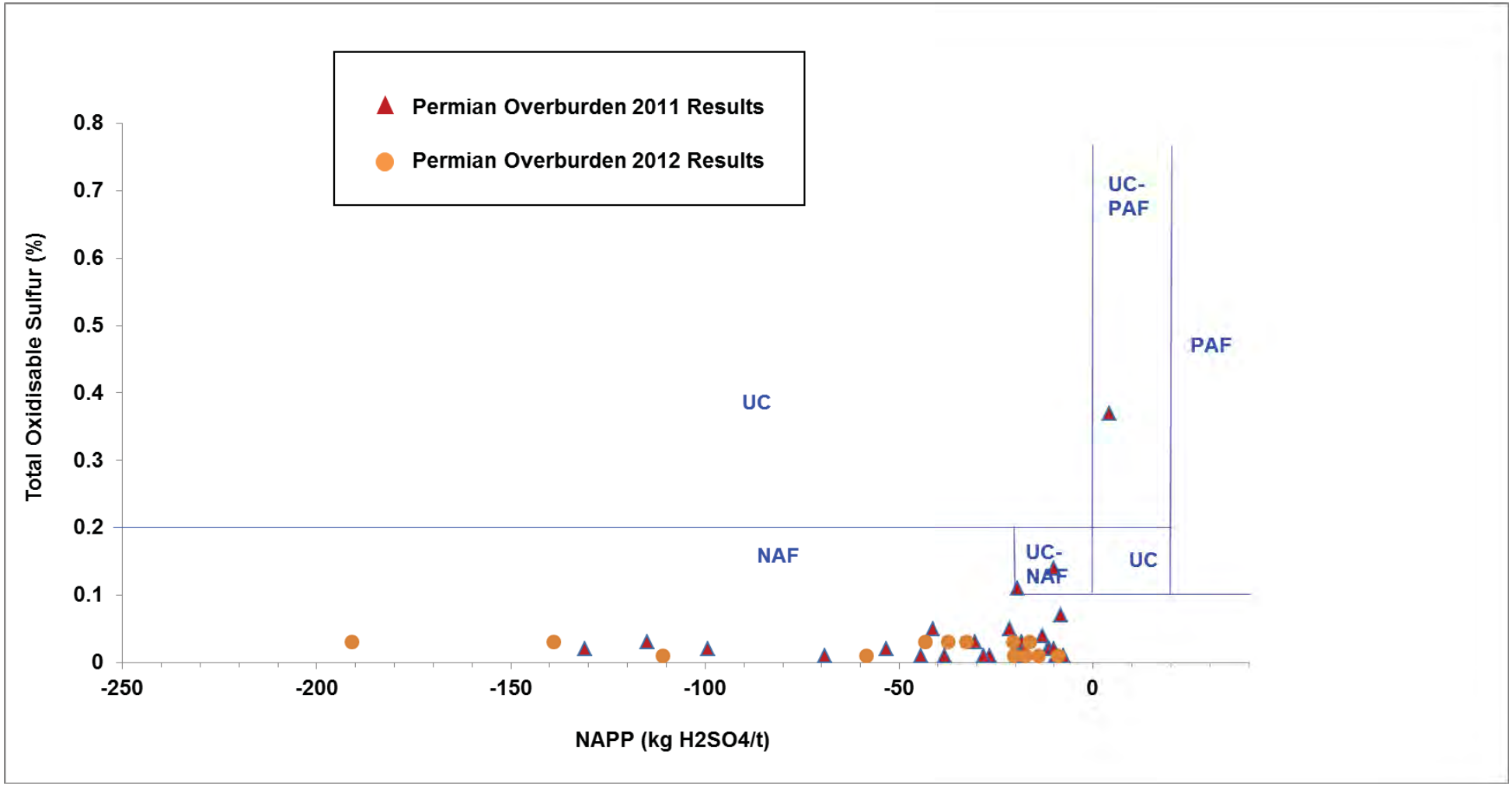

Figure 4-6 Correlation between Overburden TOS and NAPP values, Permian Overburden Samples

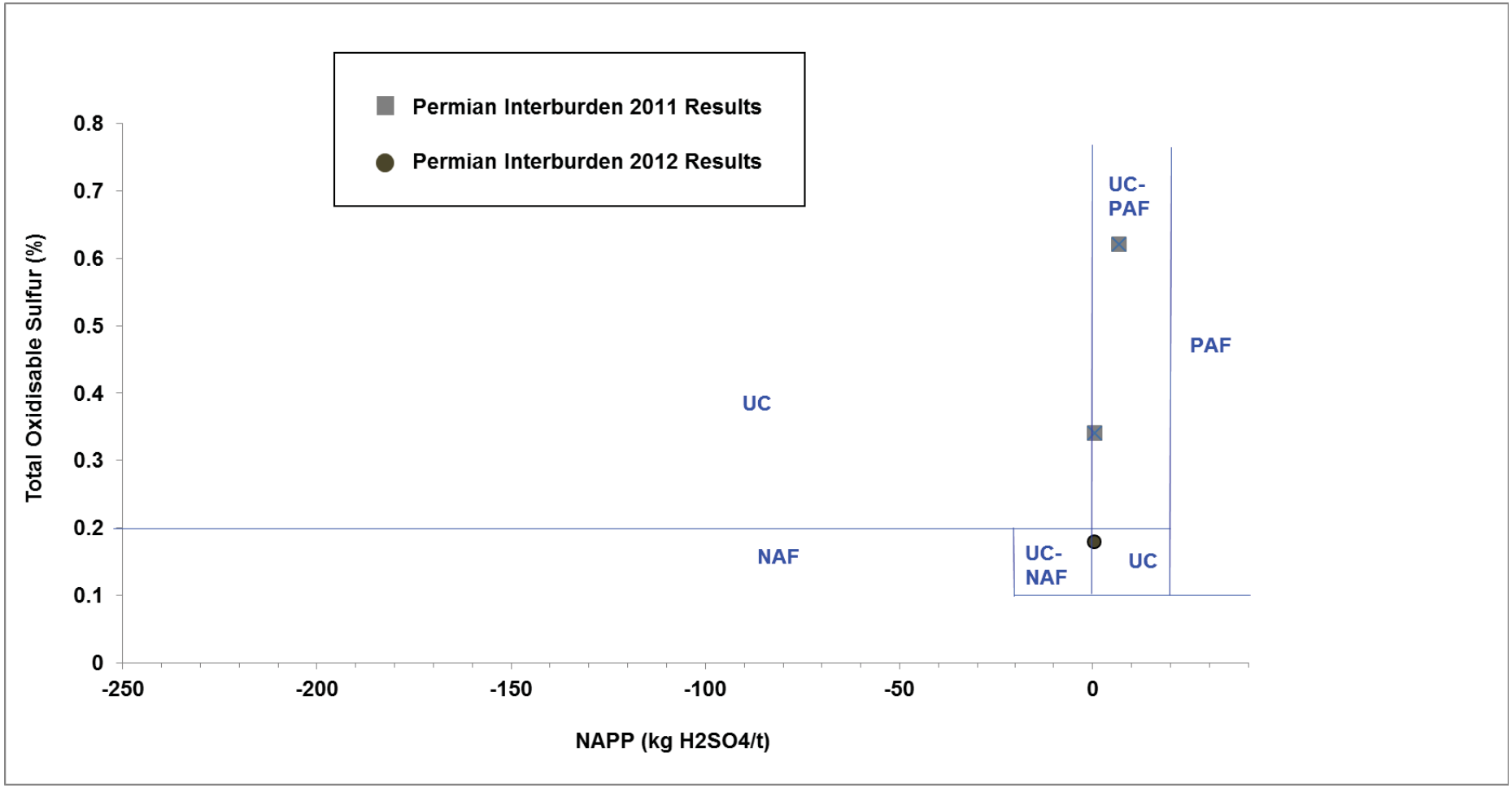

Figure 4-7 Correlation between Overburden TOS and NAPP values, Permian Interburden Samples

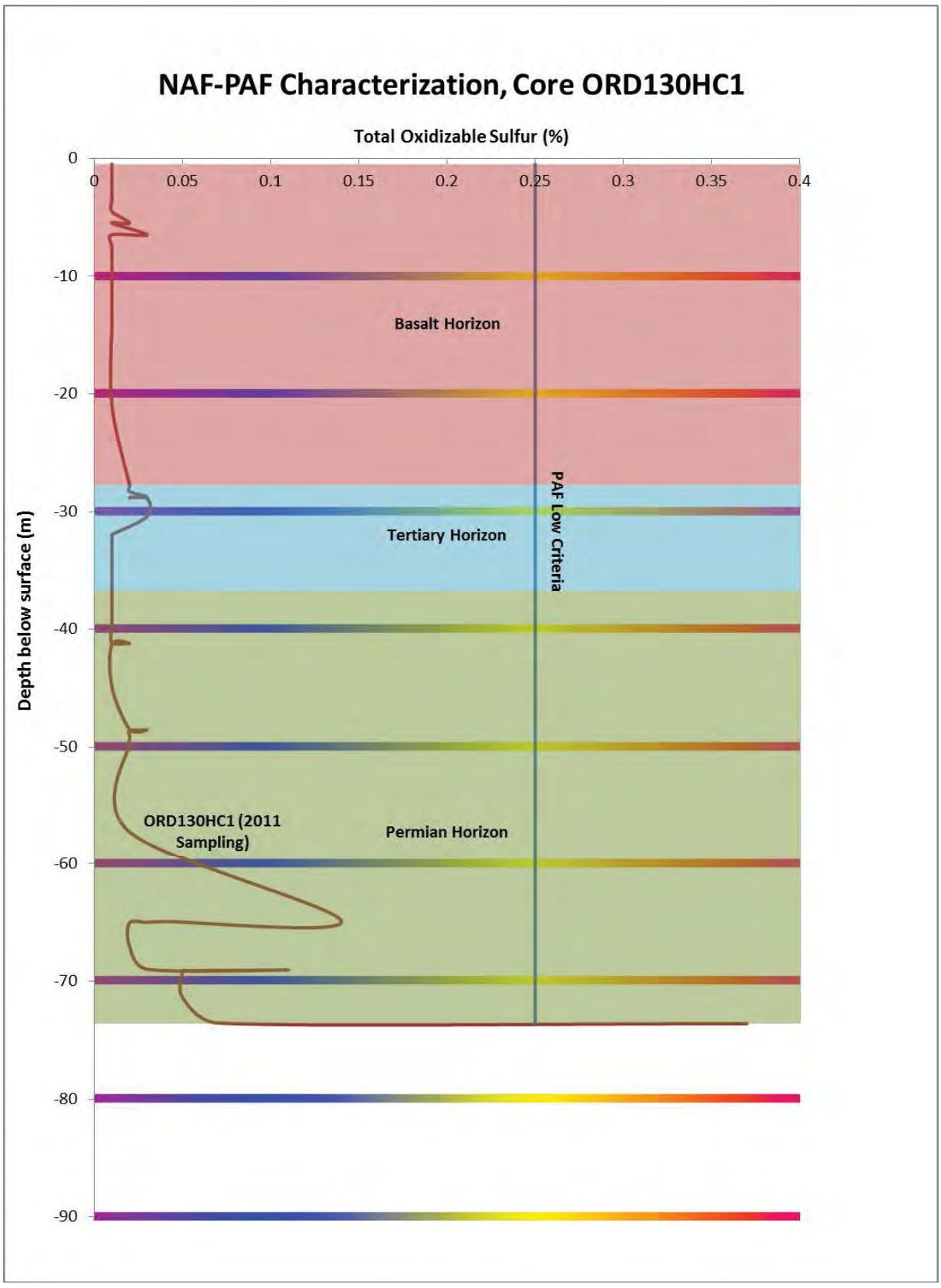

Figure 4-8 NAF-PAF Signatures of Overburden Horizons, Core ORD130HC1

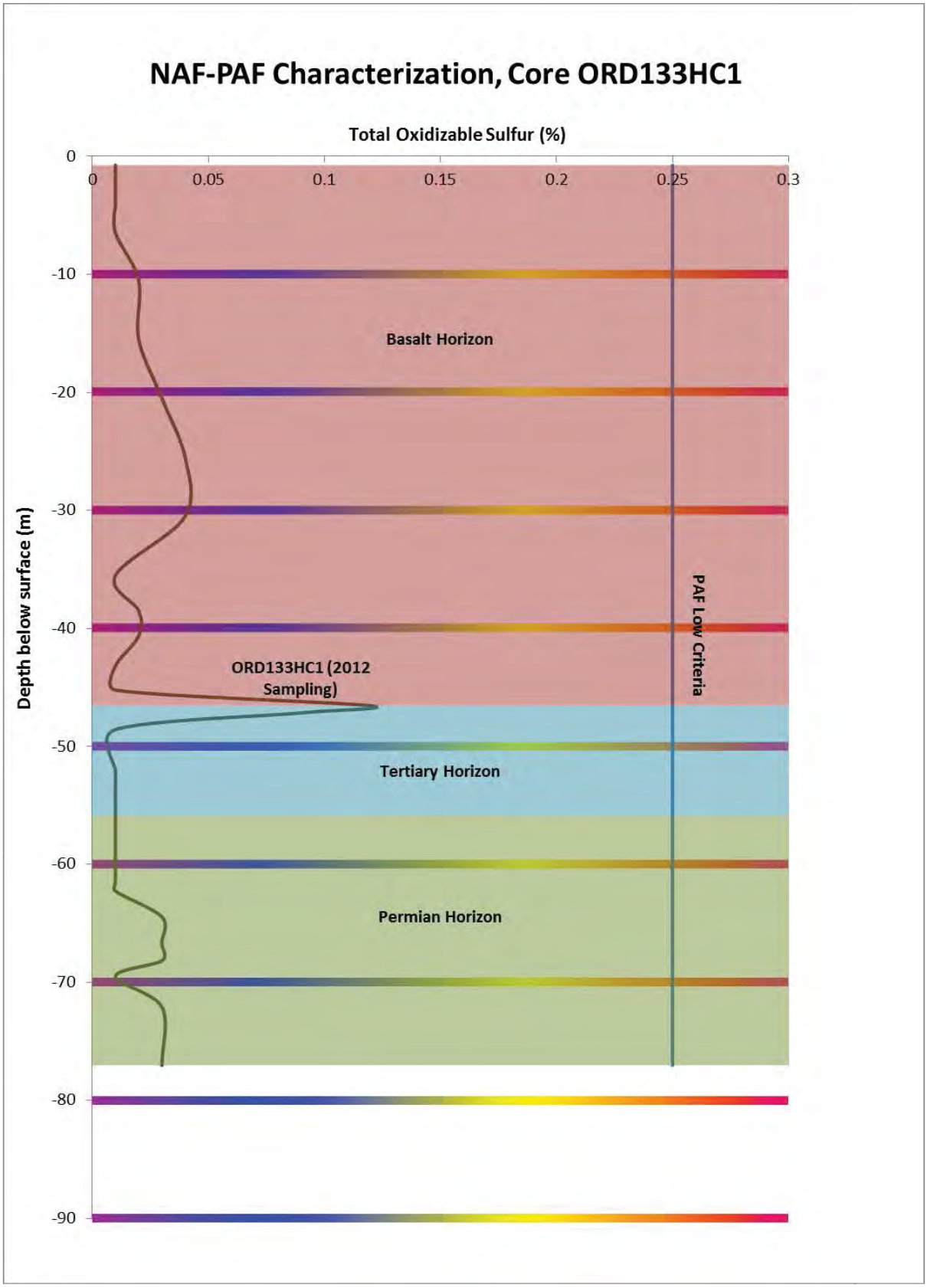

Figure 4-9 NAF-PAF Signatures of Overburden Horizons, Core ORD133HC1

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

Metal	Overburden Results						Interburden Results		Health Investigation Levels (HIL's) (Exposure Setting E - NEPC 1999) (mg/kg)	Environmental Investigation Levels (QLD AMAD, 1995) (mg/kg)
	Basalt Horizon		Tertiary Horizon		Permian Horizon		Interburden Horizon			
	Range (mg/kg)	Average (mg/kg)	Range (mg/kg)	Average (mg/kg)	Range (mg/kg)	Average (mg/kg)	Range (mg/kg)	Average (mg/kg)		
Aluminum	23900 to 50800	34832.140	5010 to 19600	11456.00	2100 to 14900	9749.783	780 to 5000	2206.667	N/A	N/A
Antimony	5 to 5	5.000	5 to 5	5.000	5 to 5	5.000	5 to 5	5.000	N/A	20
Arsenic	5 to 7	5.071	5 to 14	6.800	5 to 19	8.508	5 to 5	5.000	200	20
Barium	20 to 1820	165.040	20 to 90	50.500	30 to 100	53.533	10 to 50	23.333	N/A	400
Beryllium	1 to 3	1.639	1 to 2	1.450	1 to 3	1.712	1 to 6	3.333	40	N/A
Boron	50 to 50	50.000	50 to 50	50.000	50 to 50	50.000	50 to 60	53.333	6000	N/A
Cadmium	1 to 2	1.028	1 to 1	1.000	1 to 2	1.0200	1 to 1	1.000	40	3
Chromium	18 to 126	68.508	5 to 26	12.900	2 to 21	10.700	2 to 6	3.333	200	50
Cobalt	23 to 59	40.270	2 to 17	8.850	2 to 26	9.793	2 to 4	3.333	200	50
Copper	35 to 81	54.929	5 to 24	8.850	5 to 58	18.532	11 to 32	21.000	2000	60
Iron	30700 to 76000	55880.159	6940 to 29700	14570.000	4640 to 150000	26732.767	1440 to 16900	9813.333	N/A	N/A
Lead	5 to 6	5.036	6 to 16	10.650	7 to 33	16.227	5 to 19	10.333	600	300
Manganese	523 to 1810	887.004	5 to 855	286.300	35 to 3480	556.520	8 to 153	100.667	3000	500
Mercury	0.1 to 0.1	0.100	0.1 to 0.1	0.100	0.1 to 0.2	0.110	0.1 to 0.2	0.133	30	1
Molybdenum	2 to 3	2.139	2 to 2	2.000	2 to 3	2.020	2 to 2	2.000	N/A	40
Nickel	95 to 191	147.504	6 to 28	13.700	5 to 28	12.935	3 to 13	8.667	600	60

Metal	Overburden Results						Interburden Results		Health Investigation Levels (HIL's) (Exposure Setting E - NEPC 1999) (mg/kg)	Environmental Investigation Levels (QLD AMAD, 1995) (mg/kg)
	Basalt Horizon		Tertiary Horizon		Permian Horizon		Interburden Horizon			
	Range (mg/kg)	Average (mg/kg)	Range (mg/kg)	Average (mg/kg)	Range (mg/kg)	Average (mg/kg)	Range (mg/kg)	Average (mg/kg)		
Selenium	5 to 12	6.111	5 to 5	5.000	5 to 5	5.000	5 to 5	5.000	N/A	5
Silver	2 to 3	2.139	2 to 2	2.000	2 to 3	2.020	2	2.000	N/A	20
Strontium	98 to 1360	382.968	21 to 233	66.100	25 to 121	63.562	21 to 100	47.667	N/A	N/A
Tin	5 to 129	8.444	5 to 5	5.000	5 to 5	5.000	5	5.000	N/A	50
Titanium	220 to 1250	649.444	60 to 160	99.000	40 to 450	112.317	270 to 320	296.667	N/A	N/A
Thallium	5 to 6	5.083	5 to 5	5.000	5 to 5	5.000	5 to 5	5.000	N/A	N/A
Vanadium	21 to 116	62.353	8 to 33	17.950	9 to 58	25.293	15 to 51	34.333	N/A	70
Zinc	17 to 99	67.714	32 to 71	48.250	6 to 92	54.410	5 to 28	13.000	14000	200

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

Material Category	Units	Volume of material generated per year											Total Volume
		2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	
Estimated available overburden waste material	BCM	7,470,178	7,526,958	9,344,247	7,954,641	7,964,548	8,272,664	8,185,432	7,736,996	6,419,779	3,493,906	143,533	74,512,883
NAF (Overburden Material composite, includes Basalt, Tertiary Sedimentary and non-PAF Permian Horizon)	BCM	6,145,647	6,287,659	5,360,928	4,197,230	3,822,035	3,714,621	3,847,764	3,767,812	3,230,121	1,406,267	0	41,780,085
UC-PAF (Overburden Material Adjacent to Interburden)	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	32,732,798
UC-PAF (All Interburden/Reject Material)	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

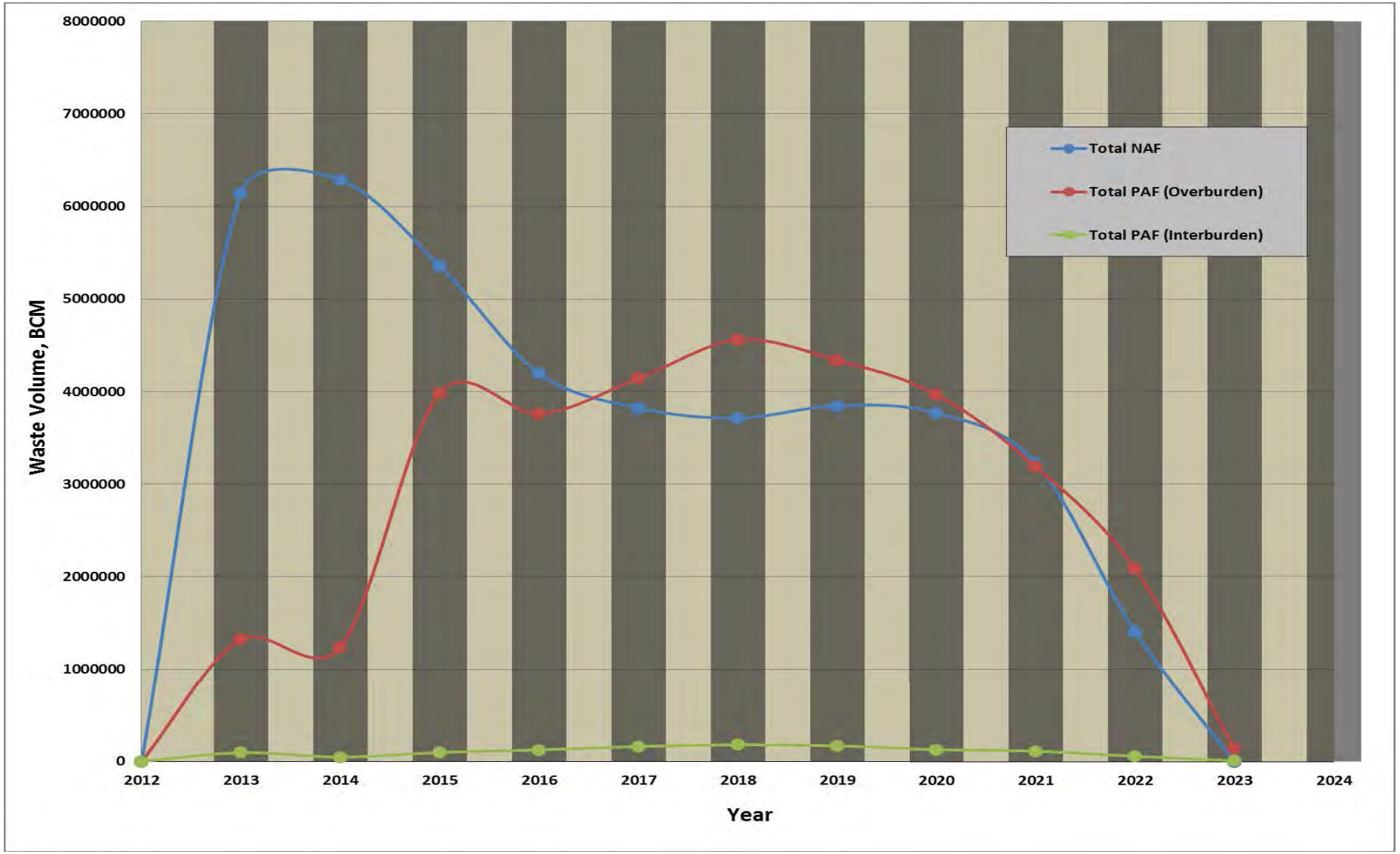

Figure 4-10 Graph of projected NAF-PAF generation within the operating life of mine

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**.

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

Analytes	Units	Sample		
		ORD130HC1 9991 INTERBURDEN	ORD130HC1 9992 INTERBURDEN	ORD133HC1 117363 INTERBURDEN
Total Sulfur	%	0.62	0.34	0.18
Acid Neutralising Capacity	kg H_2SO_4 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 H_2SO_4/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

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

Analyte	Units	Sample		
		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 physico-chemical 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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Table 5-1 Scheme for Classifying Land Suitability

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 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.

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.**

Table 5-2 Effective Rooting Depth Criteria (DERM 2011$_c$)

Descriptor		ERD occurs where:
Electrical Conductivity[1]	$EC_{1:5}$ for sorghum and wheat[1] (90% yield reduction threshold)	>0.8 dS/m
Chloride Levels	Cl 1:5	>800 mg/kg
Sodicity	ESP	>15%
pH	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 5-3 Current and draft Land Suitability PAWC Guidelines

Guideline Source	Land Suitability ranking for rain fed cropping				
	1	2	3	4	5
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	-

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**).

Table 5-4 Agricultural Land Class System

Class	Description	
A	Crop Land	Land that is suitable for current and potential crops with limitations to production which range from none to moderate levels.
B	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.
C	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.

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.	A
2	Land with minor limitations.	A
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 pasture improvement	Brigalow vegetation; appropriate for fattening beef cattle; good grazing on sown pastures and can withstand ground disturbance.
2	Land with minor limitations			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.

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

GSSE Representative Soil Type			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

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 ≥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.

Table 5-8 SCL Assessment Criterion

Map Unit/Soil Family	Site #	Comments	SCL Criterion								SCL
			1-slope (s)	2-rockiness (r)	3-gilgai microrelief (g)	4- soil depth (d)	5- wetness (w)	6= pH (p)	7- salinity (e)	8- water storage (w)	
108, Bruce	S6	Weathered horizon encountered at 0.5 m.	P	P	P	P	P	P	P	F	No
108, Bruce	S12	Weathered horizon at 0.50 m.	P	P	P	F					No
108, Bruce	S13	Soil water storage is less than 100 mm at 0.5 m weathered	P	P	P	P	P	P	P	F	No
109, Arcturus	S10	Weathered horizon at 0.50 m.	P	P	P	F					No
109, Arcturus	S11	Nil constraints	P	P	P	P	P	P	P	P	Yes
107, Rugby	S14	Nil constraints	P	P	P	P	P	P	P	P	Yes
109, Arcturus	S15	Weathered horizon at 0.50 m.	P	P	P	F					No
109, Arcturus	S16	20 % tertiary basalt rocks (200 mm).	P	P	P	P	P	P	P	P	Yes

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

GSSE Representative Soil Type			Main Limitation (s)[1]	Rainfed Cropping	Main Limitation (s)[1]	Beef Cattle Grazing	ALC Class
Site #	Map Unit/Soil Family	ASC	Description	Class	Description	Class	
Oxford Land System							
1	107, Rugby	Haplic, Self-Mulching, Brown Vertosol; Slightly Gravelly, Fine, Fine, Shallow	P_5, N_3, E_3	5	P_3, pH_2, E_1	3	C2
3	107, Rugby	Haplic, Self-Mulching, Brown Vertosol; Slightly Gravelly, Fine, Fine, Moderate	P_2, N_3, E_3	3	N_2, pH_2	2	B
12	108, Bruce	Haplic, Self-Mulching, Brown Vertosol; Non-Gravelly, Fine, Fine, Moderate	P_5, N_3, E_3	5	P_3, pH_2	3	C2/ C1 [2]
10	109, Arcturus	Self-Mulching, Grey Vertosol; Non-Gravelly, Fine, Fine, Moderate	P_4, N_3, R_3	4	P_2, N_2, pH_2, R_2	2	B
14	109, Arcturus	Haplic, Self-Mulching, Grey Vertosol; Non-Gravelly, Fine, Fine, Moderate	P_2, N_3, E_3	3	N_2, pH_2	2	B
11	109, Arcturus	Self-Mulching, Grey Vertosol; Non-Gravelly, Fine, Fine, Moderate	P_3, N_3, E_3	3	N_2, pH_2	2	B
8	110, May Downs	Haplic, Self-Mulching, Brown Vertosol; Non-Gravelly, Fine, Fine, Deep	P_2, N_3, E_3	3	N_2, pH_3, E_3	3	B
Waterford Land System							
2	105, Rugby	Haplic, Self-Mulching, Black Vertosol; Non-Gravelly, Fine, Fine, Moderate	P_3, N_3, E_3	3	N_2, pH_2	2	B
7	105, Rugby	Haplic, Self-Mulching, Black Vertosol; Slightly Gravelly, Fine, Fine, Shallow	P_4, N_3, E_3	4	N_2, pH_2, E_2	2	C1
9	105, Rugby	Haplic, Eutrophic, Brown Dermosol; Slightly Gravelly, Fine, Fine, Shallow	P_5, E_3	5	P_3, pH_2	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.

LEGEND

Project Boundary

Trigger Zones

0 1km 2km

Scale 1:45 000

Version	Date:	Author:	Checked:	Approved:
1	21/02/2013	BS	SHS	MB

FIGURE 5.1

Strategic Cropping Land
Trigger Zones

GSS ENVIRONMENTAL
Environmental, Land and Project Management Consultants

Project: Meteor Downs South Soils, Land, Overburden and Process Waste Study

Client: Endocoal Limited

File: Fg5.1_MEM08-001_SCLTriggerZones_130221

Projection: MGA 94 Zone 55

To be printed A4

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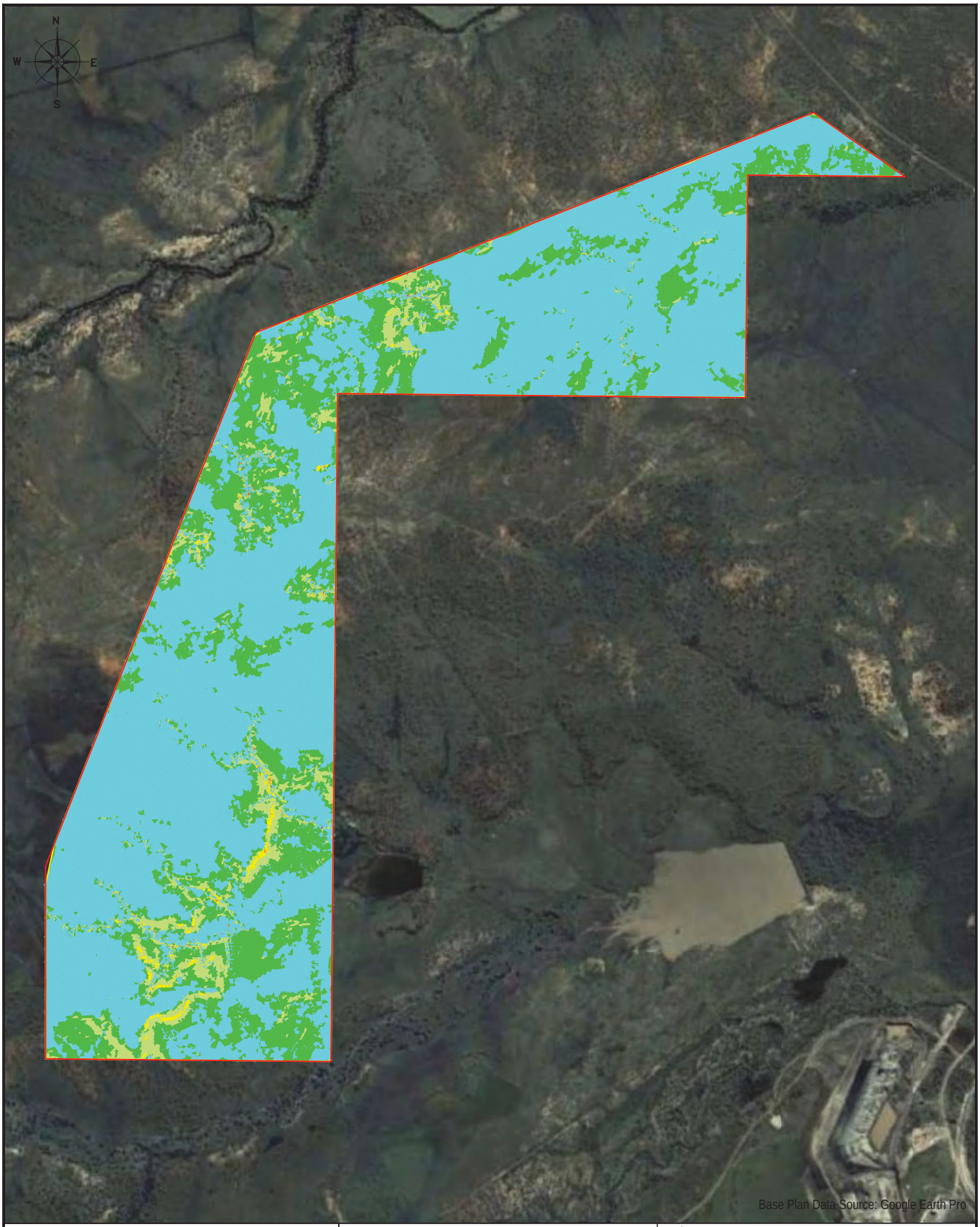

LEGEND

Project Boundary

Slope Percentage

- 0-3%
- 3-5%
- 5-10%
- 10-18%
- 18-32%
- 32-56%
- 56-100%
- >100%

0 1km 2km

Scale 1:45 000

Version	Date:	Author:	Checked:	Approved:
1	21/02/2013	BS	SHS	MB

FIGURE 5.2

Slope Analysis

GSS ENVIRONMENTAL
Environmental, Land and Project Management Consultants

Project: Meteor Downs South Soils, Land, Overburden and Process Waste Study

Client: Endocoal Limited

File: Fg5.2_MEM08-001_SlopeAnalysis_130221

Projection: MGA 94 Zone 55

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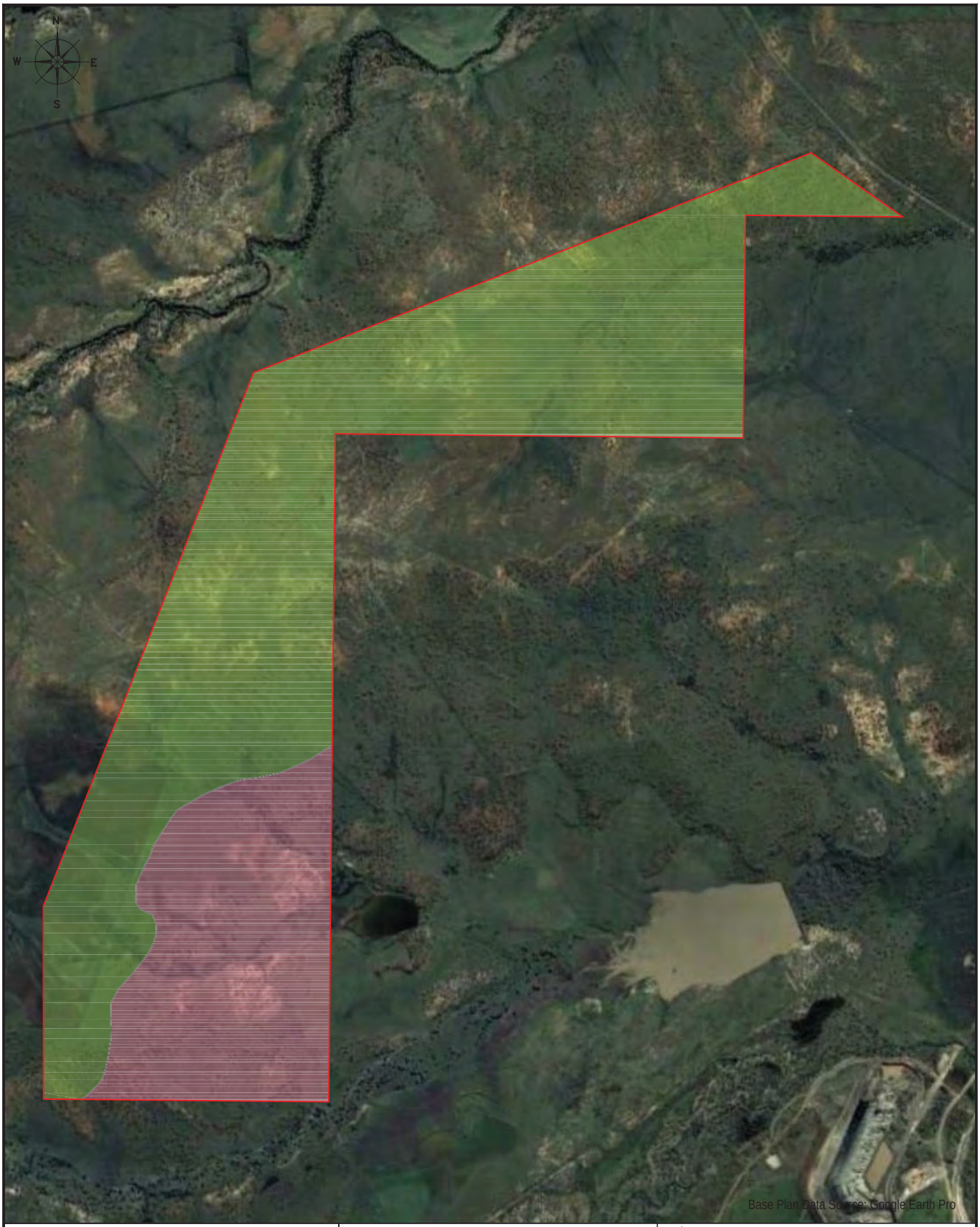

LEGEND

Project Boundary Area

Agricultural Land Classes Key

GQAL-Class A

Other-C 2

0 1km 2km

Scale 1:45 000

Version	Date:	Author:	Checked:	Approved:
1	21/2/2013	BS	SHS	MB

FIGURE 5.3

Good Quality Agricultural Land

GSS ENVIRONMENTAL
Environmental, Land and Project Management Consultants

Project: Meteor Downs South Soils, Land, Overburden and Process Waste Study

Client: Endocoal Limited

File: Fg5.3_MEM08-001_GoodQualityAgLand_130221

Projection: MGA 94 Zone 55

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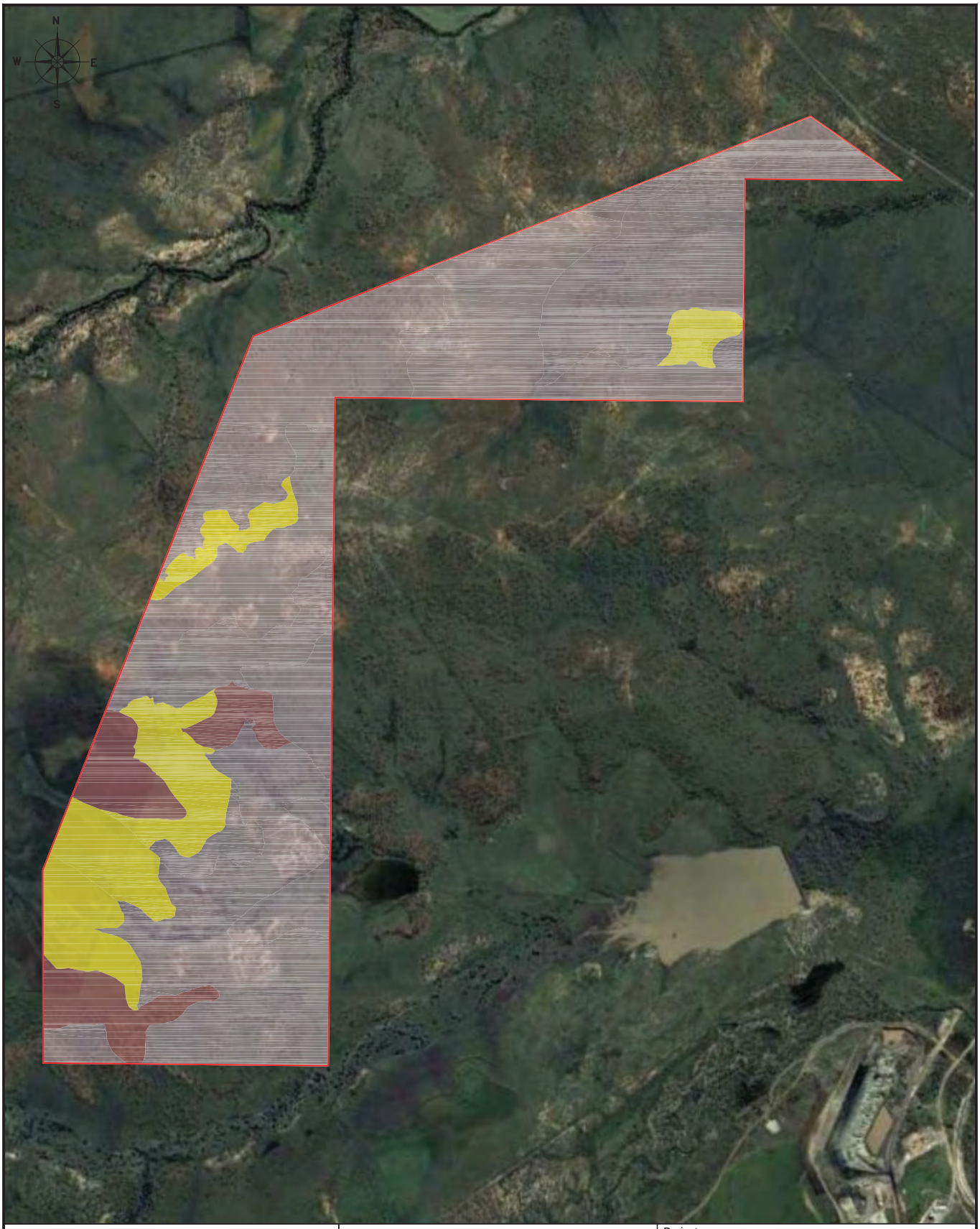

LEGEND

- Project Boundary Area
- Class B
- Class C1
- Class C2

0 1km 2km

Scale 1:45 000

Version	Date:	Author:	Checked:	Approved:
1	21/02/2013	BS	SHS	MB

FIGURE 5.4

Agricultural Land Classes

GSS ENVIRONMENTAL
Environmental, Land and Project Management Consultants

Project: Meteor Downs South Soils, Land, Overburden and Process Waste Study

Client: Endocoal Limited

File: Fg5.4_MEM08-001_AgriculturalLandClasses_130221

Projection: MGA 94 Zone 55

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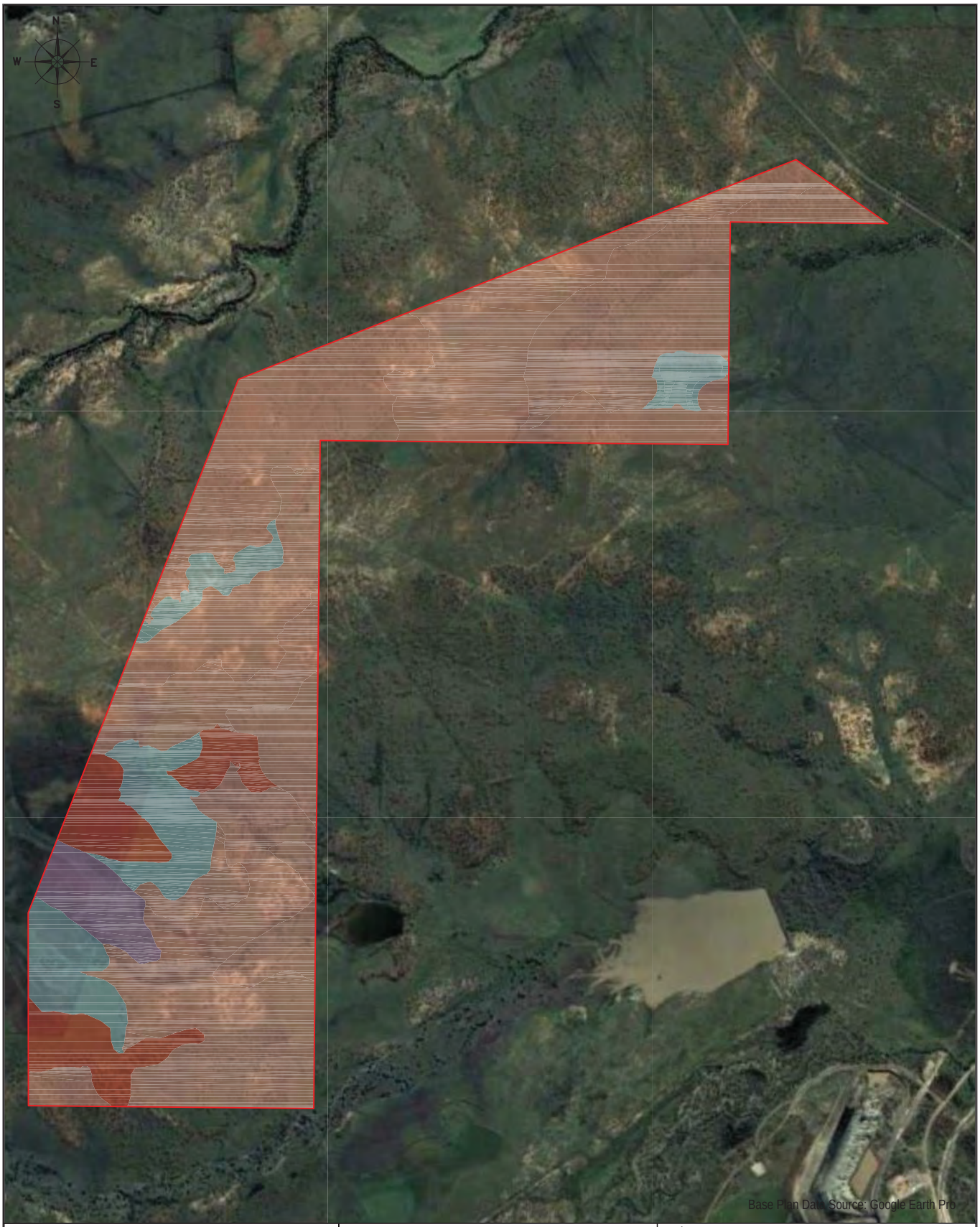

LEGEND

- Project Boundary Area
- Class 2
- Class 3
- Class 4
- Class 5

0 1km 2km

Scale 1:45 000

Version	Date:	Author:	Checked:	Approved:
1	21/02/2013	BS	SHS	MB

FIGURE 5.5

Rainfed Cropping Land

GSS ENVIRONMENTAL
Environmental, Land and Project Management Consultants

Project: Meteor Downs South Soils, Land, Overburden and Process Waste Study

Client: Endocoal Limited

File: Fg5.5_MEM08-001_RainfedCropping_130221

Projection: MGA 94 Zone 55

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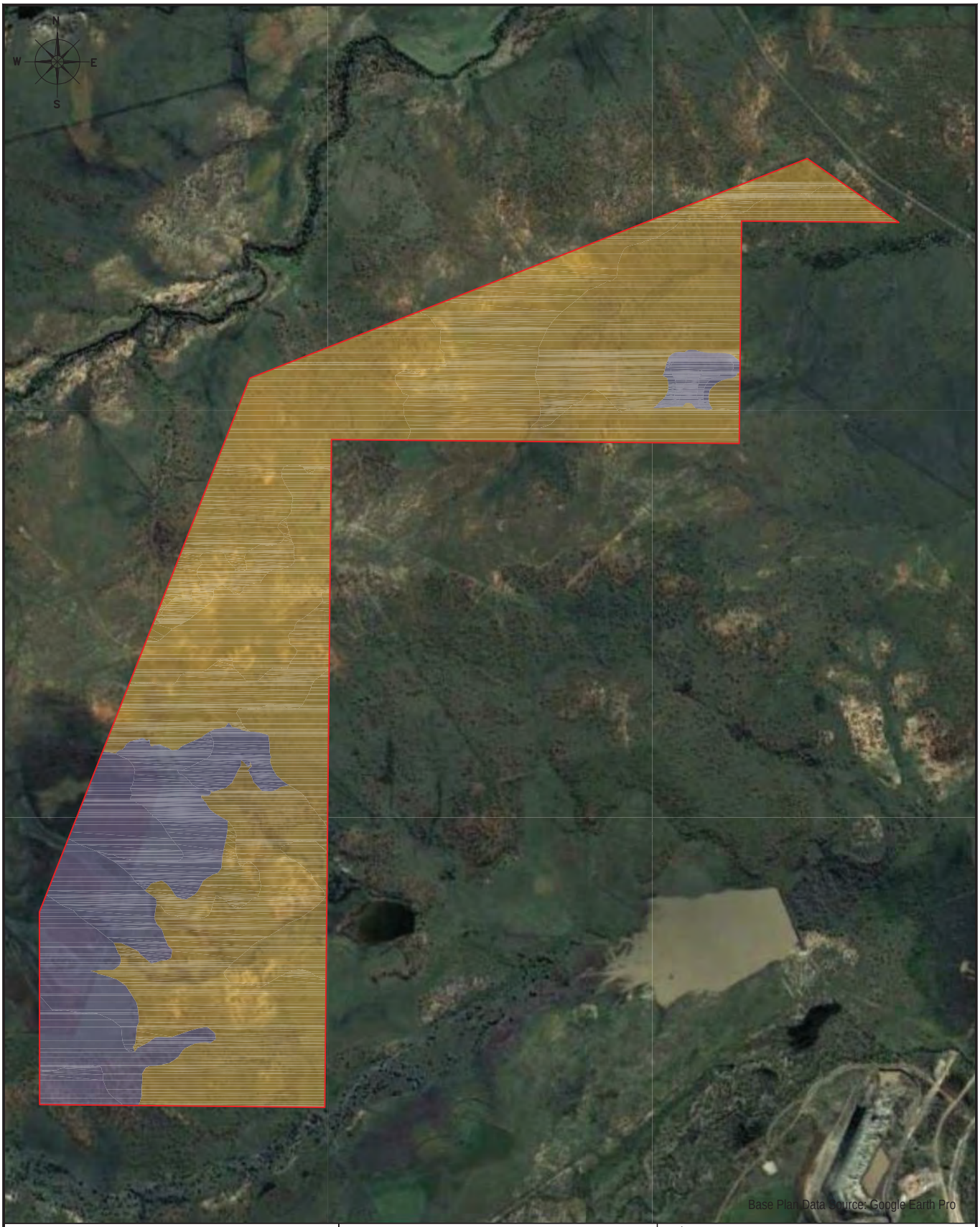

LEGEND

- Project Boundary Area
- Class 2
- Class 3

0 1km 2km

Scale 1:45 000

Version	Date:	Author:	Checked:	Approved:
1	21/02/2013	BS	SHS	MB

FIGURE 5.6

Beef Cattle Grazing Land

GSS ENVIRONMENTAL
Environmental, Land and Project Management Consultants

Project: Meteor Downs South Soils, Land, Overburden and Process Waste Study

Client: Endocoal Limited

File: Fg5.6_MEM08-001_BeefCattleGrazing_130221

Projection: MGA 94 Zone 55

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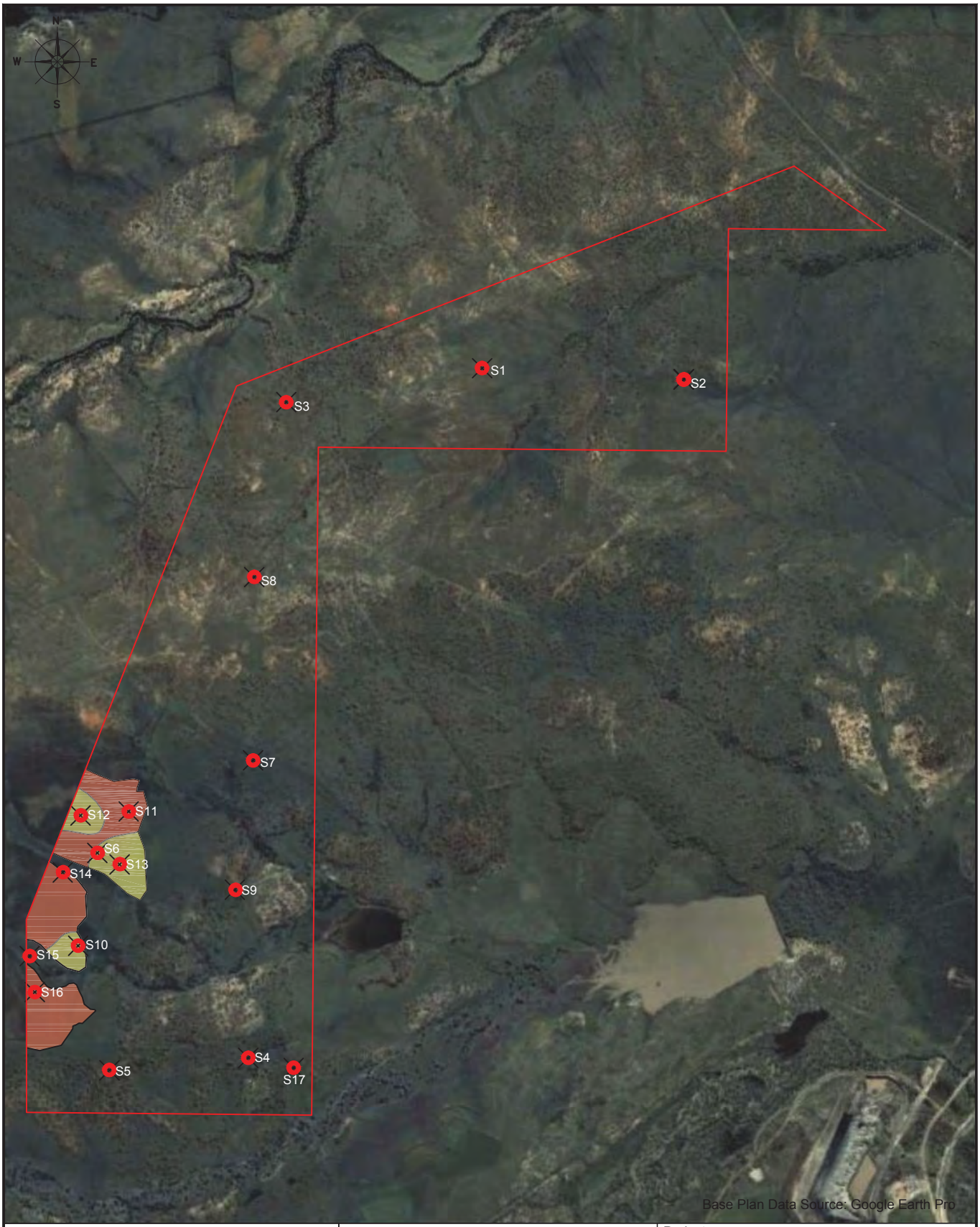

LEGEND

- Project Boundary
- Assessment Criteria - Pass
- Assessment Criteria - Fail

0 1km 2km

Scale 1:45 000

Version	Date:	Author:	Checked:	Approved:
1	22/02/2013	BS	SHS	MB

FIGURE 5.7

Strategic Cropping Land Ground Truthing

GSS ENVIRONMENTAL
Environmental, Land and Project Management Consultants

Project: Meteor Downs South Soils, Land, Overburden and Process Waste Study

Client: Endocoal Limited

File: Fg5.7_MEM08-001_SCGroundTruthing_130222

Projection: MGA 94 Zone 55

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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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Table 6-1 Growth Media Stripping Depths

Representative Soil Type			Primary Media Recommended Stripping Depth	Secondary Media Recommended Stripping Depth	Main Limitation(s)	Suitability[1]
Site #	Map Unit/ Soil Type	ASC	m	m	Description	
Oxford Land System						
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
Waterford Land System						
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

[1] 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^3 and secondary media (subsoil) at 2,469,000 m^3. When a handling loss of 10% is allowed, volumes are reduced to 614,700 m^3 and 2,222,100 m^3, primary media and secondary media respectively.

Table 6-2 Topsoil and Subsoil Volumes for Rehabilitation works

Project Component	Land unit, Soil type	Area disturbed (ha)	Estimated volume of suitable topsoil (m^3)	Estimated volume of suitable subsoil (m^3)
Infrastructure	107 Rugby	50	100,000	200,000
	108 Bruce	33	66,000	134,000
Mine Pit and Out of Pit Dump	105 Rugby	42	42,000	210,000
	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 and Tracks	107, Rugby	14	28,000	56,000
	108, Bruce	24	24,000	120,000
Total		**521**	**683,000**	**2,469,000**

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^{o} (3.5%) gradient, and gently to moderately inclined slopes length 100 m and 10^{o} (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**.

Table 6-3 Erosion Hazard Assessment

Soil Type			Area		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 undulating lowlands and plains									
1	107, Rugby	Haplic, Self-Mulching, Brown Vertosol; Slightly Gravelly, Fine, Fine, Shallow	491	30	Gently Undulating Plain	0.025	Moderate	0.026	Moderate
3		Self-Mulching, Brown Vertosol; Slightly Gravelly, Fine, Fine, Shallow			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	109, Arcturus	Haplic, Self-Mulching, Grey Vertosol; Non-Gravelly Fine, Fine, Moderate	126	8	Gently Undulating Plain	0.021	Moderate	0.020	Moderate
14		Haplic, Self-Mulching, Grey Vertosol; Non – Gravelly, Fine, Fine, Moderate			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
8	110, May Downs	Haplic, Self-Mulching, Brown Vertosol; Non-Gravelly, Fine, Fine, Deep	30	2	Gently Undulating Plain	0.027	Moderate	0.036	Moderate
Waterford Low Hills									
2	105, Rugby	Haplic, Self-Mulching, Black Vertosol; Non-Gravelly, Fine, Fine, Moderate	124	8	Gently Undulating Plain	0.020	Low	0.025	Moderate
7		Haplic, Self-Mulching, Black Vertosol; Slightly Gravelly, Fine, Fine, Shallow			Gently Undulating Plain	0.021	Moderate	0.020	Low
9		Eutrophic, Brown Dermosol; Slightly Gravelly, Fine, Fine, Shallow			Gently Undulating Plain	0.041	High	0.030	Moderate
Total			**1606**	**100**					

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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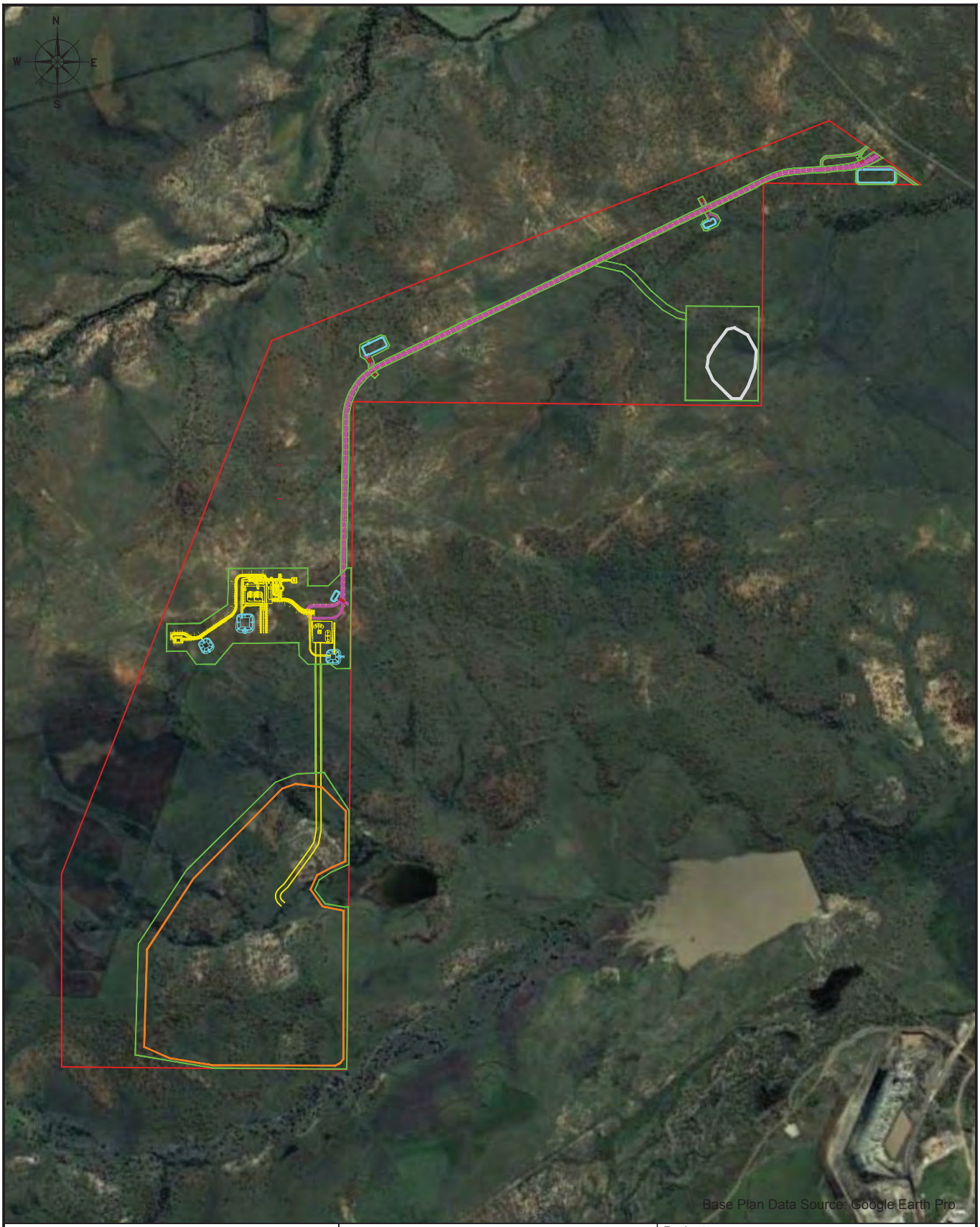
Table 6-4 Primary Media RUSLE Results

Factor	Representative Soil Types									
	1	2	3	7	8	9	10	14	12	11
R	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850
K	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
P	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
C	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
A (flats) = (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 6-5 Secondary Media RUSLE Results

Factor	Representative Soil Types									
	1	2	3	7	8	9	10	14	12	11
R	1850	1850	1850	1850	1850	1850	1850	1850	1850	1850
K	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	7.59	7.59
P	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
C	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
A (flats) = (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**



LEGEND

- Project Boundary Area
- Proposed Infrastructure
- Proposed Out of Pit Spoil Dump and Mining Area
- Proposed Quarry
- Proposed Product Haul Road
- Proposed Sediment Dams
- Disturbance Buffer

0 1km 2km

Scale 1:45 000

Version	Date:	Author:	Checked:	Approved:
2	06/03/2013	BS	SHS	MB

FIGURE 6.1

Project Disturbance Footprint

GSS ENVIRONMENTAL
Environmental, Land and Project Management Consultants

Project: Meteor Downs South Soils, Land, Overburden and Process Waste Study

Client: Endocoal Limited

File: Fg6.1_MEM08-001_ProjectDisturbanceFootprint_130306

Projection: MGA 94 Zone 55

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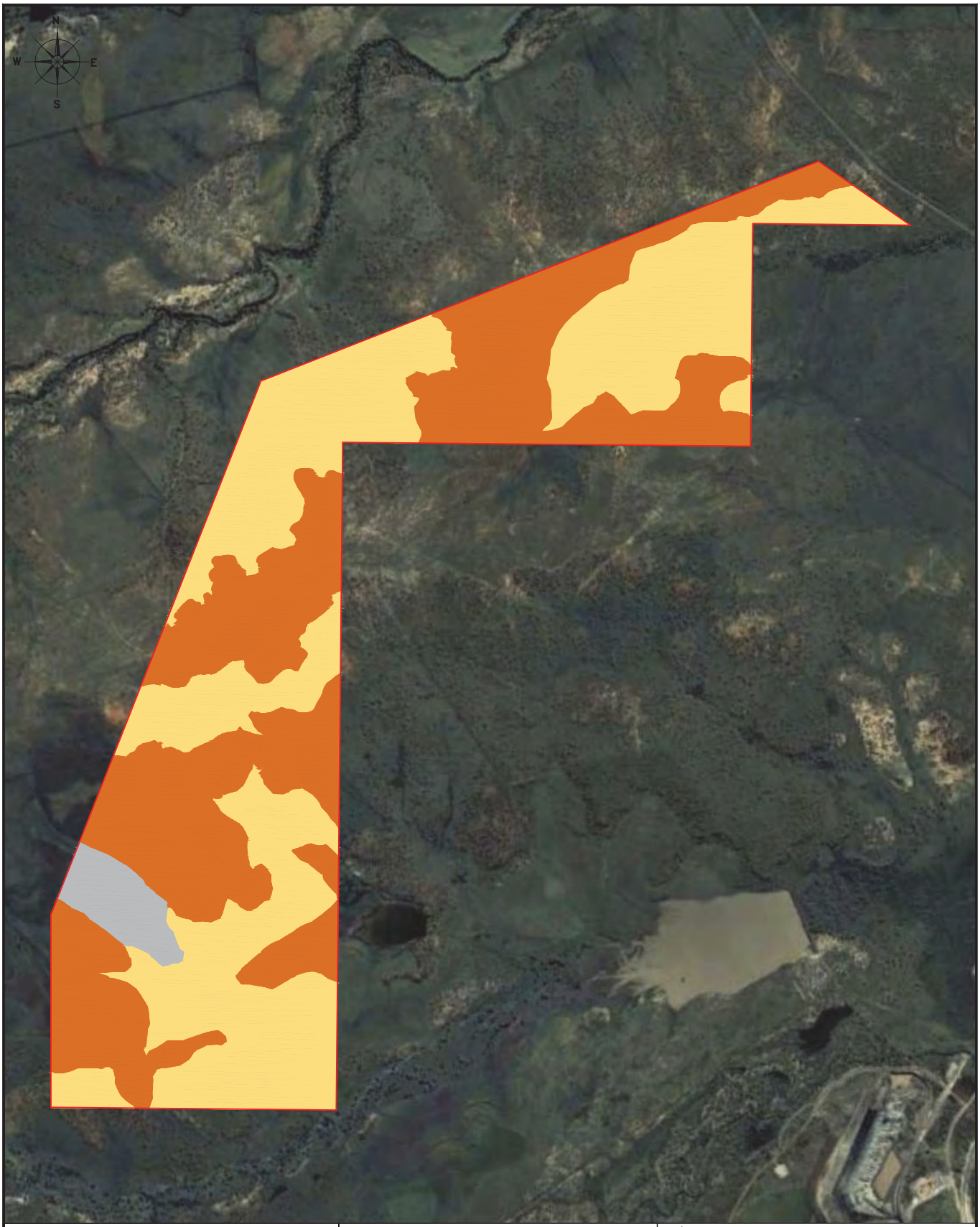

LEGEND

Project Boundary Area

Soil Stripping Depths

Soil Stripping Depth - 0.00 - 0.10

Soil Stripping Depth - 0.00 - 0.15

Soil Stripping Depth - 0.00 - 0.20

0 1km 2km

Scale 1:45 000

Version	Date:	Author:	Checked:	Approved:
1	21/02/2013	BS	SHS	MB

FIGURE 6.2

Primary Media
Recommended Stripping depth

GSS ENVIRONMENTAL
Environmental, Land and Project Management Consultants

Project: Meteor Downs South Soils, Land, Overburden and Process Waste Study

Client: Endocoal Limited

File: Fg6.2_MEM08-001_PrimaryMediaRecStrippingDepth_Infra_130221

Projection: MGA 94 Zone 55

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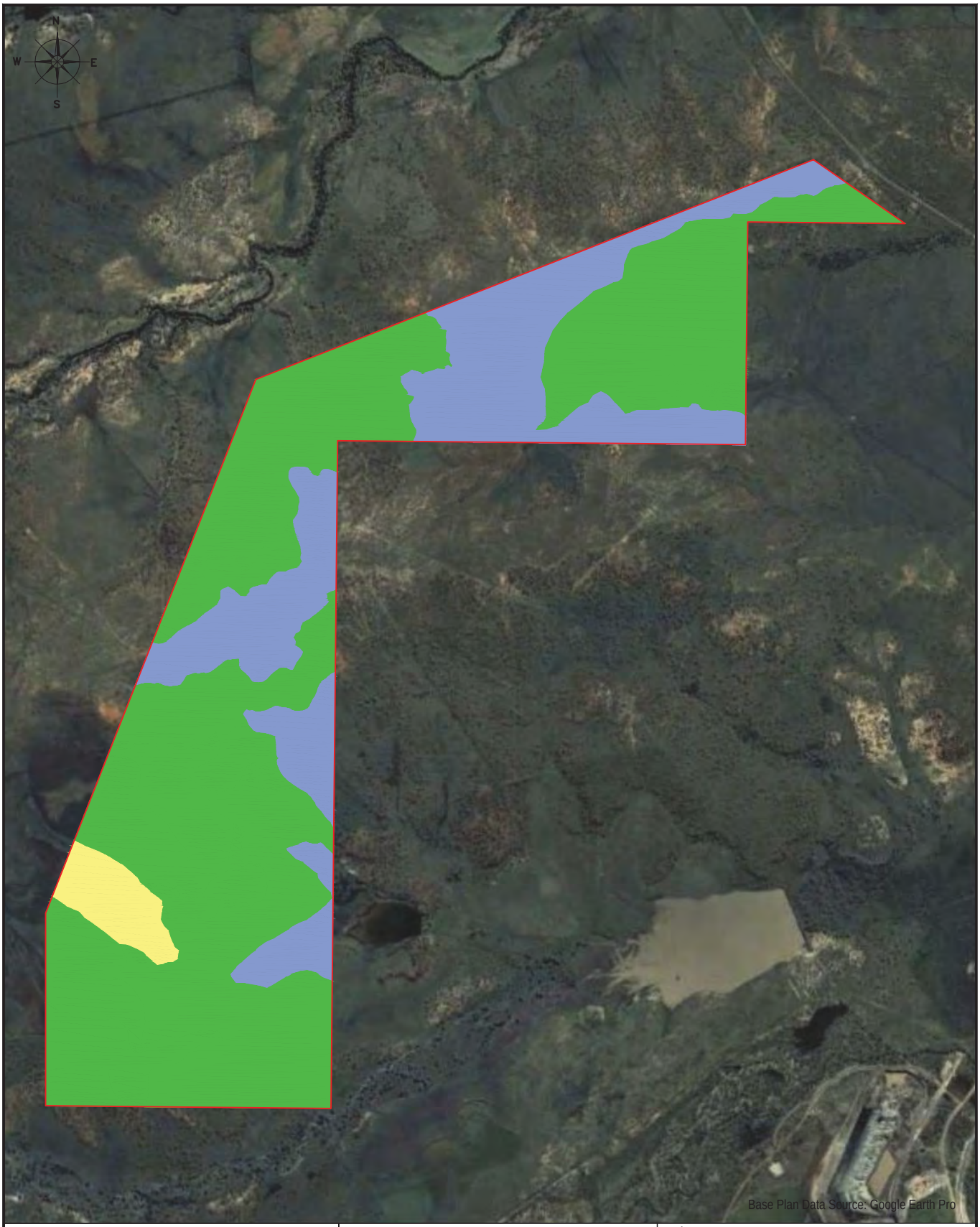

LEGEND

Project Boundary Area

Soil Stripping Depths

Soil Stripping Depth - 0.10 - 0.60

Soil Stripping Depth - 0.20 - 0.60

Soil Stripping Depth - 0.15 - 0.80

0 1km 2km

Scale 1:45 000

Version	Date:	Author:	Checked:	Approved:
1	21/02/2013	BS	SHS	MB

FIGURE 6.3

Secondary Media
Recommended Stripping Depth

GSS ENVIRONMENTAL
Environmental, Land and Project Management Consultants

Project: Meteor Downs South Soils, Land, Overburden and Process Waste Study

Client: Endocoal Limited

File: Fg6.3_MEM08-001_SecondaryMediaRecStrippingDepth_130221

Projection: MGA 94 Zone 55

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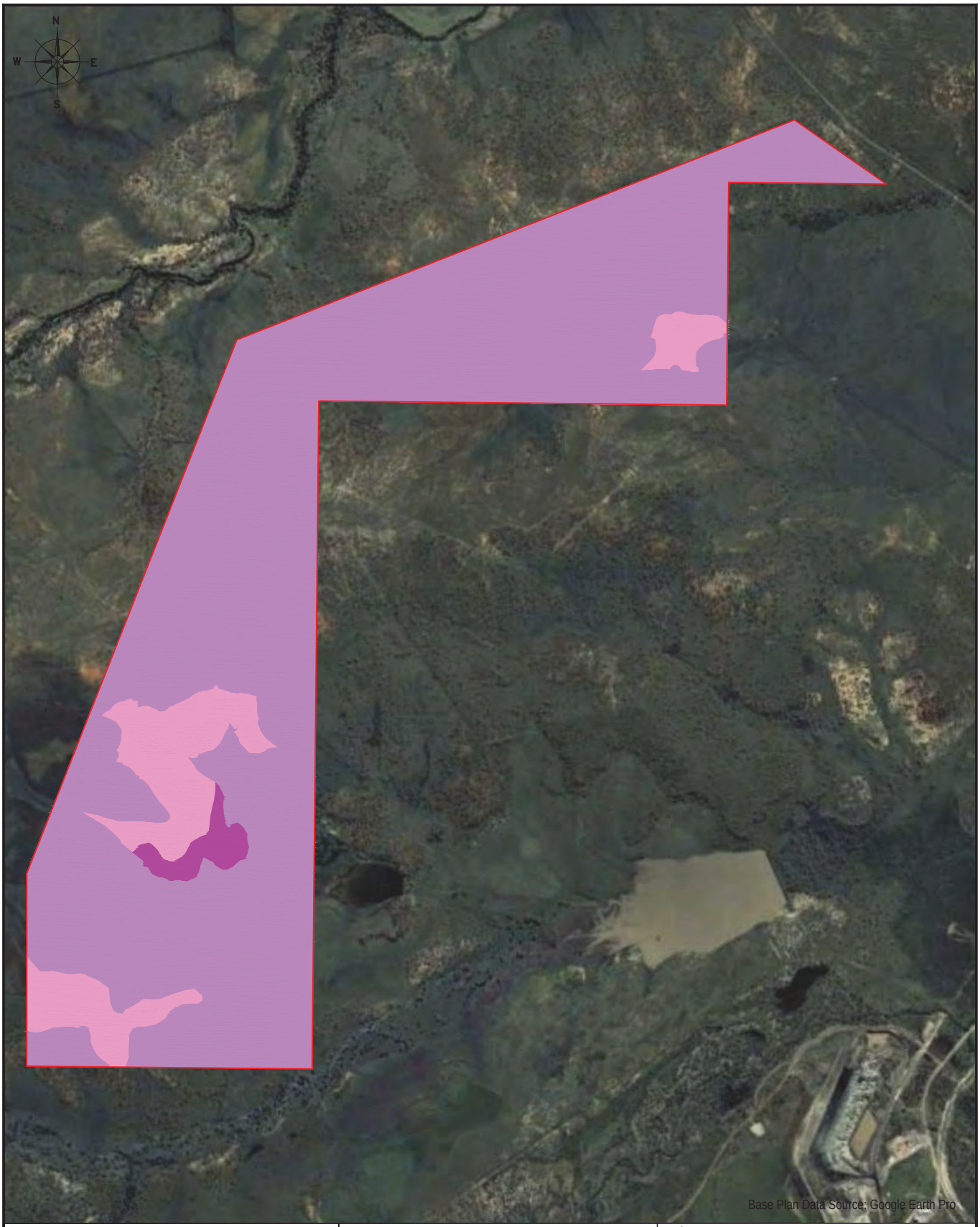

LEGEND

Project Boundary Area

Erosion Hazards

Low

Moderate

High

0 1km 2km

Scale 1:45 000

Version	Date:	Author:	Checked:	Approved:
1	21/02/2013	BS	SHS	MB

FIGURE 6.4

Primary Media
Erosion Hazard Map

GSS ENVIRONMENTAL
Environmental, Land and Project Management Consultants

Project: Meteor Downs South Soils, Land, Overburden and Process Waste Study

Client: Endocoal Limited

File: Fg6.4_MEM08-001_PrimaryMediaErosionHazrdMap_130221

MGA 94 Zone 55

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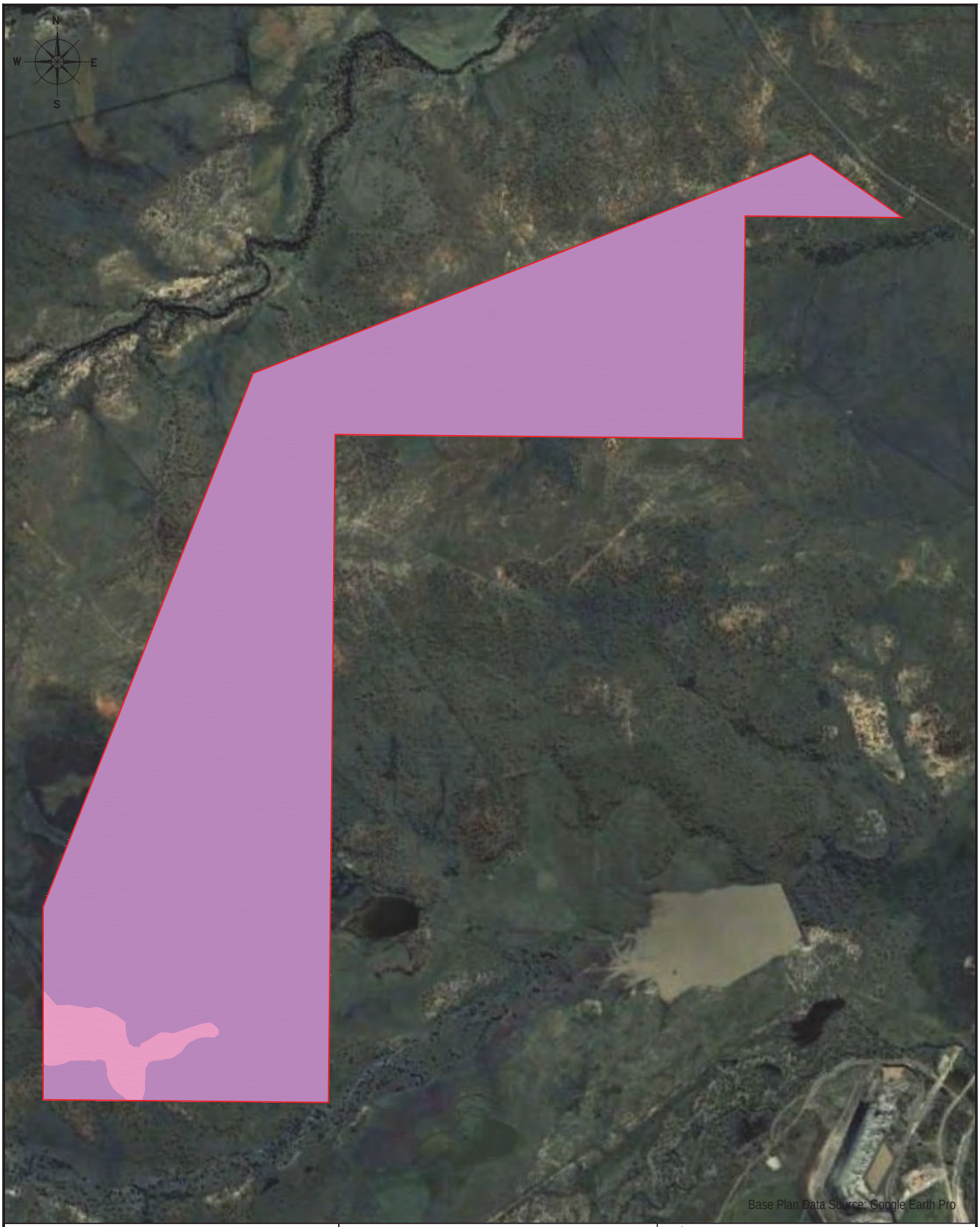

LEGEND

Project Boundary Area

Erosion Hazards

Low

Moderate

0 1km 2km

Scale 1:45 000

Version	Date:	Author:	Checked:	Approved:
1	21/02/2013	BS	SHS	MB

FIGURE 6.5

Secondary Media
Erosion Hazard Map

GSS ENVIRONMENTAL
Environmental, Land and Project Management Consultants

Project: Meteor Downs South Soils, Land, Overburden and Process Waste Study

Client: Endocoal Limited

File: Fg6.5_MEM08-001_SecondaryMediaErosionHazrdMap_130221

Projection: MGA 94 Zone 55

To be printed A4

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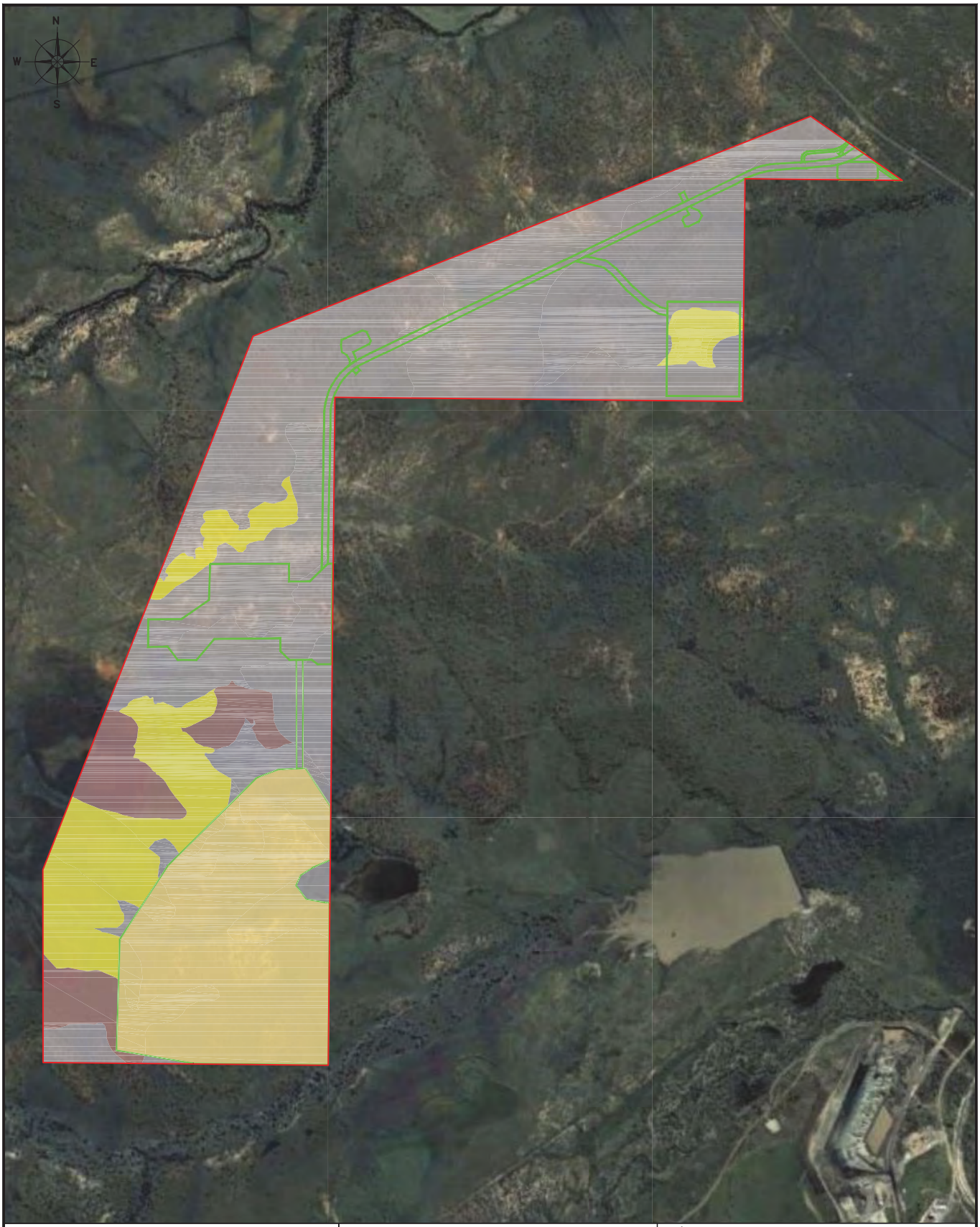

LEGEND

- Project Boundary Area
- Disturbance Buffer
- Class B
- Class C1
- Class C2
- Class D

0 1km 2km

Scale 1:45 000

Version	Date:	Author:	Checked:	Approved:
1	06/03/2013	BS	SHS	MB

FIGURE 6.6

Proposed Post Development
Agricultural Land Classes

GSS ENVIRONMENTAL
Environmental, Land and Project Management Consultants

Project: Meteor Downs South Soils, Land, Overburden and Process Waste Study

Client: Endocoal Limited

File: Fg6.6_MEM08-001_PostDevAgLandClasses_130306

Projection: MGA 94 Zone 55

To be printed A4

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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.

Table 7-1 Comparison of Trigger Maps to Survey Findings

Area	Ha	%
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

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.

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

	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

(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 co-disposed 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.

Table 7-3 Proposed Success Criteria for Erosion

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^2 in area or >10 m in length down slope.

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**.

Table 7-4 Proposed Success Criteria for Land Stability

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 *Strategic Cropping Land Act* 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

Soil Site Sampling Location Number Conversion Table

Field site number. as per ALS Laboratory Certificate of Analysis	Equivalent site number used in this report.
001	S1
002	S2
004	S3
006	S4
007	S5
008	S6
009	S7
011	S8
012	S9
014	S10
034	S11
035	S12
036	S13
037	S14
038	S15
040	S16
041	S17

Environmental Division

CERTIFICATE OF ANALYSIS

Work Order	: **EB1213989**	Page	: 1 of 24
Client	: **GSS ENVIRONMENTAL**	Laboratory	: Environmental Division Brisbane
Contact	: MR SCOTT HAYES-STANLEY	Contact	: Customer Services
Address	: LEVEL 1, 241 DENISON ST BROADMEADOW NSW, AUSTRALIA 2292	Address	: 32 Shand Street Stafford QLD Australia 4053
E-mail	: hayes_stanley@gssenvironmental.com	E-mail	: Brisbane.Enviro.Services@alsglobal.com
Telephone	: +61 02 4920 3000	Telephone	: +61 7 3243 7222
Facsimile	: +61 02 4961 3360	Facsimile	: +61 7 3243 7218
Project	: MEM08-001	QC Level	: NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Order number	: ----		
C-O-C number	: ----	Date Samples Received	: 25-MAY-2012
Sampler	: Scott Hayes-Stanley	Issue Date	: 15-JUN-2012
Site	: ----		
		No. of samples received	: 95
Quote number	: BN/355/12	No. of samples analysed	: 67

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 approved for release.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

NATA Accredited Laboratory 825

Accredited for compliance with ISO/IEC 17025.

Signatories

This document has been electronically signed by the authorized signatories indicated below. Electronic signing has been carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Kim McCabe	Senior Inorganic Chemist	Brisbane Inorganics
Stephen Hislop	Senior Inorganic Chemist	Brisbane Inorganics
Stephen Hislop	Senior Inorganic Chemist	Stafford Minerals - AY

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.

Key : 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
^ = 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.**

Analytical Results

Sub-Matrix: SOIL				Client 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
				Client sampling date / time	23-MAY-2012 15:00	23-MAY-2012 15:00	23-MAY-2012 15:00	23-MAY-2012 15:00	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	----	1	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	----	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 Analyser									
Nitrite + Nitrate as N (Sol.)	----	0.1	mg/kg		0.6	----	----	----	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser									

Analytical Results

Sub-Matrix: SOIL				Client 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
				Client sampling date / time	23-MAY-2012 15:00	23-MAY-2012 15:00	23-MAY-2012 15:00	23-MAY-2012 15:00	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	----	----	----	----

Analytical Results

Sub-Matrix: SOIL			Client 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 date / time	23-MAY-2012 15:00	23-MAY-2012 15:00	23-MAY-2012 15:00	23-MAY-2012 15:00	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	----	0.1	meq/100g	----	52.9	46.2	----	----
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	----	----	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	----	----	<2	----	----
Zinc	7440-66-6	5	mg/kg	----	----	27	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N (Sol.)	----	0.1	mg/kg	----	----	0.6	----	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								

Analytical Results

Sub-Matrix: SOIL				Client 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 date / time	23-MAY-2012 15:00	23-MAY-2012 15:00	23-MAY-2012 15:00	23-MAY-2012 15:00	23-MAY-2012 15:00
Compound	CAS Number	LOR	Unit		EB1213989-006	EB1213989-007	EB1213989-011	EB1213989-012	EB1213989-013
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser - Continued									
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	----	2	mg/kg		----	**750**	**232**	----	----
EP003: Total Organic Carbon (TOC) in Soil									
Total Organic Carbon	----	0.02	%		----	----	**1.60**	----	----

Analytical Results

Sub-Matrix: **SOIL**

Compound	CAS Number	LOR	Unit	Client 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
				Client sampling date / time: 23-MAY-2012 15:00	23-MAY-2012 15:00	23-MAY-2012 15:00	23-MAY-2012 15:00	23-MAY-2012 15:00
				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	----	1	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 Discrete Analyser								
Total Phosphorus as P	----	2	mg/kg	182	----	----	185	----

Analytical Results

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 sampling date / time	23-MAY-2012 15:00	23-MAY-2012 15:00	23-MAY-2012 15:00	23-MAY-2012 15:00	23-MAY-2012 15:00
Compound	CAS Number	LOR	Unit	EB1213989-019	EB1213989-020	EB1213989-025	EB1213989-026	EB1213989-027
EA002 : pH (Soils)								
pH Value	----	0.1	pH Unit	8.6	8.7	7.0	7.4	7.4
EA010: Conductivity								
Electrical Conductivity @ 25°C	----	1	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	meq/100g	----	0.7	1.6	----	1.9
ED007: Exchangeable Cations								
Exchangeable Calcium	----	0.1	meq/100g	----	41.7	27.7	----	31.5
Exchangeable Magnesium	----	0.1	meq/100g	----	22.3	14.7	----	15.9
Exchangeable Potassium	----	0.1	meq/100g	----	<0.1	0.3	----	0.2
Exchangeable Sodium	----	0.1	meq/100g	----	1.4	0.1	----	0.2
Cation Exchange Capacity	----	0.1	meq/100g	----	65.4	42.8	----	47.9
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	----	----	340	----	----
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	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	----	----
Copper	7440-50-8	5	mg/kg	----	----	45	----	----
Iron	7439-89-6	50	mg/kg	----	----	47200	----	----
Manganese	7439-96-5	5	mg/kg	----	----	1000	----	----
Molybdenum	7439-98-7	2	mg/kg	----	----	<2	----	----
Zinc	7440-66-6	5	mg/kg	----	----	38	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N (Sol.)	----	0.1	mg/kg	----	----	0.7	----	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								

Analytical Results

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 sampling date / time	23-MAY-2012 15:00	23-MAY-2012 15:00	23-MAY-2012 15:00	23-MAY-2012 15:00	23-MAY-2012 15:00
Compound	CAS Number	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	----	----

Analytical Results

Sub-Matrix: SOIL				Client 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
				Client sampling date / time	23-MAY-2012 15:00	23-MAY-2012 15:00	23-MAY-2012 15:00	23-MAY-2012 15:00	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	----	1	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 (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	5	mg/kg		----	----	----	----	26
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser									
Nitrite + Nitrate as N (Sol.)	----	0.1	mg/kg		----	----	----	----	0.1
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser									

Analytical Results

Sub-Matrix: **SOIL**

Compound	CAS Number	LOR	Unit	Client 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
				Client sampling date / time: 23-MAY-2012 15:00	23-MAY-2012 15:00	23-MAY-2012 15:00	23-MAY-2012 15:00	23-MAY-2012 15:00
				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

Analytical Results

Sub-Matrix: **SOIL**

Compound	CAS Number	LOR	Unit	Client 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
				Client sampling date / time: 23-MAY-2012 15:00	23-MAY-2012 15:00	23-MAY-2012 15:00	23-MAY-2012 15:00	23-MAY-2012 15:00
				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	----	1	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	----	0.9	----	----	----
ED007: Exchangeable Cations								
Exchangeable Calcium	----	0.1	meq/100g	----	21.2	----	----	----
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	----	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 Discrete Analyser								
Total Phosphorus as P	----	2	mg/kg	----	207	----	----	----

Analytical Results

Sub-Matrix: **SOIL**

Compound	CAS Number	LOR	Unit	Client 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
				Client sampling date / time: 23-MAY-2012 15:00	23-MAY-2012 15:00	23-MAY-2012 15:00	23-MAY-2012 15:00	23-MAY-2012 15:00
				EB1213989-042	EB1213989-043	EB1213989-044	EB1213989-045	EB1213989-046
EA002 : pH (Soils)								
pH Value	----	0.1	pH Unit	8.4	8.3	8.6	8.6	8.7
EA010: Conductivity								
Electrical Conductivity @ 25°C	----	1	µS/cm	97	81	112	211	161
EA055: Moisture Content								
Moisture Content (dried @ 103°C)	----	1.0	%	15.7	16.2	18.7	19.1	20.4
ED002: Exchangeable Soil Acids								
Exchangeable Soil Acids	----	0.1	meq/100g	0.8	----	----	----	0.5
ED007: 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
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 Discrete Analyser								
Total Phosphorus as P	----	2	mg/kg	160	----	----	----	265

Analytical Results

Sub-Matrix: **SOIL**

Compound	CAS Number	LOR	Unit	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 sampling date / time: 23-MAY-2012 15:00	23-MAY-2012 15:00	23-MAY-2012 15:00	23-MAY-2012 15:00	23-MAY-2012 15:00
				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	----	1	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 (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 Analyser								
Nitrite + Nitrate as N (Sol.)	----	0.1	mg/kg	----	----	----	----	0.3
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								

Analytical Results

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 sampling date / time	23-MAY-2012 15:00	23-MAY-2012 15:00	23-MAY-2012 15:00	23-MAY-2012 15:00	23-MAY-2012 15:00
Compound	CAS Number	LOR	Unit		EB1213989-047	EB1213989-048	EB1213989-049	EB1213989-050	EB1213989-055
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser - Continued									
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

Analytical Results

Sub-Matrix: **SOIL**

Compound	CAS Number	LOR	Unit	Client 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
				Client sampling date / time: 23-MAY-2012 15:00	23-MAY-2012 15:00	23-MAY-2012 15:00	23-MAY-2012 15:00	23-MAY-2012 15:00
				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	----	1	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 Discrete Analyser								
Total Phosphorus as P	----	2	mg/kg	----	----	1490	----	----

Analytical Results

Sub-Matrix: SOIL				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 sampling date / time	23-MAY-2012 15:00	23-MAY-2012 15:00	23-MAY-2012 15:00	23-MAY-2012 15:00	23-MAY-2012 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	----	1	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 (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	5	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	5	mg/kg		----	60	----	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser									
Nitrite + Nitrate as N (Sol.)	----	0.1	mg/kg		----	2.7	----	----	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser									

Analytical Results

Sub-Matrix: **SOIL**

Compound	CAS Number	LOR	Unit	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 sampling date / time: 23-MAY-2012 15:00	23-MAY-2012 15:00	23-MAY-2012 15:00	23-MAY-2012 15:00	23-MAY-2012 15:00
				EB1213989-061	EB1213989-065	EB1213989-066	EB1213989-067	EB1213989-068
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser - Continued								
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	----	----	----

Analytical Results

Sub-Matrix: SOIL				Client 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
				Client sampling date / time	23-MAY-2012 15:00	23-MAY-2012 15:00	23-MAY-2012 15:00	23-MAY-2012 15:00	23-MAY-2012 15:00
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	----	1	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	----	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 (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		----	----	<2	----	----
Zinc	7440-66-6	5	mg/kg		----	----	78	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser									
Nitrite + Nitrate as N (Sol.)	----	0.1	mg/kg		----	----	0.3	----	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser									

Analytical Results

Sub-Matrix: SOIL				Client 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
				Client sampling date / time	23-MAY-2012 15:00	23-MAY-2012 15:00	23-MAY-2012 15:00	23-MAY-2012 15:00	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)									
^ Total Nitrogen as N	----	20	mg/kg		----	----	2210	----	----
EK067G: Total Phosphorus as P by Discrete Analyser									
Total Phosphorus as P	----	2	mg/kg		----	537	1460	----	976
EP003: Total Organic Carbon (TOC) in Soil									
Total Organic Carbon	----	0.02	%		----	----	2.72	----	----

Analytical Results

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 sampling date / time	23-MAY-2012 15:00	23-MAY-2012 15:00	23-MAY-2012 15:00	23-MAY-2012 15:00	23-MAY-2012 15:00
Compound	CAS 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	----	1	µS/cm		40	38	21	58	15
EA055: Moisture Content									
Moisture Content (dried @ 103°C)	----	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	----	0.1	meq/100g		----	----	30.2	27.0	----
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		----	----	----	370	----
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		----	----	----	15000	----
Boron	7440-42-8	50	mg/kg		----	----	----	<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		----	----	----	<2	----
Zinc	7440-66-6	5	mg/kg		----	----	----	33	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser									
Nitrite + Nitrate as N (Sol.)	----	0.1	mg/kg		----	----	----	1.1	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser									

Analytical Results

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 sampling date / time	23-MAY-2012 15:00	23-MAY-2012 15:00	23-MAY-2012 15:00	23-MAY-2012 15:00	23-MAY-2012 15:00
Compound	CAS Number	LOR	Unit		EB1213989-078	EB1213989-079	EB1213989-080	EB1213989-084	EB1213989-085
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser - Continued									
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	----	2	mg/kg		----	----	698	469	----
EP003: Total Organic Carbon (TOC) in Soil									
Total Organic Carbon	----	0.02	%		----	----	----	1.38	----

Analytical Results

Sub-Matrix: **SOIL**

Compound	CAS Number	LOR	Unit	Client 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
				Client sampling date / time: 23-MAY-2012 15:00	23-MAY-2012 15:00	23-MAY-2012 15:00	23-MAY-2012 15:00	23-MAY-2012 15:00
				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	----	1	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**	----	----	----
Cation Exchange Capacity	----	0.1	meq/100g	----	**28.8**	----	----	----
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 Discrete Analyser								
Total Phosphorus as P	----	2	mg/kg	----	**215**	----	----	----

Analytical Results

Sub-Matrix: SOIL			Client sample ID	C-004 - 0.7-0.8	C-004 - 0.8-0.9	----	----	----
			Client sampling 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	----	1	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 Discrete Analyser								
Total Phosphorus as P	----	2	mg/kg	267	----	----	----	----

NSW GOVERNMENT Soil Conservation Service

Experienced people protecting your resources

709 Gundy Road, Scone NSW 2337
PO Box 283, Scone NSW 2337
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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 analysis-mechanical 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

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.

NSW GOVERNMENT Soil Conservation Service

SOIL TEST REPORT

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

SR Young
(Laboratory Manager)

Scone Research Centre, PO Box 283 Scone 2337, 709 Gundy Road Scone 2337
Ph: 02 6545 1666, Fax: 02 6545 2520

SOIL CONSERVATION SERVICE
Scone Research Service Centre

Report No: SCO12/174R1 (Preliminary)
Client Reference: Australian Laboratory Services
32 Shand Street
Stafford Qld 4053

	Method	P7B/2 Particle Size Analysis (%)					P7C/2 Particle Size Analysis – mech dis (%)					P9B/2	C6A/2	Colour	
	Sample Id	clay	silt	f sand	c sand	gravel	clay	silt	f sand	c sand	gravel	EAT	OC (%)	Dry	Moist
1	8	75	17	6	2	0	51	20	16	13	0	5	1.44	10YR2/2	1OYR2/1
2	9	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	0.60	10YR4/2	10YR3/2
8	32	50	14	17	19	<1	34	20	21	25	<1	5	1.71	10YR3/2	10YR3/2
9	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	9	18	22	51	0	4	0.22	10YR6/3	10YR4/4
12	51	41	11	28	20	<1	28	14	29	29	<1	5	1.37	10YR3/2	10YR3/2
13	52	43	12	25	20	<1	23	15	35	27	<1	5	0.69	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

SOIL CONSERVATION SERVICE
Scone Research Service Centre

Report No: SCO12/174R1 (Preliminary)
Client Reference: Australian Laboratory Services
32 Shand Street
Stafford Qld 4053

Lab No	Method	P7B/2 Particle Size Analysis (%)					P7C/2 Particle Size Analysis – mech dis (%)					P9B/2	C6A/2	Colour	
	Sample Id	clay	silt	f sand	c sand	gravel	clay	silt	f sand	c sand	gravel	EAT	OC (%)	Dry	Moist
16	62	67	22	9	2	0	44	22	17	17	0	5	2.03	10YR4/2	10YR3/2
17	63	65	18	13	4	<1	42	18	20	20	<1	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	6	3	42	14	22	19	3	5	1.22	10YR3/1	10YR2/1
21	73	65	12	9	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)	0.97	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

Environmental Division

CERTIFICATE OF ANALYSIS

Work Order	: **EB1214004**	PFgs	: 1eofe13
yaSi b	: **GSS ENVIRONMENTAL**	4FLorFbort	: Ei nCoi v si bFamCCoi eBrCLFi s
y oi bFDo	: c MeRy STTeOHAERYRTH- 4EA	y oi bFDo	: y ul bov sreRsrnCsl
HNNrsl l	: 4EdE4e1Ve231emE- ,RS- eRT BMSHmc EHmSI e RI VeHWRTMH4,He22U2	HNNrsl l	: 2eRhFi NeRbrssbeRbFfforNeQ4meHul brFaEe890
EYv FCa	: hFt sl 5l bFi ast_ gl l si nCoi v si bFaCov	EYv FCa	: BrCLFi s@i nCo@srnCsl _ FalgaoLFa@ov
Tsas. hoi s	: p+1e92e3U29e 999	Tsas. hoi s	: p+1e6e 23 e6222
8FDl v Cas	: p+1e92e3U+1e +9	8FDl v Cas	: p+1e6e 23 e6217
ProjsDo	: c Ec 97Y991	Qye4snsa	: - EPc e1UUUaeRDhsNuaseB( )eFi NeH4ReQy R ersquCsv si b
SrNsre uv Lsr	: YYYY		
y YS Yy e uv Lsr	: YYYY	mFbseRFv . asl eMsDsCsN	: 20Yc HAY2912
RFv . asr	: RDobbeOFt sl YRbFi ast	,l l usemFbs	: 1 YJW- Y2912
RCbs	: YYYY		
		- o@fe Fv . asl ersDsCsN	: U9
Quobse uv Lsr	: B- / 00/12	- o@fe Fv . asl eFi Fal sN	: 7

ThCe rs. orbe l u. srl sNsl e Fi t e . rsnCul e rs. orb(l)e wCbe bhCe rsfsrsi Ds@MsI uabl e F. . ale boe bhse l Fv . as(l)e Fl e l uLv CbsN@Hae . Fgsl e ofe bhCe rs. orbe hFnse Lssi e DhsDksNe Fi Ne F. . ronsNe for rsasFl s@

ThCey srbCCFbse ofe Hi Fal CeDoi bFCl ebhse foaabwCgeCforv FbCoi :

- Gsi srFayov v si b
- Hi FalbCCFaMsl uab

- HTHeHDDrsNCbsNe4FLorFbort e720 e HDDrsNCbsNefore Dov . aCFi Dsewbhe ,RS/,Eye16920@

Signatories

ThCe NoDuv si be hFl e Lssi e sas Dbroi CCFaal e l Cgi sNe Lt e bhse Fulhor@sNe l Cgi FborGl e CNCCFbsNe Lsaow@ EasDbroi CDe l Cgi Cge hFl e Lssi DFrrGsNeaubaCeDov . aCFi Dsewbhe roDsNursl e . sDCGsNaCe21ey 8MePFrbe11@

Signatories	*Position*	*Accreditation Category*
KVec Dy FLs	Rsi Cre orgFi CDay hsv Cb	BrCLFi se orgFi CCl
Rbs. hsi eOCao.	Rsi Cre orgFi CDay hsv Cb	BrCLFi se orgFi CCl
Rbs. hsi eOCao.	Rsi Cre orgFi CDay hsv Cb	RbFfforNac CsrFaleYeHA

PFgs	:	2eofe13
I orkeSrNsr	:	EB1213993
y aGi b	:	GRReE- d,MS- c E- TH4
ProjsDb	:	c Ec 97Y991

General Comments

Thse Fi FalbCFae . roDsNursI e ul sNe Lt e bhse Ei nCoi v si bFae mCCoi e hFnse Lssi e Nsnsao. sNe frov e sI bFLaChsNe CbsriFbCoi Fal e rsDogi CzsNe . roDsNursI e I uDhe Fl e bhol se . uLaChsNe Lt e bhse WREPHVé HPOHVé HRe Fi Ne - EPc @,i e houl s Nsnsao. sNe roDsNursI eFrsesv . aot sNaCehse FLI si DseofeNoDuv si bsNe bFi NFrN eoreLt eDaGi barsqusI b@

I hsrsev oCburseNsbsrv CFbCoi ehFl eLssi e srforv sNvérsI uabeFrsers. orbsNaoi eFeNrt evsGhbaLFl C@

I hsrseFers. orbsNaasI l ehFi e(<)ersI uabaCehGhsrehFi ehse4SMvehCev Fte LseNusebe rC Frt e Fv . ase xbrFDbNGsI bFbseNaubCoi eFi NoreCI uffCCGi bal Fv . aseforeFi FaI C@

I hsrsehbse4SMeofeFers. orbsNersI uabeNCfsrI efrov e bFi NFrNs4SMvehCev Fte LseNusebeehGhev oCburseDoi bsi bvCI uffCCGi bal Fv . ase(rsNuDsNevsGhbasv . aot sN)eorev FbrQeCbsrfsrsi Ds@

I hsi e Fv . aCgeaC seCforv FbCoi eCe obe ronCbsNaLt ehse DaGi bal Fv . aCgeNFbsI e Frse howi evCbhoubeFeC seDov . oi si b@i ehsI seCI bFi DsI Vehse C seDov . oi si behFl eLssi eFI uv sNaLt ehse FLorFbrt efore roDsI I Cge ur. ol sI @

Kst e y HRe uv Lsre=ey HRersgCbrt ei uv Lsrefrov eNFbFLFI sev FCbFCsNaLt ey hsv CFaeHLI brFDbeRsrnCbsI @Thse y hsv CFaeHLI brFDbeRsrnCbseCeFeNCCoi eofehse Hv srCFi ey hsv CFaeRoDsbI @
4SMe=e4C Cbefers. orbCg
^e=eThCersI uabeCeDov . ubsNefrov eCNCCbuFaeFi FalbseNsbsDbCoi leFbeoreFLonsehse asnsaofers. orbCg

- **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.**

PFgs : œofe13
I orkeSrNsr : EB1213993
y aSi b : GRReE- d,MS- c E- TH4
ProjsDb : c Ec 97Y991

Analytical Results

RuLYc FbrQ: **SOIL**

Compound	CAS Number	LOR	Unit	Client 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
				Client sampling date / time: 22Yc HAY2912e10:99	22Yc HAY2912e10:99	22Yc HAY2912e10:99	22Yc HAY2912e10:99	22Yc HAY2912e10:99
				EB1214004-015	EB1214004-016	EB1214004-017	EB1214004-018	EB1214004-019
EA002 : pH (Soils)								
pH Value	YYYY	9@	. OeWl ©	7.4	7.4	7.8	8.0	8.1
EA010: Conductivity								
Electrical Conductivity @ 25°C	YYYY	1	µR/Dv	46	27	33	29	59
EA055: Moisture Content								
Moisture Content (dried @ 103°C)	YYYY	1@	%	30.6	30.6	29.4	29.1	28.8
ED002: Exchangeable Soil Acids								
Exchangeable Soil Acids	YYYY	9@	v sq/199g	1.6	YYYY	YYYY	1.5	YYYY
ED007: Exchangeable Cations								
Exchangeable Calcium	YYYY	9@	v sq/199g	59.7	YYYY	YYYY	65.4	YYYY
Exchangeable Magnesium	YYYY	9@	v sq/199g	12.0	YYYY	YYYY	10.8	YYYY
Exchangeable Potassium	YYYY	9@	v sq/199g	0.7	YYYY	YYYY	0.2	YYYY
Exchangeable Sodium	YYYY	9@	v sq/199g	0.2	YYYY	YYYY	0.4	YYYY
Cation Exchange Capacity	YYYY	9@	v sq/199g	72.6	YYYY	YYYY	76.8	YYYY
ED021: Bicarbonate Extractable Potassium (Colwell)								
Bicarbonate Extractable K (Colwell)	YYYY	19	v g/kg	200	YYYY	YYYY	YYYY	YYYY
ED040: Sulfur as SO4 2-								
Sulfate as SO4 2-	13797Y6UY7	199	v g/kg	270	YYYY	YYYY	YYYY	YYYY
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	YYYY	9@1	%	<9@1	YYYY	YYYY	<9@1	YYYY
ED045G: Chloride Discrete analyser								
Chloride	1+776Y99Y+	19	v g/kg	20	<19	<19	<19	<19
ED093S: Soluble Major Cations								
Potassium	6339Y9UY6	19	v g/kg	<19	YYYY	YYYY	<19	YYYY
EG005T: Total Metals by ICP-AES								
Aluminium	632UYU9Y0	09	v g/kg	32700	YYYY	YYYY	YYYY	YYYY
Boron	6339Y32Y7	09	v g/kg	<09	YYYY	YYYY	YYYY	YYYY
Copper	6339Y09Y7	0	v g/kg	44	YYYY	YYYY	YYYY	YYYY
Iron	63 UY7UY+	09	v g/kg	46400	YYYY	YYYY	YYYY	YYYY
Manganese	63 UYU+Y0	0	v g/kg	1740	YYYY	YYYY	YYYY	YYYY
Molybdenum	63 UYU7Y6	2	v g/kg	<2	YYYY	YYYY	YYYY	YYYY
Zinc	6339Y++Y+	0	v g/kg	49	YYYY	YYYY	YYYY	YYYY
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N (Sol.)	YYYY	9@	v g/kg	5.5	YYYY	YYYY	YYYY	YYYY
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								

PFgs : 3eofe13
I orkeSrNsr : EB1213993
y aSi b : GRReE- d,MS- c E- TH4
ProjsDb : c Ec 97Y991

Analytical Results

RuLYc FbrQ: SOIL	Client 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
	Client sampling date / time	22Yc HAY2912el0:99	22Yc HAY2912el0:99	22Yc HAY2912el0:99	22Yc HAY2912el0:99	22Yc HAY2912el0:99
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 YYYY	29 v g/kg	1420	YYYY	YYYY	YYYY	YYYY
EK062: Total Nitrogen as N (TKN + NOx)						
^eTotal Nitrogen as N YYYY	29 v g/kg	1420	YYYY	YYYY	YYYY	YYYY
EK067G: Total Phosphorus as P by Discrete Analyser						
Total Phosphorus as P YYYY	2 v g/kg	483	YYYY	YYYY	335	YYYY
EP003: Total Organic Carbon (TOC) in Soil						
Total Organic Carbon YYYY	9@92 %	1.77	YYYY	YYYY	YYYY	YYYY

PFgs : 0œofe13
I orkeSrNsr : EB1213993
y aSi b : GRReE- d,MS- c E- TH4
ProjsDb : c Ec 97Y991

Analytical Results

RuLYc FbrQ: **SOIL**

	Client 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
	Client sampling date / time	22Yc HAY2912el0:99	22Yc HAY2912el0:99	22Yc HAY2912el0:99	22Yc HAY2912el0:99	22Yc HAY2912el0:99
Compound *CAS Number* *LOR* *Unit*		EB1214004-020	EB1214004-021	EB1214004-022	EB1214004-023	EB1214004-024
EA002 : pH (Soils)						
pH Value YYYY 9@ . OèWl Œ		8.2	8.3	8.4	8.6	8.6
EA010: Conductivity						
Electrical Conductivity @ 25°C YYYY 1 µR/Dv		76	128	140	105	107
EA055: Moisture Content						
Moisture Content (dried @ 103°C) YYYY 1@ %		30.3	29.4	27.8	23.9	20.4
ED002: Exchangeable Soil Acids						
Exchangeable Soil Acids YYYY 9@ v sq/199g		YYYY	1.2	YYYY	YYYY	0.5
ED007: Exchangeable Cations						
Exchangeable Calcium YYYY 9@ v sq/199g		YYYY	74.6	YYYY	YYYY	52.3
Exchangeable Magnesium YYYY 9@ v sq/199g		YYYY	10.6	YYYY	YYYY	5.6
Exchangeable Potassium YYYY 9@ v sq/199g		YYYY	0.2	YYYY	YYYY	0.1
Exchangeable Sodium YYYY 9@ v sq/199g		YYYY	0.5	YYYY	YYYY	0.4
Cation Exchange Capacity YYYY 9@ v sq/199g		YYYY	86.0	YYYY	YYYY	58.4
ED042T: Total Sulfur by LECO						
Sulfur - Total as S (LECO) YYYY 9@1 %		YYYY	<9@1	YYYY	YYYY	<9@1
ED045G: Chloride Discrete analyser						
Chloride 1+776\99Y+ 19 v g/kg		<19	<19	<19	950	<19
ED093S: Soluble Major Cations						
Potassium 6339\9UY6 19 v g/kg		YYYY	<19	YYYY	YYYY	<19
EK067G: Total Phosphorus as P by Discrete Analyser						
Total Phosphorus as P YYYY 2 v g/kg		YYYY	324	YYYY	YYYY	756

PFgs : +œofe13
I orkeSrNsr : EB1213993
y aSi b : GRReE- d,MS- c E- TH4
ProjsDb : c Ec 97Y991

Analytical Results

RuLYc FbrQ: SOIL

	Client 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
	Client sampling date / time	22Yc HAY2912el0:99	22Yc HAY2912el0:99	22Yc HAY2912el0:99	22Yc HAY2912el0:99	22Yc HAY2912el0:99
Compound	CAS Number / LOR / Unit	EB1214004-025	EB1214004-030	EB1214004-031	EB1214004-032	EB1214004-033
EA002 : pH (Soils)						
pH Value	YYYY 9@ . OeWl ©	8.8	7.7	7.7	7.8	8.0
EA010: Conductivity						
Electrical Conductivity @ 25°C	YYYY 1 µR/Dv	79	37	26	27	35
EA055: Moisture Content						
Moisture Content (dried @ 103°C)	YYYY 1@ %	14.6	26.1	26.4	25.6	26.8
ED002: Exchangeable Soil Acids						
Exchangeable Soil Acids	YYYY 9@ v sq/199g	YYYY	2.0	YYYY	1.0	YYYY
ED007: Exchangeable Cations						
Exchangeable Calcium	YYYY 9@ v sq/199g	YYYY	52.9	YYYY	58.4	YYYY
Exchangeable Magnesium	YYYY 9@ v sq/199g	YYYY	18.2	YYYY	15.7	YYYY
Exchangeable Potassium	YYYY 9@ v sq/199g	YYYY	1.3	YYYY	0.2	YYYY
Exchangeable Sodium	YYYY 9@ v sq/199g	YYYY	<9@	YYYY	0.2	YYYY
Cation Exchange Capacity	YYYY 9@ v sq/199g	YYYY	72.4	YYYY	74.5	YYYY
ED021: Bicarbonate Extractable Potassium (Colwell)						
Bicarbonate Extractable K (Colwell)	YYYY 19 v g/kg	YYYY	470	YYYY	YYYY	YYYY
ED040: Sulfur as SO4 2-						
Sulfate as SO4 2-	13797Y6UY7 199 v g/kg	YYYY	230	YYYY	YYYY	YYYY
ED042T: Total Sulfur by LECO						
Sulfur - Total as S (LECO)	YYYY 9@1 %	YYYY	<9@1	YYYY	<9@1	YYYY
ED045G: Chloride Discrete analyser						
Chloride	1+776Y99Y+ 19 v g/kg	10	<19	<19	<19	<19
ED093S: Soluble Major Cations						
Potassium	6339Y9UY6 19 v g/kg	YYYY	<19	YYYY	<19	YYYY
EG005T: Total Metals by ICP-AES						
Aluminium	632UYU9Y0 09 v g/kg	YYYY	30200	YYYY	YYYY	YYYY
Boron	6339Y32Y7 09 v g/kg	YYYY	<09	YYYY	YYYY	YYYY
Copper	6339Y09Y7 0 v g/kg	YYYY	37	YYYY	YYYY	YYYY
Iron	63 UY7UY+ 09 v g/kg	YYYY	39500	YYYY	YYYY	YYYY
Manganese	63 UYU+Y0 0 v g/kg	YYYY	2090	YYYY	YYYY	YYYY
Molybdenum	63 UYU7Y6 2 v g/kg	YYYY	<2	YYYY	YYYY	YYYY
Zinc	6339Y++Y+ 0 v g/kg	YYYY	44	YYYY	YYYY	YYYY
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser						
Nitrite + Nitrate as N (Sol.)	YYYY 9@ v g/kg	YYYY	2.8	YYYY	YYYY	YYYY
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser						

PFgs : 6ɶofe13
I orkɶSrNsr : EB1213993
y aɶi b : GRRɶE- d,MS- c E- TH4
ProjsDb : c Ec 97Y991

Analytical Results

RuLYc FbrQ: SOIL			Client 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
			Client sampling date / time	22Yc HAY2912el0:99	22Yc HAY2912el0:99	22Yc HAY2912el0:99	22Yc HAY2912el0:99	22Yc HAY2912el0:99
Compound	CAS Number	LOR	Unit	EB1214004-025	EB1214004-030	EB1214004-031	EB1214004-032	EB1214004-033
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser - Continued								
Total Kjeldahl Nitrogen as N	YYYY	29	v g/kg	YYYY	1220	YYYY	YYYY	YYYY
EK062: Total Nitrogen as N (TKN + NOx)								
^eTotal Nitrogen as N	YYYY	29	v g/kg	YYYY	1220	YYYY	YYYY	YYYY
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	YYYY	2	v g/kg	YYYY	361	YYYY	404	YYYY
EP003: Total Organic Carbon (TOC) in Soil								
Total Organic Carbon	YYYY	9@2	%	YYYY	1.72	YYYY	YYYY	YYYY

PFgs : 7œofe13
I orkeSrNsr : EB1213993
y aSi b : GRReE- d,MS- c E- TH4
ProjsDb : c Ec 97Y991

Analytical Results

RuLYc FbrQ: SOIL			Client 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
			Client sampling date / time	22Yc HAY2912el0:99	22Yc HAY2912el0:99	22Yc HAY2912el0:99	22Yc HAY2912el0:99	22Yc HAY2912el0:99
Compound	CAS Number	LOR	Unit	EB1214004-034	EB1214004-035	EB1214004-036	EB1214004-037	EB1214004-038
EA002 : pH (Soils)								
pH Value	YYYY	9@	. OèWl ©	8.0	8.2	8.3	8.5	8.6
EA010: Conductivity								
Electrical Conductivity @ 25°C	YYYY	1	µR/Dv	41	57	109	127	134
EA055: Moisture Content								
Moisture Content (dried @ 103°C)	YYYY	1@	%	23.5	28.0	17.5	24.8	23.1
ED002: Exchangeable Soil Acids								
Exchangeable Soil Acids	YYYY	9@	v sq/199g	YYYY	1.0	YYYY	0.9	YYYY
ED007: Exchangeable Cations								
Exchangeable Calcium	YYYY	9@	v sq/199g	YYYY	60.0	YYYY	47.8	YYYY
Exchangeable Magnesium	YYYY	9@	v sq/199g	YYYY	9.2	YYYY	6.7	YYYY
Exchangeable Potassium	YYYY	9@	v sq/199g	YYYY	<9@	YYYY	<9@	YYYY
Exchangeable Sodium	YYYY	9@	v sq/199g	YYYY	0.3	YYYY	0.3	YYYY
Cation Exchange Capacity	YYYY	9@	v sq/199g	YYYY	69.6	YYYY	54.9	YYYY
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	YYYY	9@1	%	YYYY	<9@1	YYYY	<9@1	YYYY
ED045G: Chloride Discrete analyser								
Chloride	1+776\99Y+	19	v g/kg	<19	<19	<19	<19	<19
ED093S: Soluble Major Cations								
Potassium	6339\9UY6	19	v g/kg	YYYY	<19	YYYY	<19	YYYY
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	YYYY	2	v g/kg	YYYY	563	YYYY	979	YYYY

PFgs : Uaofe13
I orkeSrNsr : EB1213993
y aSi b : GRReE- d,MS- c E- TH4
ProjsDb : c Ec 97Y991

Analytical Results

RuLYc FbrQ: SOIL

	Client 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 sampling date / time	22Yc HAY2912e10:99	22Yc HAY2912e10:99	22Yc HAY2912e10:99	22Yc HAY2912e10:99	22Yc HAY2912e10:99
Compound	CAS Number / LOR / Unit	EB1214004-066	EB1214004-067	EB1214004-068	EB1214004-069	EB1214004-070
EA002 : pH (Soils)						
pH Value	YYYY 9@ . OeWl ©	7.7	7.8	7.8	7.9	8.0
EA010: Conductivity						
Electrical Conductivity @ 25°C	YYYY 1 µR/Dv	92	56	23	28	31
EA055: Moisture Content						
Moisture Content (dried @ 103°C)	YYYY 1@ %	28.3	30.2	30.3	30.0	30.4
ED002: Exchangeable Soil Acids						
Exchangeable Soil Acids	YYYY 9@ v sq/199g	1.7	YYYY	YYYY	1.5	YYYY
ED007: Exchangeable Cations						
Exchangeable Calcium	YYYY 9@ v sq/199g	57.2	YYYY	YYYY	58.2	YYYY
Exchangeable Magnesium	YYYY 9@ v sq/199g	19.9	YYYY	YYYY	19.0	YYYY
Exchangeable Potassium	YYYY 9@ v sq/199g	0.5	YYYY	YYYY	0.2	YYYY
Exchangeable Sodium	YYYY 9@ v sq/199g	0.3	YYYY	YYYY	0.4	YYYY
Cation Exchange Capacity	YYYY 9@ v sq/199g	77.9	YYYY	YYYY	77.8	YYYY
ED021: Bicarbonate Extractable Potassium (Colwell)						
Bicarbonate Extractable K (Colwell)	YYYY 19 v g/kg	<299	YYYY	YYYY	YYYY	YYYY
ED040: Sulfur as SO4 2-						
Sulfate as SO4 2-	13797Y6UY7 199 v g/kg	150	YYYY	YYYY	YYYY	YYYY
ED042T: Total Sulfur by LECO						
Sulfur - Total as S (LECO)	YYYY 9@1 %	<9@1	YYYY	YYYY	<9@1	YYYY
ED045G: Chloride Discrete analyser						
Chloride	1+776Y99Y+ 19 v g/kg	<19	<19	<19	<19	<19
ED093S: Soluble Major Cations						
Potassium	6339Y9UY6 19 v g/kg	<19	YYYY	YYYY	<19	YYYY
EG005T: Total Metals by ICP-AES						
Aluminium	632UYU9Y0 09 v g/kg	32700	YYYY	YYYY	YYYY	YYYY
Boron	6339Y32Y7 09 v g/kg	<09	YYYY	YYYY	YYYY	YYYY
Copper	6339Y09Y7 0 v g/kg	41	YYYY	YYYY	YYYY	YYYY
Iron	63 UY7UY+ 09 v g/kg	41200	YYYY	YYYY	YYYY	YYYY
Manganese	63 UYU+Y0 0 v g/kg	1510	YYYY	YYYY	YYYY	YYYY
Molybdenum	63 UYU7Y6 2 v g/kg	<2	YYYY	YYYY	YYYY	YYYY
Zinc	6339Y++Y+ 0 v g/kg	47	YYYY	YYYY	YYYY	YYYY
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser						
Nitrite + Nitrate as N (Sol.)	YYYY 9@ v g/kg	0.5	YYYY	YYYY	YYYY	YYYY
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser						

Analytical Results

RuLYc FbrQ: SOIL	Client 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 sampling date / time	22Yc HAY2912el0:99	22Yc HAY2912el0:99	22Yc HAY2912el0:99	22Yc HAY2912el0:99	22Yc HAY2912el0:99
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	29 v g/kg	820	YYYY	YYYY	YYYY	YYYY
EK062: Total Nitrogen as N (TKN + NOx)						
^eTotal Nitrogen as N	29 v g/kg	820	YYYY	YYYY	YYYY	YYYY
EK067G: Total Phosphorus as P by Discrete Analyser						
Total Phosphorus as P	2 v g/kg	334	YYYY	YYYY	262	YYYY
EP003: Total Organic Carbon (TOC) in Soil						
Total Organic Carbon	9@2 %	1.20	YYYY	YYYY	YYYY	YYYY

PFgs : 11eofe13
I orkeSrNsr : EB1213993
y aSi b : GRReE- d,MS- c E- TH4
ProjsDb : c Ec 97Y991

Analytical Results

RuLYc FbrQ: SOIL			Client 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
			Client sampling date / time	22Yc HAY2912el0:99	22Yc HAY2912el0:99	22Yc HAY2912el0:99	22Yc HAY2912el0:99	22Yc HAY2912el0:99
Compound	*CAS Number*	*LOR*	*Unit*	EB1214004-071	EB1214004-072	EB1214004-073	EB1214004-074	EB1214004-075
EA002 : pH (Soils)								
pH Value	YYYY	9@	. OeWl Cb	8.1	8.7	9.0	9.0	9.0
EA010: Conductivity								
Electrical Conductivity @ 25°C	YYYY	1	µR/Dv	36	95	70	73	72
EA055: Moisture Content								
Moisture Content (dried @ 103°C)	YYYY	1@	%	27.1	11.3	19.4	15.1	14.0
ED002: Exchangeable Soil Acids								
Exchangeable Soil Acids	YYYY	9@	v sq/199g	1.5	YYYY	0.6	YYYY	YYYY
ED007: Exchangeable Cations								
Exchangeable Calcium	YYYY	9@	v sq/199g	61.7	YYYY	69.8	YYYY	YYYY
Exchangeable Magnesium	YYYY	9@	v sq/199g	20.3	YYYY	15.8	YYYY	YYYY
Exchangeable Potassium	YYYY	9@	v sq/199g	0.2	YYYY	<9@	YYYY	YYYY
Exchangeable Sodium	YYYY	9@	v sq/199g	0.5	YYYY	0.6	YYYY	YYYY
Cation Exchange Capacity	YYYY	9@	v sq/199g	82.7	YYYY	86.4	YYYY	YYYY
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	YYYY	9@1	%	<9@1	YYYY	<9@1	YYYY	YYYY
ED045G: Chloride Discrete analyser								
Chloride	1+776\99Y+	19	v g/kg	<19	<19	<19	<19	<19
ED093S: Soluble Major Cations								
Potassium	6339\9UY6	19	v g/kg	<19	YYYY	<19	YYYY	YYYY
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	YYYY	2	v g/kg	247	YYYY	266	YYYY	YYYY

PFgs : 12eofe13
I orkeSrNsr : EB1213993
y aSi b : GRReE- d,MS- c E- TH4
ProjsDb : c Ec 97Y991

Analytical Results

RuLYc FbrQ: 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 sampling date / time	22Yc HAY2912el0:99	22Yc HAY2912el0:99	22Yc HAY2912el0:99	22Yc HAY2912el0:99	22Yc HAY2912el0:99
Compound	CAS Number / LOR / Unit	EB1214004-080	EB1214004-081	EB1214004-082	EB1214004-083	EB1214004-084
EA002 : pH (Soils)						
pH Value	YYYY / 9@ / . OeWl ©	7.4	7.7	7.9	7.9	8.0
EA010: Conductivity						
Electrical Conductivity @ 25°C	YYYY / 1 / µR/Dv	78	29	27	41	48
EA055: Moisture Content						
Moisture Content (dried @ 103°C)	YYYY / 1@ / %	27.2	28.6	29.8	29.6	27.9
ED002: Exchangeable Soil Acids						
Exchangeable Soil Acids	YYYY / 9@ / v sq/199g	2.4	YYYY	YYYY	1.0	YYYY
ED007: Exchangeable Cations						
Exchangeable Calcium	YYYY / 9@ / v sq/199g	54.9	YYYY	YYYY	58.4	YYYY
Exchangeable Magnesium	YYYY / 9@ / v sq/199g	13.1	YYYY	YYYY	12.7	YYYY
Exchangeable Potassium	YYYY / 9@ / v sq/199g	0.4	YYYY	YYYY	0.1	YYYY
Exchangeable Sodium	YYYY / 9@ / v sq/199g	0.2	YYYY	YYYY	0.2	YYYY
Cation Exchange Capacity	YYYY / 9@ / v sq/199g	68.7	YYYY	YYYY	71.4	YYYY
ED021: Bicarbonate Extractable Potassium (Colwell)						
Bicarbonate Extractable K (Colwell)	YYYY / 19 / v g/kg	<299	YYYY	YYYY	YYYY	YYYY
ED040: Sulfur as SO4 2-						
Sulfate as SO4 2-	13797Y6UY7 / 199 / v g/kg	140	YYYY	YYYY	YYYY	YYYY
ED042T: Total Sulfur by LECO						
Sulfur - Total as S (LECO)	YYYY / 9@1 / %	<9@1	YYYY	YYYY	<9@1	YYYY
ED045G: Chloride Discrete analyser						
Chloride	1+776Y99Y+ / 19 / v g/kg	<19	<19	<19	<19	<19
ED093S: Soluble Major Cations						
Potassium	6339Y9UY6 / 19 / v g/kg	<19	YYYY	YYYY	<19	YYYY
EG005T: Total Metals by ICP-AES						
Aluminium	632UYU9Y0 / 09 / v g/kg	29900	YYYY	YYYY	YYYY	YYYY
Boron	6339Y32Y7 / 09 / v g/kg	<09	YYYY	YYYY	YYYY	YYYY
Copper	6339Y09Y7 / 0 / v g/kg	41	YYYY	YYYY	YYYY	YYYY
Iron	63 UY7UY+ / 09 / v g/kg	43900	YYYY	YYYY	YYYY	YYYY
Manganese	63 UYU+Y0 / 0 / v g/kg	1660	YYYY	YYYY	YYYY	YYYY
Molybdenum	63 UYU7Y6 / 2 / v g/kg	<2	YYYY	YYYY	YYYY	YYYY
Zinc	6339Y++Y+ / 0 / v g/kg	45	YYYY	YYYY	YYYY	YYYY
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser						
Nitrite + Nitrate as N (Sol.)	YYYY / 9@ / v g/kg	0.8	YYYY	YYYY	YYYY	YYYY
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser						

Analytical Results

RuLYc FbrQ: 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 sampling date / time	22Yc HAY2912e10:99	22Yc HAY2912e10:99	22Yc HAY2912e10:99	22Yc HAY2912e10:99	22Yc HAY2912e10:99
Compound / CAS Number / LOR / Unit		EB1214004-080	EB1214004-081	EB1214004-082	EB1214004-083	EB1214004-084
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser - Continued						
Total Kjeldahl Nitrogen as N	YYYY / 29 / v g/kg	910	YYYY	YYYY	YYYY	YYYY
EK062: Total Nitrogen as N (TKN + NOx)						
^eTotal Nitrogen as N	YYYY / 29 / v g/kg	910	YYYY	YYYY	YYYY	YYYY
EK067G: Total Phosphorus as P by Discrete Analyser						
Total Phosphorus as P	YYYY / 2 / v g/kg	317	YYYY	YYYY	279	YYYY
EP003: Total Organic Carbon (TOC) in Soil						
Total Organic Carbon	YYYY / 9@82 / %	1.21	YYYY	YYYY	YYYY	YYYY

PFgs : 13ɵofɶ13
I orkɵSrNsr : EB1213993
y ɵSi b : GRRɵE- d,MS- c E- TH4
ProjsDb : c Ec 97Ÿ991

Analytical Results

RuLYc FbrQ: SOIL			Client sample ID	C-035-0.5-0.6	C-035-0.6-0.7	C-035-0.7-0.8	ŸŸŸŸ	ŸŸŸŸ
			Client sampling date / time	22Ÿc HAŸ2912ɵ10:99	22Ÿc HAŸ2912ɵ10:99	22Ÿc HAŸ2912ɵ10:99	ŸŸŸŸ	ŸŸŸŸ
Compound	*CAS Number*	*LOR*	*Unit*	EB1214004-085	EB1214004-086	EB1214004-087	----	----
EA002 : pH (Soils)								
pH Value	ŸŸŸŸ	9@	. OɵWl ©	8.5	8.8	8.7	ŸŸŸŸ	ŸŸŸŸ
EA010: Conductivity								
Electrical Conductivity @ 25°C	ŸŸŸŸ	1	µR/Dv	118	79	69	ŸŸŸŸ	ŸŸŸŸ
EA055: Moisture Content								
Moisture Content (dried @ 103°C)	ŸŸŸŸ	1@	%	22.6	16.2	12.6	ŸŸŸŸ	ŸŸŸŸ
ED002: Exchangeable Soil Acids								
Exchangeable Soil Acids	ŸŸŸŸ	9@	v sq/199g	ŸŸŸŸ	0.4	ŸŸŸŸ	ŸŸŸŸ	ŸŸŸŸ
ED007: Exchangeable Cations								
Exchangeable Calcium	ŸŸŸŸ	9@	v sq/199g	ŸŸŸŸ	54.3	ŸŸŸŸ	ŸŸŸŸ	ŸŸŸŸ
Exchangeable Magnesium	ŸŸŸŸ	9@	v sq/199g	ŸŸŸŸ	7.7	ŸŸŸŸ	ŸŸŸŸ	ŸŸŸŸ
Exchangeable Potassium	ŸŸŸŸ	9@	v sq/199g	ŸŸŸŸ	<9@	ŸŸŸŸ	ŸŸŸŸ	ŸŸŸŸ
Exchangeable Sodium	ŸŸŸŸ	9@	v sq/199g	ŸŸŸŸ	0.2	ŸŸŸŸ	ŸŸŸŸ	ŸŸŸŸ
Cation Exchange Capacity	ŸŸŸŸ	9@	v sq/199g	ŸŸŸŸ	62.2	ŸŸŸŸ	ŸŸŸŸ	ŸŸŸŸ
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	ŸŸŸŸ	9@1	%	ŸŸŸŸ	<9@1	ŸŸŸŸ	ŸŸŸŸ	ŸŸŸŸ
ED045G: Chloride Discrete analyser								
Chloride	1+776\99Y+	19	v g/kg	30	<19	<19	ŸŸŸŸ	ŸŸŸŸ
ED093S: Soluble Major Cations								
Potassium	6339\9UY6	19	v g/kg	ŸŸŸŸ	<19	ŸŸŸŸ	ŸŸŸŸ	ŸŸŸŸ
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	ŸŸŸŸ	2	v g/kg	ŸŸŸŸ	580	ŸŸŸŸ	ŸŸŸŸ	ŸŸŸŸ

NSW GOVERNMENT Soil Conservation Service

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 analysis-mechanical 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

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.

NSW GOVERNMENT Soil Conservation Service

SOIL TEST REPORT

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

SR Young
(Laboratory Manager)

Scone Research Centre, PO Box 283 Scone 2337, 709 Gundy Road Scone 2337
Ph: 02 6545 1666, Fax: 02 6545 2520

SOIL CONSERVATION SERVICE
Scone Research Service Centre

Report No: SCO12/175R1 (Preliminary)
Client Reference: Australian Laboratory Services
32 Shand Street
Stafford Qld 4053

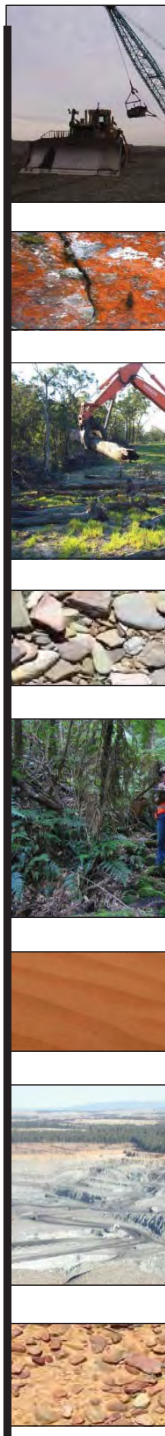
	Method	P7B/2 Particle Size Analysis (%)					P7C/2 Particle Size Analysis – mech dis (%)					P9B/2	C6A/2	Colour	
	Sample Id	clay	silt	f sand	c sand	gravel	clay	silt	f sand	c sand	gravel	EAT	OC (%)	Dry	Moist
1	26	74	17	6	3	0	39	19	29	29	0	5	2.02	10YR4/1	10YR3/1
2	27	85	13	4	1	0	41	23	24	24	0	5	1.48	10YR4/1	10YR3/1
3	28	81	11	6	2	0	32	28	26	26	0	5	1.26	10YR4/1	10YR3/1
4	29	25	10	16	46	3	21	12	52	52	3	4	0.39	10YR5/2	10YR4/2
5	39	75	16	8	1	0	41	18	24	24	0	5	1.50	10YR4/1	10YR3/1
6	40	70	18	9	3	0	44	22	21	21	0	5	1.28	10YR4/1	10YR3/1
7	41	51	14	14	20	1	32	20	27	27	1	4	1.00	10YR5/1	10YR3/2
8	42	22	15	21	30	12	21	19	31	31	12	4	0.57	10YR6/2	10YR4/2
9	76	74	17	7	2	<1	44	16	27	27	<1	5	0.97	10YR4/1	10YR3/1
10	77	80	15	3	2	0	46	19	22	22	0	5	1.04	10YR4/1	10YR3/1
11	78	67	13	7	13	0	43	19	21	21	0	4	0.90	10YR4/1	10YR2/1
12	79	16	10	16	48	10	19	12	51	51	10	4	0.26	7.5YR5/2	7.5YR3/2
13	88	69	19	8	4	0	43	23	20	20	0	5	1.21	10YR4/1	10YR3/1
14	89	73	16	8	3	<1	43	23	20	20	<1	5	1.00	10YR4/2	10YR2/2
15	90	12	11	19	56	2	15	19	54	54	2	4	0.25	10YR5/3	10YR3/3

END OF TEST REPORT

Appendix 2

Topsoil Management Plan

Meteor Downs South 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.

Table 2.1 Stripping Recommendations

	Soil Type		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

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.

Table 2.2.3 Monitoring Procedure

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.

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**.

Table 2.3. Key Performance Indicators

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.

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

CERTIFICATE OF ANALYSIS

Work Order	: **EB1119039**	Page	: 1 of 25
Client	: **ENDOCOAL LTD**	Laboratory	: Environmental Division Brisbane
Contact	: MS KAYLIE HYLAND	Contact	: Customer Services
Address	: SUITE 2 / 1 SWANN RD TARINGA BRISBANE QUEENSLAND 4068	Address	: 32 Shand Street Stafford QLD Australia 4053
E-mail	: cash.sale@alsenviro.com	E-mail	: Brisbane.Enviro.Services@alsglobal.com
Telephone	: +61 7 3720 9300	Telephone	: +61 7 3243 7222
Facsimile	: +61 7 3720 9311	Facsimile	: +61 7 3243 7218
Project	: Orion Downs	QC Level	: NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Order number	: ----		
C-O-C number	: ----	Date Samples Received	: 13-SEP-2011
Sampler	: Kaylie Hyland	Issue Date	: 29-SEP-2011
Site	: ----		
		No. of samples received	: 55
Quote 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 approved for release.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

NATA Accredited Laboratory 825

This document is issued in accordance with NATA accreditation requirements.

Accredited for compliance with ISO/IEC 17025.

Signatories

This document has been electronically signed by the authorized signatories indicated below. Electronic signing has been carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Kim McCabe	Senior Inorganic Chemist	Brisbane Inorganics
Myles.Clark	Acid Sulfate Soils Supervisor	Brisbane Acid Sulphate Soils
Myles.Clark	Acid Sulfate Soils Supervisor	Stafford Minerals - AY

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.

Key : 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
^ = 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.**

Analytical Results

Sub-Matrix: **ROCK**

Compound	CAS Number	LOR	Unit	Client sample ID: 9939	9940	9941	9942	9943
				Client sampling date / time: 28-AUG-2011 15:00	28-AUG-2011 15:00	28-AUG-2011 15:00	28-AUG-2011 15:00	28-AUG-2011 15:00
				EB1119039-001	EB1119039-002	EB1119039-003	EB1119039-004	EB1119039-005
EA002 : pH (Soils)								
pH Value	----	0.1	pH Unit	8.2	8.5	8.6	8.7	8.4
EA009: Nett Acid Production Potential								
^ Net Acid Production Potential	----	0.5	kg H2SO4/t	-72.1	-94.4	-89.5	-141	-105
EA010: Conductivity								
Electrical Conductivity @ 25°C	----	1	µS/cm	121	147	129	127	143
EA011E-A: pH OX								
pH (OX)	----	0.1	pH Unit	8.1	8.4	9.3	9.1	9.1
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	72.4	94.4	89.5	141	106
^ ANC as CaCO3	----	0.1	% CaCO3	7.4	9.6	9.1	14.4	10.8
Fizz Rating	----	0	Fizz Unit	2	2	2	3	2
EA055: Moisture Content								
^ Moisture Content (dried @ 103°C)	----	1.0	%	38.3	42.1	38.6	33.3	39.1
ED007: Exchangeable Cations								
^ Exchangeable Calcium	----	0.1	meq/100g	58.8	56.1	59.6	48.4	51.8
^ Exchangeable Magnesium	----	0.1	meq/100g	22.1	16.5	12.8	10.5	15.2
^ Exchangeable Potassium	----	0.1	meq/100g	1.0	0.5	0.4	0.3	0.4
^ Exchangeable Sodium	----	0.1	meq/100g	0.9	1.1	1.4	1.3	1.3
^ Cation Exchange Capacity	----	0.1	meq/100g	82.8	74.2	74.1	60.5	68.8
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	20	30	30	20	20
ED093S: Soluble Major Cations								
Calcium	7440-70-2	10	mg/kg	80	100	80	70	90
Magnesium	7439-95-4	10	mg/kg	30	40	30	30	40
Sodium	7440-23-5	10	mg/kg	90	110	100	90	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	38500	40200	39800	31600	50800
Antimony	7440-36-0	5	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	420	130	30	60	140
Beryllium	7440-41-7	1	mg/kg	<2	<2	<2	<2	<2
Boron	7440-42-8	50	mg/kg	<50	<50	<50	<50	<50
Cadmium	7440-43-9	1	mg/kg	<1	<1	<1	<1	<1

Analytical Results

Sub-Matrix: **ROCK**

Compound	CAS Number	LOR	Unit	Client sample ID: 9939	9940	9941	9942	9943
				Client sampling date / time: 28-AUG-2011 15:00	28-AUG-2011 15:00	28-AUG-2011 15:00	28-AUG-2011 15:00	28-AUG-2011 15:00
				EB1119039-001	EB1119039-002	EB1119039-003	EB1119039-004	EB1119039-005
EG005T: Total Metals by ICP-AES - Continued								
Chromium	7440-47-3	2	mg/kg	89	66	54	48	81
Cobalt	7440-48-4	2	mg/kg	59	40	42	36	27
Copper	7440-50-8	5	mg/kg	50	54	55	44	35
Iron	7439-89-6	50	mg/kg	48000	52200	54400	41600	39500
Lead	7439-92-1	5	mg/kg	<5	<5	<5	<5	<5
Manganese	7439-96-5	5	mg/kg	1810	880	778	819	693
Molybdenum	7439-98-7	2	mg/kg	<2	<2	<2	<2	<2
Nickel	7440-02-0	2	mg/kg	141	144	150	152	174
Selenium	7782-49-2	5	mg/kg	12	8	<5	6	7
Silver	7440-22-4	2	mg/kg	<2	<2	<2	<2	<2
Strontium	7440-24-6	2	mg/kg	160	460	1130	1360	575
Tin	7440-31-5	5	mg/kg	<5	<5	<5	<5	<5
Vanadium	7440-62-2	5	mg/kg	90	68	64	45	73
Zinc	7440-66-6	5	mg/kg	70	82	82	63	60
Titanium	7440-32-6	10	mg/kg	700	730	680	800	360
Thallium	7440-28-0	5	mg/kg	6	<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 Discrete Analyser								
Nitrite + Nitrate as N (Sol.)	---	0.1	mg/kg	0.1	0.2	1.8	14.3	1.5

Analytical Results

Sub-Matrix: **ROCK**

Compound	CAS Number	LOR	Unit	Client sample ID	9944	9945	9946	9947	9948
				Client sampling date / time	28-AUG-2011 15:00	28-AUG-2011 15:00	28-AUG-2011 15:00	28-AUG-2011 15:00	28-AUG-2011 15:00
					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	9.0
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	3	3
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	90	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	5	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		80	140	30	50	50
Beryllium	7440-41-7	1	mg/kg		<2	<2	<2	<3	<2
Boron	7440-42-8	50	mg/kg		<50	<50	<50	<50	<50
Cadmium	7440-43-9	1	mg/kg		<1	<1	<1	<1	<1

Analytical Results

Sub-Matrix: **ROCK**

Compound	CAS Number	LOR	Unit	Client sample ID	9944	9945	9946	9947	9948
				Client sampling date / time	28-AUG-2011 15:00	28-AUG-2011 15:00	28-AUG-2011 15:00	28-AUG-2011 15:00	28-AUG-2011 15:00
					EB1119039-006	EB1119039-007	EB1119039-008	EB1119039-009	EB1119039-010
EG005T: Total Metals by ICP-AES - Continued									
Chromium	7440-47-3	2	mg/kg		74	75	53	58	68
Cobalt	7440-48-4	2	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	5	mg/kg		<5	<5	<5	<5	<5
Manganese	7439-96-5	5	mg/kg		684	730	498	774	994
Molybdenum	7439-98-7	2	mg/kg		<2	<2	<2	<3	<2
Nickel	7440-02-0	2	mg/kg		148	147	142	142	157
Selenium	7782-49-2	5	mg/kg		11	8	<5	<5	<5
Silver	7440-22-4	2	mg/kg		<2	<2	<2	<3	<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	5	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 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		4.8	9.9	16.2	7.9	13.4
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser									
Nitrite + Nitrate as N (Sol.)	---	0.1	mg/kg		4.8	9.9	16.2	8.0	13.4

Analytical Results

Sub-Matrix: **ROCK**

Compound	CAS Number	LOR	Unit	Client sample ID	9949	9950	9951	9952	9953
				Client sampling date / time	28-AUG-2011 15:00	28-AUG-2011 15:00	28-AUG-2011 15:00	28-AUG-2011 15:00	28-AUG-2011 15:00
					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									
^ Net Acid Production Potential	----	0.5	kg H2SO4/t		-126	-124	-121	-124	-132
EA010: Conductivity									
Electrical Conductivity @ 25°C	----	1	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 equiv./t		126	124	121	124	132
^ ANC as CaCO3	----	0.1	% CaCO3		12.9	12.6	12.4	12.6	13.5
Fizz Rating	----	0	Fizz Unit		3	3	3	3	3
EA055: Moisture Content									
^ Moisture Content (dried @ 103°C)	----	1.0	%		36.5	34.2	37.7	32.9	4.4
ED007: Exchangeable Cations									
^ Exchangeable Calcium	----	0.1	meq/100g		52.2	53.5	32.0	48.9	33.2
^ Exchangeable Magnesium	----	0.1	meq/100g		15.5	14.4	9.6	13.2	7.7
^ Exchangeable Potassium	----	0.1	meq/100g		0.5	0.5	0.5	0.8	1.7
^ Exchangeable Sodium	----	0.1	meq/100g		1.1	1.1	0.6	1.2	2.7
^ Cation Exchange Capacity	----	0.1	meq/100g		69.3	69.6	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	90	80	70	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	5	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		90	130	300	90	<20
Beryllium	7440-41-7	1	mg/kg		<2	<2	<3	<3	<2
Boron	7440-42-8	50	mg/kg		<50	<50	<50	<50	<50
Cadmium	7440-43-9	1	mg/kg		<1	<1	<1	<1	<1

Analytical Results

Sub-Matrix: **ROCK**

Compound	CAS Number	LOR	Unit	Client sample ID	9949	9950	9951	9952	9953
				Client sampling date / time	28-AUG-2011 15:00	28-AUG-2011 15:00	28-AUG-2011 15:00	28-AUG-2011 15:00	28-AUG-2011 15:00
					EB1119039-011	EB1119039-012	EB1119039-013	EB1119039-014	EB1119039-015
EG005T: Total Metals by ICP-AES - Continued									
Chromium	7440-47-3	2	mg/kg		58	68	81	50	18
Cobalt	7440-48-4	2	mg/kg		39	44	51	44	23
Copper	7440-50-8	5	mg/kg		48	50	56	53	36
Iron	7439-89-6	50	mg/kg		44500	48800	53800	46900	30700
Lead	7439-92-1	5	mg/kg		<5	<5	<5	<5	<5
Manganese	7439-96-5	5	mg/kg		836	928	1170	1040	670
Molybdenum	7439-98-7	2	mg/kg		<2	<2	<3	<3	<2
Nickel	7440-02-0	2	mg/kg		138	150	161	151	95
Selenium	7782-49-2	5	mg/kg		<5	<5	11	10	7
Silver	7440-22-4	2	mg/kg		<2	<2	<3	<3	<2
Strontium	7440-24-6	2	mg/kg		132	128	253	320	681
Tin	7440-31-5	5	mg/kg		<5	<5	<5	129	<5
Vanadium	7440-62-2	5	mg/kg		55	65	77	48	21
Zinc	7440-66-6	5	mg/kg		72	79	83	76	60
Titanium	7440-32-6	10	mg/kg		630	690	930	530	240
Thallium	7440-28-0	5	mg/kg		<5	<5	6	6	<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	<0.1	0.4	0.5
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser									
Nitrite + Nitrate as N (Sol.)	---	0.1	mg/kg		<0.1	0.1	<0.1	0.4	0.5

Analytical Results

Sub-Matrix: **ROCK**

Compound	CAS Number	LOR	Unit	Client sample ID	9954	9993	9955	9956	9957
				Client sampling date / time	28-AUG-2011 15:00	28-AUG-2011 15:00	28-AUG-2011 15:00	28-AUG-2011 15:00	28-AUG-2011 15:00
					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									
^ 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	99	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 equiv./t		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		3	3	3	1	1
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
^ Exchangeable Magnesium	----	0.1	meq/100g		7.8	6.0	4.0	14.1	13.4
^ Exchangeable Potassium	----	0.1	meq/100g		1.5	1.7	0.8	0.8	0.8
^ 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	<5	<5
Arsenic	7440-38-2	5	mg/kg		<5	<5	<5	<5	<5
Barium	7440-39-3	10	mg/kg		<30	<20	<30	60	30
Beryllium	7440-41-7	1	mg/kg		<3	<2	<3	2	1
Boron	7440-42-8	50	mg/kg		<50	<50	<50	<50	<50
Cadmium	7440-43-9	1	mg/kg		<1	<1	<2	<1	<1

Analytical Results

Sub-Matrix: **ROCK**

Compound	CAS Number	LOR	Unit	Client sample ID	9954	9993	9955	9956	9957
				Client sampling date / time	28-AUG-2011 15:00	28-AUG-2011 15:00	28-AUG-2011 15:00	28-AUG-2011 15:00	28-AUG-2011 15:00
					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**	**9**
Cobalt	7440-48-4	2	mg/kg		**32**	**30**	**31**	**15**	**17**
Copper	7440-50-8	5	mg/kg		**43**	**43**	**40**	**24**	**9**
Iron	7439-89-6	50	mg/kg		**36100**	**36600**	**34300**	**15500**	**9630**
Lead	7439-92-1	5	mg/kg		<5	<5	<5	**7**	**6**
Manganese	7439-96-5	5	mg/kg		**1090**	**1440**	**1360**	**290**	**185**
Molybdenum	7439-98-7	2	mg/kg		<3	<2	<3	<2	<2
Nickel	7440-02-0	2	mg/kg		**127**	**129**	**130**	**18**	**18**
Selenium	7782-49-2	5	mg/kg		**10**	<5	**5**	<5	<5
Silver	7440-22-4	2	mg/kg		<3	<2	<3	<2	<2
Strontium	7440-24-6	2	mg/kg		**726**	**886**	**561**	**27**	**21**
Tin	7440-31-5	5	mg/kg		<5	<5	<5	<5	<5
Vanadium	7440-62-2	5	mg/kg		**25**	**23**	**25**	**23**	**16**
Zinc	7440-66-6	5	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 Discrete Analyser									
Nitrite + Nitrate as N (Sol.)	---	0.1	mg/kg		**0.4**	**0.7**	**0.4**	**0.3**	<0.1

Analytical Results

Sub-Matrix: **ROCK**

Compound	CAS Number	LOR	Unit	Client sample ID	9958	9959	9960	9961	9962
				Client sampling date / time	28-AUG-2011 15:00	28-AUG-2011 15:00	28-AUG-2011 15:00	28-AUG-2011 15:00	28-AUG-2011 15:00
					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									
^ 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	----	1	µS/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./t		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	1	2	1
EA055: Moisture Content									
^ Moisture Content (dried @ 103°C)	----	1.0	%		15.5	15.5	11.8	17.9	12.3
ED007: Exchangeable Cations									
^ Exchangeable Calcium	----	0.1	meq/100g		27.3	26.3	21.3	26.9	22.0
^ Exchangeable Magnesium	----	0.1	meq/100g		11.7	11.5	17.2	14.7	15.8
^ Exchangeable Potassium	----	0.1	meq/100g		0.7	0.7	0.6	0.8	0.5
^ Exchangeable Sodium	----	0.1	meq/100g		1.8	1.8	2.3	2.3	2.2
^ 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	<5	<5	<5	<5
Arsenic	7440-38-2	5	mg/kg		<5	<5	<5	<5	<5
Barium	7440-39-3	10	mg/kg		30	30	20	30	20
Beryllium	7440-41-7	1	mg/kg		1	1	1	1	1
Boron	7440-42-8	50	mg/kg		<50	<50	<50	<50	<50
Cadmium	7440-43-9	1	mg/kg		<1	<1	<1	<1	<1

Analytical Results

Sub-Matrix: **ROCK**

Compound	CAS Number	LOR	Unit	Client sample ID: 9958	9959	9960	9961	9962
				Client sampling date / time: 28-AUG-2011 15:00	28-AUG-2011 15:00	28-AUG-2011 15:00	28-AUG-2011 15:00	28-AUG-2011 15:00
				EB1119039-021	EB1119039-022	EB1119039-023	EB1119039-024	EB1119039-025
EG005T: Total Metals by ICP-AES - Continued								
Chromium	7440-47-3	2	mg/kg	8	7	5	7	6
Cobalt	7440-48-4	2	mg/kg	16	15	4	4	4
Copper	7440-50-8	5	mg/kg	7	5	<5	6	<5
Iron	7439-89-6	50	mg/kg	9680	9530	11100	12300	12100
Lead	7439-92-1	5	mg/kg	6	6	8	10	8
Manganese	7439-96-5	5	mg/kg	201	153	180	191	183
Molybdenum	7439-98-7	2	mg/kg	<2	<2	<2	<2	<2
Nickel	7440-02-0	2	mg/kg	16	14	7	10	10
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	22	24	42	66	67
Tin	7440-31-5	5	mg/kg	<5	<5	<5	<5	<5
Vanadium	7440-62-2	5	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	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	0.3	0.4	0.4
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N (Sol.)	---	0.1	mg/kg	<0.1	<0.1	0.3	0.4	0.4

Analytical Results

Sub-Matrix: **ROCK**

Compound	CAS Number	LOR	Unit	Client sample ID	9963	9964	9965	9966	9967
				Client sampling date / time	28-AUG-2011 15:00	28-AUG-2011 15:00	28-AUG-2011 15:00	28-AUG-2011 15:00	28-AUG-2011 15:00
					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	----	1	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 equiv./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	1	1
EA055: Moisture Content									
^ Moisture Content (dried @ 103°C)	----	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
^ Exchangeable Potassium	----	0.1	meq/100g		0.6	0.6	0.5	0.7	0.7
^ 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	6	<5
Barium	7440-39-3	10	mg/kg		40	40	30	50	30
Beryllium	7440-41-7	1	mg/kg		1	1	<1	3	3
Boron	7440-42-8	50	mg/kg		<50	<50	<50	<50	<50
Cadmium	7440-43-9	1	mg/kg		<1	<1	<1	<2	<1

Analytical Results

Sub-Matrix: **ROCK**

Compound	CAS Number	LOR	Unit	Client sample ID: 9963	9964	9965	9966	9967
				Client sampling date / time: 28-AUG-2011 15:00	28-AUG-2011 15:00	28-AUG-2011 15:00	28-AUG-2011 15:00	28-AUG-2011 15:00
				EB1119039-026	EB1119039-027	EB1119039-028	EB1119039-029	EB1119039-030
EG005T: Total Metals by ICP-AES - Continued								
Chromium	7440-47-3	2	mg/kg	**9**	**6**	**5**	**11**	**14**
Cobalt	7440-48-4	2	mg/kg	**10**	**6**	**4**	**18**	**12**
Copper	7440-50-8	5	mg/kg	**14**	**9**	**7**	**14**	**37**
Iron	7439-89-6	50	mg/kg	**15000**	**11000**	**7280**	**42600**	**18000**
Lead	7439-92-1	5	mg/kg	**8**	**8**	**10**	**17**	**18**
Manganese	7439-96-5	5	mg/kg	**824**	**816**	**855**	**393**	**170**
Molybdenum	7439-98-7	2	mg/kg	<2	<2	<2	<3	<2
Nickel	7440-02-0	2	mg/kg	**28**	**9**	**6**	**28**	**20**
Selenium	7782-49-2	5	mg/kg	<5	<5	<5	**5**	<5
Silver	7440-22-4	2	mg/kg	<2	<2	<2	<3	<2
Strontium	7440-24-6	2	mg/kg	**233**	**136**	**98**	**40**	**25**
Tin	7440-31-5	5	mg/kg	<5	<5	<5	<5	<5
Vanadium	7440-62-2	5	mg/kg	**14**	**13**	**8**	**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 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	**0.5**	**0.3**	**0.3**	**1.9**	**1.2**
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N (Sol.)	---	0.1	mg/kg	**0.5**	**0.3**	**0.3**	**1.9**	**1.2**

Analytical Results

Sub-Matrix: **ROCK**

Compound	CAS Number	LOR	Unit	Client sample ID	9968	9969	9970	9971	9972
				Client sampling date / time	28-AUG-2011 15:00	28-AUG-2011 15:00	28-AUG-2011 15:00	28-AUG-2011 15:00	28-AUG-2011 15:00
					EB1119039-031	EB1119039-032	EB1119039-033	EB1119039-034	EB1119039-035
EA002 : pH (Soils)									
pH Value	----	0.1	pH Unit		9.8	9.8	9.9	9.9	9.9
EA009: Nett Acid Production Potential									
^ Net Acid Production Potential	----	0.5	kg H2SO4/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 Unit		8.2	7.8	8.2	8.2	9.6
EA013: Acid Neutralising Capacity									
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t		7.6	9.7	69.3	28.2	38.6
^ ANC as CaCO3	----	0.1	% CaCO3		0.8	1.0	7.1	2.9	3.9
Fizz Rating	----	0	Fizz Unit		1	0	2	2	2
EA055: Moisture Content									
^ Moisture Content (dried @ 103°C)	----	1.0	%		10.7	8.1	10.6	10.7	10.7
ED007: Exchangeable Cations									
^ Exchangeable Calcium	----	0.1	meq/100g		10.6	21.9	21.2	31.0	27.7
^ Exchangeable Magnesium	----	0.1	meq/100g		9.4	13.0	14.5	14.6	15.7
^ Exchangeable Potassium	----	0.1	meq/100g		0.9	1.0	1.0	1.0	0.6
^ Exchangeable Sodium	----	0.1	meq/100g		1.6	2.0	2.2	2.1	2.3
^ Cation Exchange Capacity	----	0.1	meq/100g		22.6	37.9	38.9	48.7	46.4
ED042T: Total Sulfur by LECO									
Sulfur - Total as S (LECO)	----	0.01	%		<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		130	140	130	150	160
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		5230	11100	9480	10500	6680
Antimony	7440-36-0	5	mg/kg		<5	<5	<5	<5	<5
Arsenic	7440-38-2	5	mg/kg		<5	6	5	6	9
Barium	7440-39-3	10	mg/kg		30	30	40	40	50
Beryllium	7440-41-7	1	mg/kg		2	1	1	1	1
Boron	7440-42-8	50	mg/kg		<50	<50	<50	<50	<50
Cadmium	7440-43-9	1	mg/kg		<1	<1	<1	<1	<1

Analytical Results

Sub-Matrix: **ROCK**

Compound	CAS Number	LOR	Unit	Client sample ID: 9968	9969	9970	9971	9972
				Client sampling date / time: 28-AUG-2011 15:00	28-AUG-2011 15:00	28-AUG-2011 15:00	28-AUG-2011 15:00	28-AUG-2011 15:00
				EB1119039-031	EB1119039-032	EB1119039-033	EB1119039-034	EB1119039-035
EG005T: Total Metals by ICP-AES - Continued								
Chromium	7440-47-3	2	mg/kg	6	21	7	13	6
Cobalt	7440-48-4	2	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	5	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	<2	<2	<2	2	<2
Nickel	7440-02-0	2	mg/kg	6	22	21	18	10
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	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	5	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 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	1.4	4.4	0.7	5.7	0.9
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N (Sol.)	---	0.1	mg/kg	1.4	4.4	0.7	5.7	0.9

Analytical Results

Sub-Matrix: **ROCK**

Compound	CAS Number	LOR	Unit	Client sample ID	9973	9974	9975	9976	9977
				Client sampling date / time	28-AUG-2011 15:00	28-AUG-2011 15:00	28-AUG-2011 15:00	28-AUG-2011 15:00	28-AUG-2011 15:00
					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									
^ Net Acid Production Potential	----	0.5	kg H2SO4/t		-53.4	-44.5	-99.4	-115	-131
EA010: Conductivity									
Electrical Conductivity @ 25°C	----	1	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 equiv./t		54.0	44.8	100	116	132
^ 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	6.6	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	9	10	12	8
Barium	7440-39-3	10	mg/kg		40	40	40	30	30
Beryllium	7440-41-7	1	mg/kg		<1	<1	2	2	1
Boron	7440-42-8	50	mg/kg		<50	<50	<50	<50	<50
Cadmium	7440-43-9	1	mg/kg		<1	<1	<1	<1	<1

Analytical Results

Sub-Matrix: **ROCK**

Compound	CAS Number	LOR	Unit	Client sample ID	9973	9974	9975	9976	9977
				Client sampling date / time	28-AUG-2011 15:00	28-AUG-2011 15:00	28-AUG-2011 15:00	28-AUG-2011 15:00	28-AUG-2011 15:00
					EB1119039-036	EB1119039-037	EB1119039-038	EB1119039-039	EB1119039-040
EG005T: Total Metals by ICP-AES - Continued									
Chromium	7440-47-3	2	mg/kg		5	5	8	10	12
Cobalt	7440-48-4	2	mg/kg		8	8	13	24	13
Copper	7440-50-8	5	mg/kg		9	10	6	6	5
Iron	7439-89-6	50	mg/kg		6090	6760	18200	15500	13900
Lead	7439-92-1	5	mg/kg		13	13	10	13	9
Manganese	7439-96-5	5	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	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		55	52	60	70	79
Tin	7440-31-5	5	mg/kg		<5	<5	<5	<5	<5
Vanadium	7440-62-2	5	mg/kg		9	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	90
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		1.2	1.3	0.1	0.2	0.2
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser									
Nitrite + Nitrate as N (Sol.)	---	0.1	mg/kg		1.2	1.3	0.1	0.2	0.2

Analytical Results

Sub-Matrix: **ROCK**

Compound	CAS Number	LOR	Unit	Client sample ID	9978	9979	9980	9981	9982
				Client sampling date / time	28-AUG-2011 15:00	28-AUG-2011 15:00	28-AUG-2011 15:00	28-AUG-2011 15:00	28-AUG-2011 15:00
					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									
^ 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	----	1	µS/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		1	1	1	1	1
EA055: Moisture Content									
^ Moisture Content (dried @ 103°C)	----	1.0	%		11.7	10.2	11.1	10.2	8.7
ED007: Exchangeable Cations									
^ Exchangeable Calcium	----	0.1	meq/100g		20.2	23.3	21.0	25.4	25.2
^ Exchangeable Magnesium	----	0.1	meq/100g		13.6	12.0	13.6	13.2	13.4
^ Exchangeable Potassium	----	0.1	meq/100g		1.0	1.0	1.0	0.8	0.9
^ 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	<5	<5	<5	<5
Barium	7440-39-3	10	mg/kg		30	30	30	50	60
Beryllium	7440-41-7	1	mg/kg		2	2	2	2	2
Boron	7440-42-8	50	mg/kg		<50	<50	<50	<50	<50
Cadmium	7440-43-9	1	mg/kg		<1	<1	<1	<1	<1

Analytical Results

Sub-Matrix: **ROCK**

Compound	CAS Number	LOR	Unit	Client sample ID	9978	9979	9980	9981	9982
				Client sampling date / time	28-AUG-2011 15:00	28-AUG-2011 15:00	28-AUG-2011 15:00	28-AUG-2011 15:00	28-AUG-2011 15:00
					EB1119039-041	EB1119039-042	EB1119039-043	EB1119039-044	EB1119039-045
EG005T: Total Metals by ICP-AES - Continued									
Chromium	7440-47-3	2	mg/kg		**5**	**7**	**6**	**5**	**6**
Cobalt	7440-48-4	2	mg/kg		**17**	**22**	**22**	**4**	**4**
Copper	7440-50-8	5	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	5	mg/kg		**61**	**100**	**65**	**60**	**88**
Molybdenum	7439-98-7	2	mg/kg		<2	<2	<2	<2	<2
Nickel	7440-02-0	2	mg/kg		**15**	**18**	**18**	**6**	**7**
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		**49**	**47**	**50**	**62**	**66**
Tin	7440-31-5	5	mg/kg		<5	<5	<5	<5	<5
Vanadium	7440-62-2	5	mg/kg		**11**	**14**	**13**	**24**	**22**
Zinc	7440-66-6	5	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 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		**0.5**	**1.2**	**0.6**	**0.7**	**0.6**
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser									
Nitrite + Nitrate as N (Sol.)	---	0.1	mg/kg		**0.5**	**1.2**	**0.6**	**0.7**	**0.6**

Analytical Results

Sub-Matrix: **ROCK**

Compound	CAS Number	LOR	Unit	Client sample ID: 9983	9984	9985	9986	9987
				Client sampling date / time: 28-AUG-2011 15:00	28-AUG-2011 15:00	28-AUG-2011 15:00	28-AUG-2011 15:00	28-AUG-2011 15:00
				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								
^ 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	----	1	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 equiv./t	19.3	18.2	31.3	22.9	22.9
^ ANC as CaCO3	----	0.1	% CaCO3	2.0	1.9	3.2	2.3	2.3
Fizz Rating	----	0	Fizz Unit	1	1	2	1	1
EA055: Moisture Content								
^ Moisture Content (dried @ 103°C)	----	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	7090	6210
Antimony	7440-36-0	5	mg/kg	<5	<5	<5	<5	<5
Arsenic	7440-38-2	5	mg/kg	<5	<5	9	9	5
Barium	7440-39-3	10	mg/kg	40	50	40	100	40
Beryllium	7440-41-7	1	mg/kg	2	2	1	1	2
Boron	7440-42-8	50	mg/kg	<50	<50	<50	<50	<50
Cadmium	7440-43-9	1	mg/kg	<1	<1	<1	<1	<1

Analytical Results

Sub-Matrix: **ROCK**

Compound	CAS Number	LOR	Unit	Client sample ID	9983	9984	9985	9986	9987
				Client sampling date / time	28-AUG-2011 15:00	28-AUG-2011 15:00	28-AUG-2011 15:00	28-AUG-2011 15:00	28-AUG-2011 15:00
					EB1119039-046	EB1119039-047	EB1119039-048	EB1119039-049	EB1119039-050
EG005T: Total Metals by ICP-AES - Continued									
Chromium	7440-47-3	2	mg/kg		**4**	**6**	**5**	**6**	**6**
Cobalt	7440-48-4	2	mg/kg		**7**	**6**	**5**	**6**	**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	5	mg/kg		**20**	**33**	**18**	**24**	**19**
Manganese	7439-96-5	5	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		**8**	**8**	**11**	**12**	**12**
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		**63**	**64**	**57**	**55**	**58**
Tin	7440-31-5	5	mg/kg		<5	<5	<5	<5	<5
Vanadium	7440-62-2	5	mg/kg		**12**	**17**	**14**	**20**	**36**
Zinc	7440-66-6	5	mg/kg		**66**	**51**	**70**	**69**	**45**
Titanium	7440-32-6	10	mg/kg		**110**	**190**	**100**	**140**	**240**
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**	**0.2**	**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 Analyser									
^ 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 Discrete Analyser									
Nitrite + Nitrate as N (Sol.)	---	0.1	mg/kg		**0.6**	**0.5**	**0.7**	**1.4**	**0.2**

Analytical Results

Sub-Matrix: **ROCK**

Compound	CAS Number	LOR	Unit	Client sample ID: 9988	9989	9990	9991	9992
				Client sampling date / time: 28-AUG-2011 15:00	28-AUG-2011 15:00	28-AUG-2011 15:00	28-AUG-2011 15:00	28-AUG-2011 15:00
				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	----	1	µS/cm	121	95	51	64	31
EA011-B: Dissolved Major Anions								
Sulfur as S	63705-05-5	1	mg/L	----	----	----	70	40
Chloride	16887-00-6	1	mg/L	----	----	----	<1	<1
EA011-C: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	----	----	----	28	14
Magnesium	7439-95-4	1	mg/L	----	----	----	12	5
Sodium	7440-23-5	1	mg/L	----	----	----	4	3
Potassium	7440-09-7	1	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 equiv./t	42.9	10.6	7.1	12.1	9.7
^ ANC as CaCO3	----	0.1	% CaCO3	4.4	1.1	0.7	1.2	1.0
Fizz Rating	----	0	Fizz Unit	2	1	0	1	0
EA055: Moisture Content								
^ Moisture Content (dried @ 103°C)	----	1.0	%	9.2	11.6	12.1	23.2	17.8
ED007: Exchangeable Cations								
^ Exchangeable Calcium	----	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								

Analytical Results

Sub-Matrix: **ROCK**

Compound	CAS Number	LOR	Unit	Client sample ID	9988	9989	9990	9991	9992
				Client sampling date / time	28-AUG-2011 15:00	28-AUG-2011 15:00	28-AUG-2011 15:00	28-AUG-2011 15:00	28-AUG-2011 15:00
					EB1119039-051	EB1119039-052	EB1119039-053	EB1119039-054	EB1119039-055
ED045G: Chloride Discrete analyser - Continued									
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		120	100	60	80	40
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		4580	4220	2100	840	780
Antimony	7440-36-0	5	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		30	30	30	10	<10
Beryllium	7440-41-7	1	mg/kg		2	2	5	6	3
Boron	7440-42-8	50	mg/kg		<50	<50	<50	<50	60
Cadmium	7440-43-9	1	mg/kg		<1	<1	<1	<1	<1
Chromium	7440-47-3	2	mg/kg		6	3	2	2	2
Cobalt	7440-48-4	2	mg/kg		4	<2	<2	4	4
Copper	7440-50-8	5	mg/kg		14	44	58	20	11
Iron	7439-89-6	50	mg/kg		11600	4640	13300	16900	1440
Lead	7439-92-1	5	mg/kg		19	20	19	5	7
Manganese	7439-96-5	5	mg/kg		295	35	47	153	8
Molybdenum	7439-98-7	2	mg/kg		<2	<2	<2	<2	<2
Nickel	7440-02-0	2	mg/kg		14	6	5	13	10
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		56	41	27	22	21
Tin	7440-31-5	5	mg/kg		<5	<5	<5	<5	<5
Vanadium	7440-62-2	5	mg/kg		58	20	45	51	15
Zinc	7440-66-6	5	mg/kg		46	14	6	<5	6
Titanium	7440-32-6	10	mg/kg		450	40	40	270	320
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		0.3	0.3	0.2	0.1	0.1
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser									

Analytical Results

Sub-Matrix: ROCK				Client sample ID	9988	9989	9990	9991	9992
				Client sampling date / time	28-AUG-2011 15:00	28-AUG-2011 15:00	28-AUG-2011 15:00	28-AUG-2011 15:00	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) by Discrete Analyser - Continued									
Nitrite + Nitrate as N (Sol.)	----	0.1	mg/kg		**0.3**	**0.3**	**0.2**	**0.1**	**0.1**

Environmental Division

CERTIFICATE OF ANALYSIS

Work Order	: **EB1222679**	Page	: 1 of 17
Client	: **ENDOCOAL LTD**	Laboratory	: Environmental Division Brisbane
Contact	: MR BRUCE OGILVIE	Contact	: Customer Services
Address	: SUITE 2 / 1 SWANN RD TARINGA BRISBANE QUEENSLAND 4068	Address	: 32 Shand Street Stafford QLD Australia 4053
E-mail	: cash.sale@alsenviro.com	E-mail	: Brisbane.Enviro.Services@alsglobal.com
Telephone	: +61 7 3720 9300	Telephone	: +61 7 3243 7222
Facsimile	: +61 7 3720 9311	Facsimile	: +61 7 3243 7218
Project	: Orion Downs - Meteor Downs South OBA	QC Level	: NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Order number	: ----		
C-O-C number	: ----	Date Samples Received	: 08-AUG-2012
Sampler	: Cameron Tomko	Issue Date	: 12-SEP-2012
Site	: ----		
		No. of samples received	: 32
Quote number	: ----	No. of samples analysed	: 32

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 approved for release.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

NATA Accredited Laboratory 825

Accredited for compliance with ISO/IEC 17025.

Signatories

This document has been electronically signed by the authorized signatories indicated below. Electronic signing has been carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Jonathon Angell	Inorganic Coordinator	Brisbane Inorganics
Kim McCabe	Senior Inorganic Chemist	Brisbane Inorganics
Kim McCabe	Senior Inorganic Chemist	Stafford Minerals - AY
Matt Frost	Senior Organic Chemist	Brisbane Inorganics
SATISH.TRIVEDI	2 IC Acid Sulfate Soils Supervisor	Brisbane Acid Sulphate Soils

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.

Key : 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
^ = 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 EB1222626-001 shows poor duplicate results due to sample heterogeneity. Confirmed by visual inspection.**
- **EG005T (Total Metals): Sample EB1222679-001 (117332) shows poor matrix spike recovery due to matrixinterference. Confirmed by visual inspection.**

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	117332	117333	117334	117335	117336
			Client sampling date / time	02-AUG-2012 15:00	02-AUG-2012 15:00	02-AUG-2012 15:00	02-AUG-2012 15:00	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	90	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

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Client sample ID	117332	117333	117334	117335	117336
				Client sampling date / time	02-AUG-2012 15:00	02-AUG-2012 15:00	02-AUG-2012 15:00	02-AUG-2012 15:00	02-AUG-2012 15:00
Compound	CAS Number	LOR	Unit		EB1222679-001	EB1222679-002	EB1222679-003	EB1222679-004	EB1222679-005
EG005T: Total Metals by ICP-AES - Continued									
Barium	7440-39-3	10	mg/kg		480	180	100	90	60
Beryllium	7440-41-7	1	mg/kg		1	1	1	1	1
Boron	7440-42-8	50	mg/kg		<50	<50	<50	<50	<50
Cadmium	7440-43-9	1	mg/kg		<1	<1	<1	<1	<1
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	5	mg/kg		6	<5	<5	<5	<5
Manganese	7439-96-5	5	mg/kg		1450	762	565	731	823
Molybdenum	7439-98-7	2	mg/kg		<2	<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	5	mg/kg		<5	<5	<5	<5	<5
Vanadium	7440-62-2	5	mg/kg		103	77	73	76	50
Zinc	7440-66-6	5	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 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		0.8	0.4	0.2	<0.1	<0.1
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser									
Nitrite + Nitrate as N (Sol.)	----	0.1	mg/kg		0.8	0.4	0.2	<0.1	<0.1

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	117337	117338	117339	117340	117341
			Client sampling 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	----	1	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	3	3	3	3	3
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	----	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	<5	<5	<5	<5	<5
Arsenic	7440-38-2	5	mg/kg	<5	<5	<5	<5	<5

Analytical Results

Sub-Matrix: **SOIL** (Matrix: **SOIL**)

Compound	CAS Number	LOR	Unit	Client sample ID	117337	117338	117339	117340	117341
				Client sampling 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
					EB1222679-006	EB1222679-007	EB1222679-008	EB1222679-009	EB1222679-010
EG005T: Total Metals by ICP-AES - Continued									
Barium	7440-39-3	10	mg/kg		50	30	20	30	90
Beryllium	7440-41-7	1	mg/kg		<1	1	1	<1	1
Boron	7440-42-8	50	mg/kg		<50	<50	<50	<50	<50
Cadmium	7440-43-9	1	mg/kg		<1	<1	<1	<1	<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	66
Iron	7439-89-6	50	mg/kg		65400	69400	76000	83700	70900
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		<2	<2	<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	99	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 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 Discrete Analyser									
Nitrite + Nitrate as N (Sol.)	----	0.1	mg/kg		<0.1	<0.1	0.2	0.2	0.1

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Client sample ID	117342	117343	117344	117345	117346
				Client sampling 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	----	1	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		3	3	3	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

Analytical Results

Sub-Matrix: **SOIL** (Matrix: **SOIL**)

Compound	CAS Number	LOR	Unit	Client sample ID	117342	117343	117344	117345	117346
				Client sampling 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
					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	90
Beryllium	7440-41-7	1	mg/kg		<1	<1	<1	1	2
Boron	7440-42-8	50	mg/kg		<50	<50	<50	<50	<50
Cadmium	7440-43-9	1	mg/kg		<1	<1	<1	<1	<1
Chromium	7440-47-3	2	mg/kg		53	69	101	71	26
Cobalt	7440-48-4	2	mg/kg		37	36	38	27	6
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 Discrete Analyser									
Nitrite + Nitrate as N (Sol.)	----	0.1	mg/kg		<0.1	0.1	0.2	0.2	0.1

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Client sample ID	117347	117348	117349	117350	117351
				Client sampling date / time	05-AUG-2012 15:00	05-AUG-2012 15:00	05-AUG-2012 15:00	05-AUG-2012 15:00	05-AUG-2012 15:00
Compound	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	----	1	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		1	2	2	1	1
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	0.6	0.6
Exchangeable Sodium	----	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	%		0.09	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	6	8	8	<5
Barium	7440-39-3	10	mg/kg		60	60	70	60	70
Beryllium	7440-41-7	1	mg/kg		2	2	1	2	1

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Client sample ID	117347	117348	117349	117350	117351
				Client sampling date / time	05-AUG-2012 15:00	05-AUG-2012 15:00	05-AUG-2012 15:00	05-AUG-2012 15:00	05-AUG-2012 15:00
Compound	CAS Number	LOR	Unit		EB1222679-016	EB1222679-017	EB1222679-018	EB1222679-019	EB1222679-020
EG005T: Total Metals by ICP-AES - Continued									
Boron	7440-42-8	50	mg/kg		<50	<50	<50	<50	<50
Cadmium	7440-43-9	1	mg/kg		<1	<1	<1	<1	<1
Chromium	7440-47-3	2	mg/kg		**11**	**18**	**17**	**20**	**17**
Cobalt	7440-48-4	2	mg/kg		**2**	**5**	**15**	**13**	**10**
Copper	7440-50-8	5	mg/kg		**6**	**10**	**7**	**6**	**13**
Iron	7439-89-6	50	mg/kg		**6940**	**11600**	**17700**	**29700**	**18500**
Lead	7439-92-1	5	mg/kg		**15**	**13**	**14**	**16**	**16**
Manganese	7439-96-5	5	mg/kg		<5	**391**	**245**	**179**	**63**
Molybdenum	7439-98-7	2	mg/kg		<2	<2	<2	<2	<2
Nickel	7440-02-0	2	mg/kg		**6**	**11**	**19**	**12**	**12**
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		**57**	**70**	**60**	**36**	**54**
Tin	7440-31-5	5	mg/kg		<5	<5	<5	<5	<5
Vanadium	7440-62-2	5	mg/kg		**15**	**18**	**20**	**26**	**36**
Zinc	7440-66-6	5	mg/kg		**32**	**53**	**55**	**54**	**44**
Titanium	7440-32-6	10	mg/kg		**130**	**120**	**80**	**90**	**120**
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		**0.2**	**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**

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Client sample ID	117352	117353	117354	117355	117356
				Client sampling date / time	05-AUG-2012 15:00	05-AUG-2012 15:00	05-AUG-2012 15:00	05-AUG-2012 15:00	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	----	1	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	1	1	1	3
ED007: Exchangeable Cations									
Exchangeable Calcium	----	0.1	meq/100g		30.2	27.0	25.9	27.4	26.4
Exchangeable Magnesium	----	0.1	meq/100g		5.3	4.9	6.8	6.4	2.5
Exchangeable Potassium	----	0.1	meq/100g		0.6	0.6	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	5	<5	10	10
Barium	7440-39-3	10	mg/kg		70	50	80	90	70
Beryllium	7440-41-7	1	mg/kg		2	1	2	2	2

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Client sample ID	117352	117353	117354	117355	117356
				Client sampling date / time	05-AUG-2012 15:00	05-AUG-2012 15:00	05-AUG-2012 15:00	05-AUG-2012 15:00	05-AUG-2012 15:00
Compound	CAS Number	LOR	Unit		EB1222679-021	EB1222679-022	EB1222679-023	EB1222679-024	EB1222679-025
EG005T: Total Metals by ICP-AES - Continued									
Boron	7440-42-8	50	mg/kg		<50	<50	<50	<50	<50
Cadmium	7440-43-9	1	mg/kg		<1	<1	<1	<1	1
Chromium	7440-47-3	2	mg/kg		21	15	16	10	14
Cobalt	7440-48-4	2	mg/kg		8	9	3	8	10
Copper	7440-50-8	5	mg/kg		9	<5	13	19	12
Iron	7439-89-6	50	mg/kg		25900	28600	17400	39700	150000
Lead	7439-92-1	5	mg/kg		14	12	14	18	7
Manganese	7439-96-5	5	mg/kg		436	146	64	999	3480
Molybdenum	7439-98-7	2	mg/kg		<2	<2	<2	<2	<2
Nickel	7440-02-0	2	mg/kg		9	11	6	12	10
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		74	56	78	81	121
Tin	7440-31-5	5	mg/kg		<5	<5	<5	<5	<5
Vanadium	7440-62-2	5	mg/kg		27	25	25	22	57
Zinc	7440-66-6	5	mg/kg		54	64	38	62	30
Titanium	7440-32-6	10	mg/kg		130	80	120	100	60
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	<0.1	0.2	0.1
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser									
Nitrite + Nitrate as N (Sol.)	----	0.1	mg/kg		0.1	0.1	<0.1	0.2	0.1

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)

Compound	CAS Number	LOR	Unit	Client sample ID	117357	117358	117359	117360	117361
				Client sampling date / time	05-AUG-2012 15:00	05-AUG-2012 15:00	05-AUG-2012 15:00	05-AUG-2012 15:00	05-AUG-2012 15:00
					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	3	1	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	1	mg/kg		2	3	1	<1	1

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Client sample ID	117357	117358	117359	117360	117361
				Client sampling date / time	05-AUG-2012 15:00	05-AUG-2012 15:00	05-AUG-2012 15:00	05-AUG-2012 15:00	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	1	mg/kg		<1	1	<1	<1	<1
Chromium	7440-47-3	2	mg/kg		12	12	12	14	15
Cobalt	7440-48-4	2	mg/kg		8	26	9	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	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		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	5	mg/kg		69	44	74	47	73
Titanium	7440-32-6	10	mg/kg		100	50	110	80	110
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		0.2	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 Analyser									
Nitrite + Nitrate as N (Sol.)	----	0.1	mg/kg		0.2	0.2	0.2	0.2	0.2

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	117362	117363	----	----	----
			Client sampling date / time	06-AUG-2012 15:00	06-AUG-2012 15:00	----	----	----
Compound	CAS Number	LOR	Unit	EB1222679-031	EB1222679-032	----	----	----
EA002 : pH (Soils)								
pH Value	----	0.1	pH Unit	8.9	7.6	----	----	----
EA009: Nett Acid Production Potential								
Net Acid Production Potential	----	0.5	kg H2SO4/t	-43.3	<0.5	----	----	----
EA010: Conductivity								
Electrical Conductivity @ 25°C	----	1	µS/cm	297	120	----	----	----
EA011-B: Dissolved Major Anions								
Sulfur as S	63705-05-5	1	mg/L	----	19	----	----	----
Chloride	16887-00-6	1	mg/L	----	<1	----	----	----
EA011-C: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	----	14	----	----	----
Magnesium	7439-95-4	1	mg/L	----	8	----	----	----
Sodium	7440-23-5	1	mg/L	----	4	----	----	----
Potassium	7440-09-7	1	mg/L	----	3	----	----	----
EA011-D: Calculated Components								
Calculated Acid Component	----	0.1	kg H2SO4/t	----	5.7	----	----	----
Calculated Neutralisng Component	----	0.1	kg H2SO4/t	----	8.2	----	----	----
Calculated NAG Acidity	----	0.1	kg H2SO4/t	----	<0.1	----	----	----
EA011E-A: pH OX								
pH (OX)	----	0.1	pH Unit	9.9	4.2	----	----	----
pH -2 (ext)	----	0.1	pH Unit	----	5.9	----	----	----
EA013: 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	----	----	----
Fizz Rating	----	0	Fizz Unit	2	1	----	----	----
ED007: Exchangeable Cations								
Exchangeable Calcium	----	0.1	meq/100g	28.6	5.7	----	----	----
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	----	----	----
Cation Exchange Capacity	----	0.1	meq/100g	36.8	11.4	----	----	----
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	0.03	0.18	----	----	----

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Client sample ID	117362	117363	----	----	----
				Client sampling date / time	06-AUG-2012 15:00	06-AUG-2012 15:00	----	----	----
Compound	CAS Number	LOR	Unit		EB1222679-031	EB1222679-032	----	----	----
ED045G: Chloride Discrete analyser									
Chloride	16887-00-6	10	mg/kg		<10	<10	----	----	----
ED093S: Soluble Major Cations									
Calcium	7440-70-2	10	mg/kg		<10	<10	----	----	----
Magnesium	7439-95-4	10	mg/kg		<10	<10	----	----	----
Sodium	7440-23-5	10	mg/kg		290	110	----	----	----
Potassium	7440-09-7	10	mg/kg		30	10	----	----	----
EG005T: Total Metals by ICP-AES									
Aluminium	7429-90-5	50	mg/kg		11100	5000	----	----	----
Antimony	7440-36-0	5	mg/kg		<5	<5	----	----	----
Arsenic	7440-38-2	5	mg/kg		7	<5	----	----	----
Barium	7440-39-3	10	mg/kg		50	50	----	----	----
Beryllium	7440-41-7	1	mg/kg		1	<1	----	----	----
Boron	7440-42-8	50	mg/kg		<50	<50	----	----	----
Cadmium	7440-43-9	1	mg/kg		<1	<1	----	----	----
Chromium	7440-47-3	2	mg/kg		10	6	----	----	----
Cobalt	7440-48-4	2	mg/kg		5	<2	----	----	----
Copper	7440-50-8	5	mg/kg		30	32	----	----	----
Iron	7439-89-6	50	mg/kg		15000	11100	----	----	----
Lead	7439-92-1	5	mg/kg		19	19	----	----	----
Manganese	7439-96-5	5	mg/kg		318	141	----	----	----
Molybdenum	7439-98-7	2	mg/kg		<2	<2	----	----	----
Nickel	7440-02-0	2	mg/kg		11	3	----	----	----
Selenium	7782-49-2	5	mg/kg		<5	<5	----	----	----
Silver	7440-22-4	2	mg/kg		<2	<2	----	----	----
Strontium	7440-24-6	2	mg/kg		57	100	----	----	----
Tin	7440-31-5	5	mg/kg		<5	<5	----	----	----
Vanadium	7440-62-2	5	mg/kg		26	37	----	----	----
Zinc	7440-66-6	5	mg/kg		79	28	----	----	----
Titanium	7440-32-6	10	mg/kg		90	300	----	----	----
Thallium	7440-28-0	5	mg/kg		<5	<5	----	----	----
EG035T: Total Recoverable Mercury by FIMS									
Mercury	7439-97-6	0.1	mg/kg		0.2	0.2	----	----	----
EK057G: Nitrite as N by Discrete Analyser									

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	117362	117363	----	----	----
			Client sampling date / time	06-AUG-2012 15:00	06-AUG-2012 15:00	----	----	----
Compound	CAS Number	LOR	Unit	EB1222679-031	EB1222679-032	----	----	----
EK057G: Nitrite as N by Discrete Analyser - Continued								
Nitrite as N (Sol.)	----	0.1	mg/kg	<0.1	<0.1	----	----	----
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N (Sol.)	----	0.1	mg/kg	**0.1**	**0.1**	----	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N (Sol.)	----	0.1	mg/kg	**0.1**	**0.1**	----	----	----

Appendix C

Approved Regional Interests Development Approval (RIDA)

Queensland Government

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**.

Table 1: Approved activities

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

Area of regional interest	Resource activity	Location	Area of disturbance
	facilities • Coal Handling Preparation Plant, including crushing and screening equipment • Water and sediment management systems • Haul roads • Sewerage treatment plant • Fire protection systems		
	Extraction activities including: • Open cut mining pit • Spoil dump • Water and sediment management systems • Haul roads • Plant parking areas • Temporary workers facilities • Fire protection systems	Part of Lot 1 on SP174071	50.72ha
	Ancillary mine support activities including: • Water and sediment management systems • Haul roads • Quarry • Security facilities • Offices • Fire protection systems	Part of Lot 4 on SP170470	40.29ha
	Ancillary mine support activities including: • Water and sediment management systems • Haul roads • Fire protection systems	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: a) The approved drawing, *Figure AC1 Mine Infrastructure and PALU (undated)* **(See Attachment 2)** b) The activities identified in Table 1: Approved activities.	For the duration of the conduct of the 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.	a) Any disturbance of land in accordance with this RIDA is not to impact adversely on other priority agricultural land uses in the PAA. 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: i) name, address and contact number of the complainant 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 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.	While construction is occurring and then for the duration of the conduct of the approved activities

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 and 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)*