NOVEMBER 2010

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BROCKMAN RESOURCES LIMITED
MARILLANA IRON ORE PROJECT
TOPSOIL MANAGEMENT PLAN

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BROCKMAN RESOURCES LTD

MARILLANA IRON ORE PROJECT

TOPSOIL MANAGEMENT PLAN

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NOVEMBER 2010

Document Status						
Rev	**Author**	**Reviewer/s**	**Date**	**Approved for Issue**		
				Name	**Distributed To**	**Date**
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ACRONYMS

ASX	Australian Stock Exchange
CCP	Conceptual Closure Plan
DEC	Department of Environment and Conservation
DMP	Department of Mines and Petroleum
EMS	Environmental Management System
EPA	Environmental Protection Authority
PEMP	Project Environmental Management Plan
PER	Public Environmental Review
TMP	Topsoil Management Plan

1 INTRODUCTION

Brockman Iron Pty Ltd (Brockman) proposes the Marillana Iron Ore Project (the Project). The Project is located approximately 100 km northwest of Newman, in the Hamersley Iron Ore Province in the Pilbara region of Western Australia.

The Project is located within E47/1408 and is subject to applications M47/1414 and M47/1419. All tenements are held by Brockman Iron Pty Ltd, a wholly owned subsidiary of ASX listed company Brockman Resources Limited.

Brockman proposes to develop the Project which consists of a 700-750 Mt iron ore mine, processing facility and associated infrastructure. The Project will consist of conventional open pit mining operations, wet ore processing, stockpiling and the establishment and maintenance of an accommodation village and supporting infrastructure. The mine is anticipated to yield up to 19 Mtpa over 20 years. Ore will be transported by rail to Port Hedland, where it will be exported to world markets.

This Topsoil Management Plan (TMP) forms part of the supporting documentation that is to be submitted to the Department of Mines and Petroleum (DMP) for assessment with the Brockman Marillana Iron Ore Project Mining Proposal.

1.1 PURPOSE AND SCOPE

The effective and appropriate re-use of topsoil is essential in achieving successful rehabilitation outcome for the Project. Topsoil is a strategic resource which can significantly reduce revegetation timeframes and therefore expedite performance bond return.

The purpose of this TMP is to provide guidance and direction to the Project for the management and use of the topsoil resource recovered, in order to ensure successful rehabilitation for the Project.

This TMP is intended as a guide only and will be reviewed and updated periodically throughout the life of the mine in response to technology changes, research and to address changes to management strategies.

This TMP outlines:

- Relevant Legislation and Commitments;
- Existing Resource: Topsoil and subsoil characteristics; and
- Methodologies for harvesting and preserving topsoil, including:
    - Harvestable topsoil volumes, stockpile dimensions and location;
    - Estimated volumes of topsoils and other subsoil materials required for closure rehabilitation and decommissioning.

This TMP applies to the Marillana Iron Ore Project, undertaken by, or for, Brockman Resources Ltd and should be read in conjunction with Brockman's Conceptual Closure Plan (CCP), Environmental Management System (EMS) procedures manual and Project Environmental Management Plan (PEMP).

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2 LEGISLATION AND MANAGEMENT COMMITMENTS

There is a range of legislation that relates to mine site rehabilitation and is therefore linked to topsoil management. In Western Australia the legislation of most relevance includes:

- *The Environmental Protection Act 1986;*
- *The Mining Act 1978*; and
- *The Soil and Land Conservation Act 1945*.

In addition to the above legislation, Brockman has made specific environmental commitments relating to topsoil management from the Brockman Resources Marillana Iron Ore Project *Public Environmental Review (PER):*

- Commitment 8: Brockman will ensure that modified and/or created landforms are left in a stable and safe condition post mine closure and reflect natural landforms in the surrounding area.
- Commitment 9: Twenty-four months prior to mine closure, a Mine Closure Plan will be finalised in consultation with the Department of Environment and Conservation (DEC) and DMP. The plan will define appropriate closure criteria necessary for the establishment of safe landforms and self sustaining ecosystems, and set out procedures for monitoring in order to meet compliance with the closure criteria.
- Commitment 11: Rehabilitation will occur progressively as disturbed areas are no longer required for mining activities.
- Commitment 12: Soil characterisation assessments will be conducted to determine the suitability of topsoil for supporting rehabilitation.

The PER included the *Conceptual Closure Plan* as a supporting document which makes the following commitment directly relates to the management of topsoil:

- Commitment 12: Topsoil remains viable and has the capacity to support a safe, stable and functioning ecosystem that meets the requirements of the post-mining land use.

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3 EXISTING RESOURCES

The Project lies within a large region of soils that have been classified by Bettenay et al. (1967) as dominated by:

- red earth;
- hard-setting loamy soils;
- loamy soils with pedalogic organisation;
- dissected pediments; and
- outwash plains.

The three soil types that are most applicable to the Project area are the red earth plains of the Fortescue valley, the surface cover of which consists of stony gravels, the dissected pediments forming low stony hills and the outwash plains; both of which support a surface cover of gravel and the hard setting loamy soils with red clay subsoils forming dissected stony pediments, hills and mesas. As a consequence of the sparse vegetation cover and the erosive force of heavy summer cyclonic rains, much of the soil on the hill slopes tends to be transported down to the valleys and plains.

In botanical surveys of the Project area (*ecologia*, 2009), eight vegetation units were identified within the Project area (see Figure 3.1), with some units further classified into twelve subunits. The vegetation units were associated with the following landforms: Creekline, minor drainage channels on footslope, clay pan, minor channel/depression, floodplain, longitudinal sand dunes, swale between dunes, and sandy plain/minor footslope. The landscape of the Project area historically, and currently, is being utilised for pastoralism and is significantly degraded in some areas.

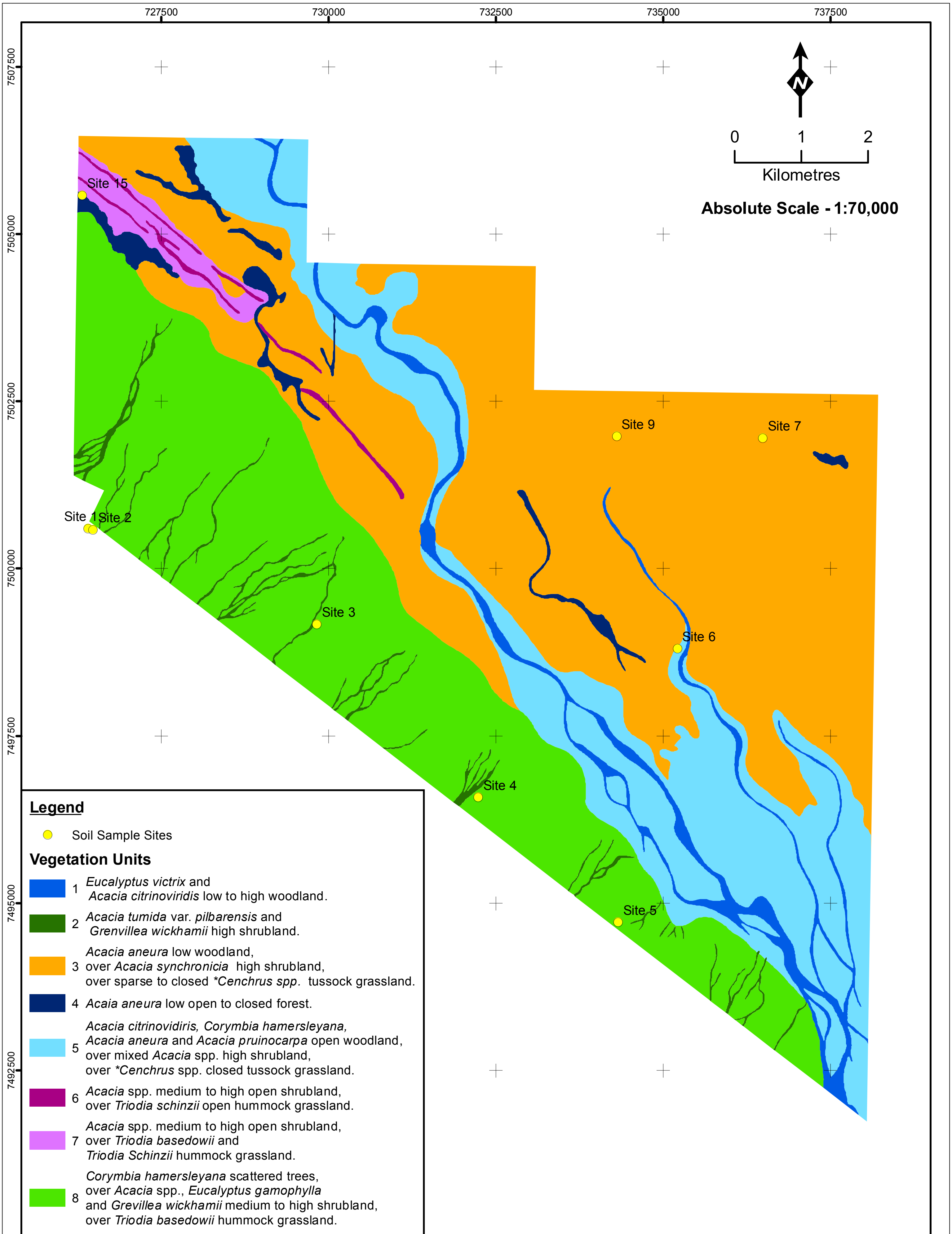
Representative topsoil samples were taken from across the Project area in May 2010 as presented in Figure 3.1 and Table 3.1 below. These investigations identify the physical and chemical properties of topsoil across the Project area, and correlation with vegetation communities. Further soil characterisation assessments will be conducted to ascertain the suitability of the topsoil for rehabilitation purposes.

Table 3.1 – Topsoil Sample Locations and Corresponding Vegetation Units of the Project Area

Site	Location (GDA94, 50K)		Habitat	Vegetation	Equivalent to Marillana Veg Unit
	Easting mE	Northing mN			
Site 1	726411	7500600	Minor channel on rocky footslope	Isolated low trees of Corymbia hamersleyana, over Acacia tumida open tall shrubland, over Tephrosia rosea and Indigofera monophylla open low shrubland.	2
Site 2	726483	7500589	Rocky ironstone footslope	Isolated Acacia inaequilatera tall shrubs, over Triodia basedowii hummock grassland.	8
Site 3	729824	7499174	Sandy red plain	Acacia inaequilatera and Acacia pachyacra sparse tall shrubland, over Triodia basedowii hummock grassland.	8
Site 4	732237	7496580	Sandy red plain / footslope, few ironstone rocks	Grevillea wickhamii open tall shrubland, over Triodia basedowii hummock grassland.	8

Site 5	734327	7494712	Sandy red plain / footslope, moderate ironstone rocks	Eucalyptus gamophylla open low mallee woodland, over Triodia basedowii hummock grassland.	8
Site 6	735210	7498806	Red-orange, sandy-clay floodplain, no rocks, very degraded	Acacia pruinocarpa sparse low woodland, over Acacia synchronicia open tall to mid shrubland, over *Cenchrus ciliaris open tussock grassland.	5
Site 7	736487	7501951	Clay pan, no rocks	Acacia synchronicia tall shrubland, over *Cenchrus ciliaris open tussock grassland.	3
Site 9	734301	7501978	Clay pan, no rocks	Acacia aneura open low woodland, over Acacia synchronicia open tall to mid shrubland over *Cenchrus ciliaris open tussock grassland.	3
Site 15	726322	7505580	Clay pan, no rocks	Acacia aneura low woodland.	4

The detailed analytical methodology and results from topsoil analysis at Marillana are provided in Appendix A and a summary is presented below in Table 3.2. The pH values of soil samples taken from Marillana range from 4.9 to 6.5.



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Brockman Marillana Flora and Vegetation Map and Topsoil Sampling sites

Figure: 3.1
Project ID: 1291

Drawn: AH
Date: 29/10/10

Coordinate System
Name: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994

Unique Map ID: AH272

A4

Table 3.2 – Results of Topsoil Analysis

	Method Code	Limit of Reporting	Units	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 9	Site 15
Stones	(>2mm)	0.1	%	60.7	51.4	2.2	20.3	10.2	20.4	21.3	44.1	12.6
EC	(1:5)	1	mS/m	2	2	4	2	<1	3	2	4	4
TDS	(1:5)	10	mg/kg	79	74	140	64	14	110	74	140	120
pH	(CaCl2)	0.1		5.8	5.4	5.8	5.4	4.9	6.5	6	6.3	5.4
Sand	(S07)	0.5	%	91.5	90	90	89.5	93	84	74.5	59.5	87.5
Silt	(S07)	0.5	%	2.5	3.5	3.5	3.5	2	7.5	11	22.5	6.5
Clay	(S07)	0.5	%	6	6.5	6.5	7	5	8.5	14.5	18	6
OrgC	(W/B)	0.05	%	0.16	0.46	1.02	0.22	0.18	0.63	0.53	0.54	0.37
C:N	(calc)	0.1		11	19	15	12	13	19	16	12	9
Emerson	Class	1		2	2	2	2	2	2	2	2	2
N	(total)	0.005	%	0.015	0.024	0.069	0.019	0.014	0.033	0.034	0.046	0.042
NO3-N	NO3-NH4	1	mg/kg	5	5	13	4	1	5	3	9	10
P	(totals)	10	mg/kg	460	500	290	450	480	290	260	330	440
B	(M3)	0.1	mg/kg	0.2	0.2	0.2	<0.1	<0.1	0.1	0.2	0.2	<0.1
Ca	(M3)	10	mg/kg	380	440	790	340	180	1200	920	1600	530
Cd	(M3)	0.01	mg/kg	<0.01	0.02	0.02	0.02	<0.01	0.02	0.04	0.04	<0.01
Co	(M3)	0.01	mg/kg	0.88	0.79	0.9	1	0.73	2.2	2.9	4.1	1.4
Cu	(M3)	0.1	mg/kg	0.6	0.9	0.9	1	0.6	1.8	3.5	4.6	1
Fe	(M3)	1	mg/kg	40	46	48	44	43	68	72	80	55
K	(M3)	1	mg/kg	95	130	180	120	47	170	260	370	210
Mg	(M3)	10	mg/kg	74	100	100	81	51	280	280	440	91
Mn	(M3)	0.05	mg/kg	60	89	96	100	63	110	150	200	110
Mo	(M3)	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	<0.01
Na	(M3)	1	mg/kg	<1	<1	2	2	<1	4	4	7	4
Ni	(M3)	0.1	mg/kg	0.2	0.4	0.4	0.3	0.1	0.6	1.3	1.4	0.4
P	(M3)	1	mg/kg	2	4	6	3	2	8	5	18	15
S	(M3)	1	mg/kg	2	2	3	2	1	3	3	6	3
Zn	(M3)	0.1	mg/kg	0.3	0.4	0.9	0.4	0.4	1.1	1.6	1.8	1.6
As	(M3)	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1	<0.1
Pb	(M3)	0.1	mg/kg	0.3	0.5	0.4	0.6	0.6	0.4	0.5	0.4	0.5
Se	(M3)	0.1	mg/kg	<0.1	<0.1	0.1	<0.1	<0.1	0.1	<0.1	0.1	<0.1

Baseline information provides valuable pre-mining information about the soils and their characteristics prior to disturbance. Based upon the information above, the soil units can be classified and related to the vegetation communities which have been mapped for the Project area.

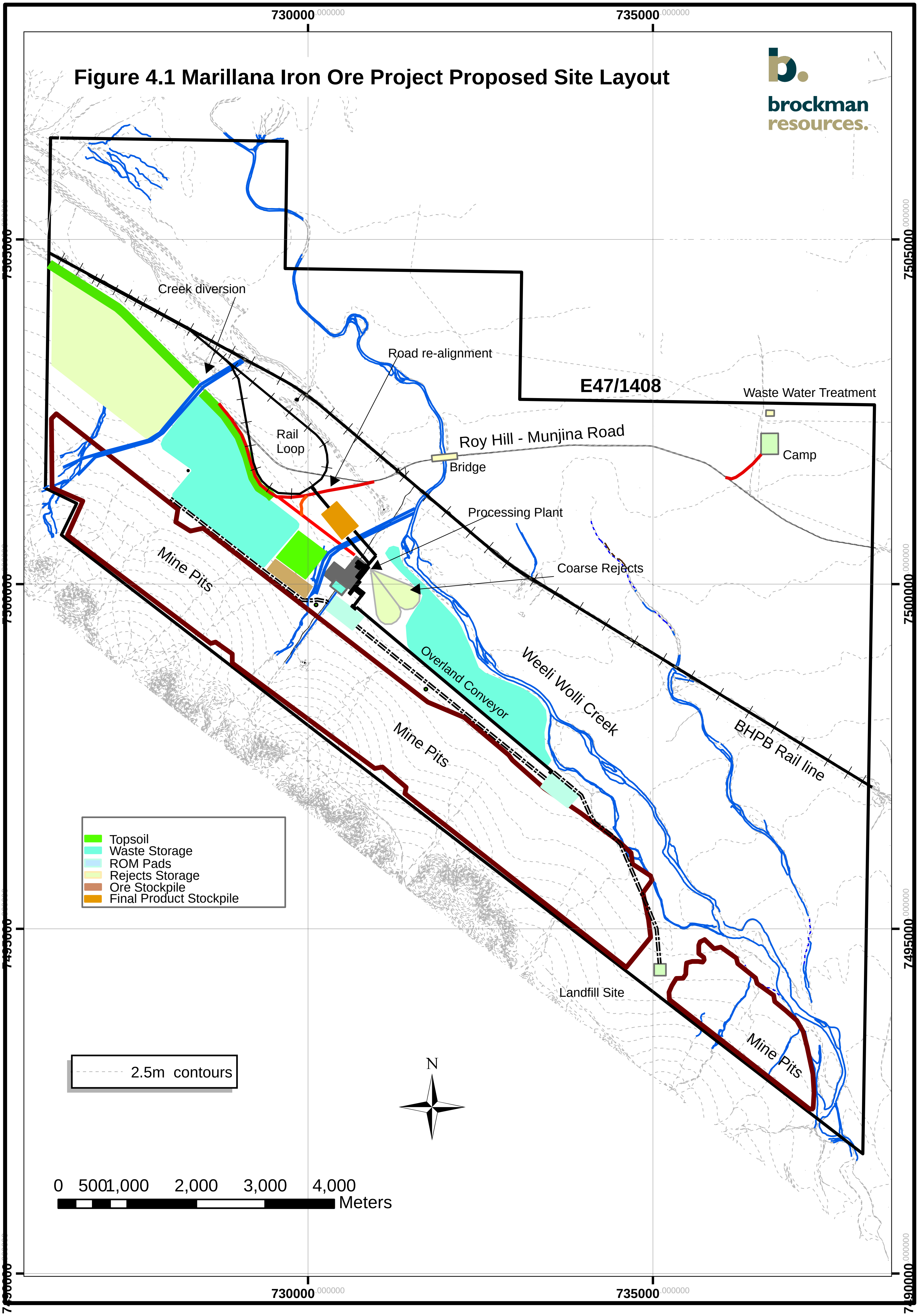
A detailed rehabilitation programme will be developed within the first two years of mining activities which will include development of completion criteria to determine when rehabilitation can be considered self-sustaining.

4 TOPSOIL MANAGEMENT

Topsoil management for the mining operations involves several key components. These include:

- Baseline topsoil investigations carried out across the Project area. Soil characterization assessments will be conducted to ascertain the suitability of the topsoil for rehabilitation purposes.
- Stripping will be undertaken progressively and in the appropriate quantities, to a maximum depth of 200 mm where possible… The aim is to maximise recovery of topsoil and plant growth media from each cleared area.
- As the mine development progresses, topsoil will be used directly in rehabilitation to rehabilitate disturbed areas, or stored for the shortest possible period of time. The soil will be stockpiled at a height no greater than 2 m in height where possible. Topsoil will be stored such that it is protected from internal rainfall and runoff using temporary vegetation or mulching, and protected from external runoff using diversion banks/drains.
- Where topsoil requires storage for longer periods of time (due to mining schedule), it will be stored in engineered stockpiles 10 – 20 m in height to minimise the disturbance footprint. Additional soil amelioration, such as seeding and fertilisation, will be required to maximise the effectiveness of the topsoil during rehabilitation. Topsoil will be stored in areas that pose minimal impact on surface and ground water, and reduce the potential for pollution, see Figure 4.1.
- Topsoil utilisation is scheduled and planned as part of the detailed rehabilitation programme. Rehabilitation areas will be subject to restricted access.

Figure 4.1 Marillana Iron Ore Project Proposed Site Layout



4.1 MINE PLANNING

Topsoil stripping and stockpiling is one of the first steps of the site development and construction, for example, preliminary earthworks. It is important that the total resource available is fully utilised and is made available for rehabilitation.

Mine planning has incorporated topsoil stripping and haulage into the mining schedule, to ensure that topsoil on the advancing mine pit, Fine Rejects Storage (FRS) and external waste dumps is removed and stored in appropriate locations.

The Operations / SHE Manager shall ensure that all areas designated for topsoil storage are clearly identified as being for such purpose.

Rehabilitation will occur progressively where possible, as disturbed areas are no longer required for mining activities. Topsoil will be stripped and placed directly onto areas requiring rehabilitation to a depth of at least 100 mm where possible. Where this is not possible it will be stockpiled separately and away from water courses.

Mine planning and the rehabilitation plans will be consulted regularly to determine if any areas would be available during the year for rehabilitation.

For each land disturbance activity, the operations are required to complete and submit a Site Disturbance Permit (EMS Form 8) prior to work commencing. As part of the permit, the disturbance area and expected topsoil volume are to be recorded.

4.2 STRIPPING

Maximising topsoil recovery during development and construction is important to ensure that there is sufficient topsoil available for rehabilitation. Potential impacts from inadequate stripping management procedures include dust emissions, altered soil structure, and the dispersal and spread of weed species.

As a method for reducing topsoil related environmental impacts, topsoil will be stripped and placed directly onto areas requiring rehabilitation to a depth of at least 100 mm. Where this is not practical, topsoil will be stockpiled separately and away from water courses, and vegetation debris, logs and leaf litter will be retained where possible for reuse during rehabilitation. A temporary cover of the stockpile may be required to minimise losing this important resource to rain and wind erosion.

Stripping of topsoil at the mine pit will commence at the eastern end of the orebody and work progressively to the west. The footprint of the active mining area and the temporary waste dumps will be stripped of topsoil to a maximum depth of 200 mm and stockpiled as per Figure 4.1. This topsoil will be stored in selected areas ready to be used when rehabilitation work is possible.

It is anticipated that minor topsoil stockpiles will be located in small areas not required for infrastructure and closer to the source of the topsoil, in order to reduce haulage distances. This will reduce further the volume of topsoil to be stored in the main topsoil stockpile areas.

Topsoil should not be stripped when wet, as this leads to compaction and the loss of soil structure. Scrapers have proven to be the most efficient machine for stripping flat, relatively deep soil, in particular soil from flood plains or drainage lines. The most common method for soil stripping at

Marillana is the use of large dozers. Care should be taken when stripping to minimise compaction of soil. This can be achieved by stripping from the outer edges first and working inwards.

The estimated volume of topsoil that will be harvested during clearing for this Project is 5,970,000 m^3. The volume of topsoil harvested during clearing and Project rehabilitation requirements are summarised in Table 4.1 below.

Table 4.1 – Estimated Topsoil Requirements for the Project

Disturbance Area	Estimated Topsoil Removed (m^3) (m^2 x 0.2m depth)	Estimated Topsoil Replacement (m^3) (m^2x 0.1m depth)
Mine Pit area (1,648 ha)	3,296,000 m^3	1,648,000 m^3
Overburden Stockpiles (587 ha)	1,174,000 m^3	587,000 m^3
Ore Stockpiles (13 ha)	26,000 m^3	13,000 m^3
Topsoil Stockpiles (78 ha)	156,000 m^3	78,000 m^3
Processing area footprint incl. Stockyard and rail loop (234 ha)	468,000 m^3	234,000 m^3
Fine Rejects Storage Facility (247 ha)	494,000 m^3	247,000 m^3
Ancillary infrastructure (30 ha)	60,000 m^3	30,000 m^3
Services and Infrastructure (148 ha)	296,000 m^3	148,000 m^3
Total (2985 ha)	**5,970,000 m^3**	**2,985,000 m^3**

There will be sufficient volume within the stockpile areas allocated for all topsoil to be stripped and stored for the required time. Upon completion of the Project Definitive Feasibility Study (DFS), further details of stockpile construction, scheduled stripping dates and redeployment timeframes will become available and incorporated into the TMP and Rehabilitation Plan.

4.3 STORAGE

Ideally, topsoil should not be stockpiled. However, it is not possible to avoid the storage of topsoil as the progressive nature of the mining schedule which indicates that the majority of the land disturbed by the Project will only be available for final rehabilitation at Year 7 of the Project life.

Prior to site development, topsoil must be removed, and stockpiled for future use. Surface and subsoil material will be stockpiled separately. Stockpiles will be constructed to minimise deterioration of seed, nutrients and soil biota, by avoiding topsoil collection when saturated following rainfall (this will promote composting), and by creating stockpiles of lower height (one to three metres) where possible. The duration of stockpiling will be minimised where possible. Vegetation debris, logs and leaf litter will be retained where possible for reuse during rehabilitation.

As the mine progresses, topsoil will be used directly in rehabilitation to rehabilitate disturbed areas, or stored for only a short period of time, to maximise the benefits of the microbial fraction.

The initial topsoil recovered from the mine pit will not be able to be used for at least seven years and will therefore be stockpiled in engineered stockpiles (up to 10 m in height) to minimise the topsoil stockpile disturbance footprint. It is acknowledged that the long storage time of the initially stockpiled topsoil will lead to the loss of biological fraction. Therefore, additional soil amelioration, such as seeding and fertilisation, will be required to maximise the benefit of the topsoil during rehabilitation. Seeding of the stockpile with a grass/legume mixture or native nitrogen-fixing species will assist in erosion control and reduce the loss of beneficial soil micro-organisms.

Where topsoil cannot be directly transferred to exposed surfaces requiring rehabilitation, it will be stockpiled on an area expected to occupy 78 ha. This will be stored in the areas as per Figure 4.1. Topsoil storage will be located away from drainage lines and upstream of sediment basins, with protection from internal rainfall and runoff using temporary vegetation or mulching, and external runoff using diversion banks/drains.

4.4 RECOVERY

Rehabilitation will be carried out progressively over the life of the Project. It is expected that the rehabilitation will include the use of topsoil recovered from the stockpiles, ground preparation such as deep ripping and scarification of the top surface and the sowing of local native seeds. Some degree of soil amelioration through the addition of fertiliser and/or soil pH adjustment may also be required, while the strong seasonality in germination displayed by many native plants at this site may require more than one seeding program to obtain the sought-after diversity in vegetative cover. The selected combination of methods will have been developed in the rehabilitation plan.

The rehabilitation techniques will be regularly reviewed, based on knowledge gained by trials, monitoring performance of existing rehabilitation in other parts of the Pilbara as well as site specific information on waste and topsoil characterisation and performance.

Rehabilitation monitoring will be carried out until revegetation meets the designed completion criteria and is signed off by the DMP.

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5 REVIEW

This TMP will be regularly reviewed, based on knowledge gained by field trials, harvest and preservation methodologies, monitoring performance of topsoil management in other parts of the Pilbara as well as site specific information on topsoil characterisation and performance.

It is expected that the topsoil management techniques will evolve with time and their implementation should be regularly reviewed and updated.

Review of the TMP will include:

- Topsoil and subsoil characteristics in relation to plant growth;
- Review and validation of the topsoil and subsoil volumes, stockpile dimensions and locations;
- Review and improvement of the TMP at least every five years over the life of the Project to consider changes in site conditions, operations, technology and community expectations; and
- Reviews and updates on the TMP in relation to the estimated volumes of topsoils and other materials required for rehabilitation and closure.

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6 REPORTING

Reporting procedures will be established during operations and will continue to ensure that results of all field trials and actions are properly recorded, referenced, and available for other personnel and for long-term reference.

A register of topsoil stockpiles will be maintained on-site recording location, stockpile number, the date placed, the source location, the volume and type (topsoil/subsoil) and comments (including rehandling/relocation, seeding etc). Topsoil utilisation for rehabilitation will also be recorded.

Compliance with this will be reported to the DEC and the DMP during and at the end of operations in the Annual Environmental Report.

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7 REFERENCES

Bettenay, E., Churchward, H.M.,McArthur, W.M. and Northcote,K.H. (1967). *Atlas of Australian Soils. Explanatory data for Sheet 6, Meekatharra - Hamersley Range area.* Commonwealth Scientific and Industrial Research Organisation, and Melbourne University Press. Cambridge University Press, London and New York.

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APPENDIX A ANALYTICAL METHODOLOGY AND RESULTS FROM TOPSOIL ANALYSIS

Report of Examination

Order No. 1140
Your Ref
Our Ref 09A0547
Enquiries Rick Staker
Telephone 08 9422 9952

Garry Connell
Ecologia
1025 Wellington Street
West Perth WA 6005

Report on 9 samples of soil
Received on 08/06/2010

CCWA ID	Client ID	Client Description
09A0547 / 001	Site 1	Site 1
09A0547 / 002	Site 2	Site 2
09A0547 / 003	Site 3	Site 3
09A0547 / 004	Site 4	Site 4
09A0547 / 005	Site 5	Site 5
09A0547 / 006	Site 6	Site 6
09A0547 / 007	Site 7	Site 7
09A0547 / 008	Site 9	Site 9
09A0547 / 009	Site 15	Site 15

CCWA ID			001	002	003	004
Client ID			Site 1	Site 2	Site 3	Site 4
Analyte	**Method**	**Unit**				
Stones	(>2mm)	%	60.7	51.4	2.2	20.3
EC	(1:5)	mS/m	2	2	4	2
Sal_soil	(1:5)	mg/kg	79	74	140	64
pH	(CaCl2)		5.8	5.4	5.8	5.4
Sand	(S07)	%	91.5	90.0	90.0	89.5
Silt	(S07)	%	2.5	3.5	3.5	3.5
Clay	(S07)	%	6.0	6.5	6.5	7.0
OrgC	(W/B)	%	0.16	0.46	1.02	0.22
C:N	(calc)		11.0	19.0	15.0	12.0
Emerson	Class		2	2	2	2
N	(total)	%	0.015	0.024	0.069	0.019
NO3-N	NO3-NH4	mg/kg	5	5	13	4
P	(totals)	mg/kg	460	500	290	450
B	(M3)	mg/kg	0.2	0.2	0.2	<0.1
Ca	(M3)	mg/kg	380	440	790	340
Cd	(M3)	mg/kg	<0.01	0.02	0.02	0.02
Co	(M3)	mg/kg	0.88	0.79	0.90	1.0
Cu	(M3)	mg/kg	0.6	0.9	0.9	1.0

CCWA ID			001	002	003	004
Client ID			Site 1	Site 2	Site 3	Site 4
Analyte	**Method**	**Unit**				
Fe	(M3)	mg/kg	40	46	48	44
K	(M3)	mg/kg	95	130	180	120
Mg	(M3)	mg/kg	74	100	100	81
Mn	(M3)	mg/kg	60	89	96	100
Mo	(M3)	mg/kg	<0.01	<0.01	<0.01	<0.01
Na	(M3)	mg/kg	<1	<1	2	2
Ni	(M3)	mg/kg	0.2	0.4	0.4	0.3
P	(M3)	mg/kg	2	4	6	3
S	(M3)	mg/kg	2	2	3	2
Zn	(M3)	mg/kg	0.3	0.4	0.9	0.4
As	(M3)	mg/kg	<0.1	<0.1	<0.1	<0.1
Pb	(M3)	mg/kg	0.3	0.5	0.4	0.6
Se	(M3)	mg/kg	<0.1	<0.1	0.1	<0.1

CCWA ID			005	006	007	008
Client ID			Site 5	Site 6	Site 7	Site 9
Analyte	**Method**	**Unit**				
Stones	(>2mm)	%	10.2	20.4	21.3	44.1
EC	(1:5)	mS/m	<1	3	2	4
Sal_soil	(1:5)	mg/kg	14	110	74	140
pH	(CaCl2)		4.9	6.5	6.0	6.3
Sand	(S07)	%	93.0	84.0	74.5	59.5
Silt	(S07)	%	2.0	7.5	11.0	22.5
Clay	(S07)	%	5.0	8.5	14.5	18.0
OrgC	(W/B)	%	0.18	0.63	0.53	0.54
C:N	(calc)		13.0	19.0	16.0	12.0
Emerson	Class		2	2	2	2
N	(total)	%	0.014	0.033	0.034	0.046
NO3-N	NO3-NH4	mg/kg	1	5	3	9
P	(totals)	mg/kg	480	290	260	330
B	(M3)	mg/kg	<0.1	0.1	0.2	0.2
Ca	(M3)	mg/kg	180	1200	920	1600
Cd	(M3)	mg/kg	<0.01	0.02	0.04	0.04
Co	(M3)	mg/kg	0.73	2.2	2.9	4.1
Cu	(M3)	mg/kg	0.6	1.8	3.5	4.6
Fe	(M3)	mg/kg	43	68	72	80
K	(M3)	mg/kg	47	170	260	370
Mg	(M3)	mg/kg	51	280	280	440
Mn	(M3)	mg/kg	63	110	150	200
Mo	(M3)	mg/kg	0.01	<0.01	<0.01	<0.01
Na	(M3)	mg/kg	<1	4	4	7
Ni	(M3)	mg/kg	0.1	0.6	1.3	1.4

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CCWA ID			005	006	007	008
Client ID			Site 5	Site 6	Site 7	Site 9
Analyte	**Method**	**Unit**				
P	(M3)	mg/kg	2	8	5	18
S	(M3)	mg/kg	1	3	3	6
Zn	(M3)	mg/kg	0.4	1.1	1.6	1.8
As	(M3)	mg/kg	<0.1	<0.1	<0.1	0.1
Pb	(M3)	mg/kg	0.6	0.4	0.5	0.4
Se	(M3)	mg/kg	<0.1	0.1	<0.1	0.1

CCWA ID			009
Client ID			Site 15
Analyte	**Method**	**Unit**	
Stones	(>2mm)	%	12.6
EC	(1:5)	mS/m	4
Sal_soil	(1:5)	mg/kg	120
pH	(CaCl2)		5.4
Sand	(S07)	%	87.5
Silt	(S07)	%	6.5
Clay	(S07)	%	6.0
OrgC	(W/B)	%	0.37
C:N	(calc)		9.0
Emerson	Class		2
N	(total)	%	0.042
NO3-N	NO3-NH4	mg/kg	10
P	(totals)	mg/kg	440
B	(M3)	mg/kg	<0.1
Ca	(M3)	mg/kg	530
Cd	(M3)	mg/kg	<0.01
Co	(M3)	mg/kg	1.4
Cu	(M3)	mg/kg	1.0
Fe	(M3)	mg/kg	55
K	(M3)	mg/kg	210
Mg	(M3)	mg/kg	91
Mn	(M3)	mg/kg	110
Mo	(M3)	mg/kg	<0.01
Na	(M3)	mg/kg	4
Ni	(M3)	mg/kg	0.4
P	(M3)	mg/kg	15
S	(M3)	mg/kg	3
Zn	(M3)	mg/kg	1.6
As	(M3)	mg/kg	<0.1
Pb	(M3)	mg/kg	0.5
Se	(M3)	mg/kg	<0.1

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Analyte	Method	Description
As	(M3)	Arsenic, As extracted by Mehlich No 3 - method S42
B	(M3)	Boron,B extracted by Mehlich No 3 - method S42
C:N	(calc)	Carbon : Nitrogen ratio (calculated)
Ca	(M3)	Calcium,Ca extracted by Mehlich No 3 - method S42
Cd	(M3)	Cadmium,Cd extracted by Mehlich No 3 - method S42
Clay	(S07)	Fraction less than 0.002mm by method S07
Co	(M3)	Cobalt,Co extracted by Mehlich No 3 - method S42
Cu	(M3)	Copper,Cu extracted by Mehlich No 3 - method S42
EC	(1:5)	Electrical conductivity (1:5) at 25 deg C by method S02
Emerson	Class	Emerson class number by AS 1289 C.8.1
Fe	(M3)	Iron, Fe extracted by Mehlich No 3 - method S42
K	(M3)	Potassium, K extracted by Mehlich No 3 - method S42
Mg	(M3)	Magnesium, Mg extracted by Mehlich No 3 - method S42
Mn	(M3)	Manganese, Mn extracted by Mehlich No 3 - method S42
Mo	(M3)	Molybdenum, Mo extracted by Mehlich No 3 - method S42
N	(total)	Total Nitrogen, N by method S10
Na	(M3)	Sodium, Na extracted by Mehlich No 3 - method S42
Ni	(M3)	Nickel, Ni extracted by Mehlich No 3 - method S42
NO3-N	NO3-NH4	Nitrate nitrogen N, extracted in 1M KCl by method S11.0
OrgC	(W/B)	Organic Carbon C, Walkley and Black method S09.
P	(M3)	Phosphorus, P extracted by Mehlich No 3 - method S42
P	(totals)	Phosphorus,P Total by method S14
Pb	(M3)	Lead, Pb extracted by Mehlich No 3 - method S42
pH	(CaCl2)	pH (1:5) in 0.01M CaCl2 by method S03
S	(M3)	Sulphur, S extracted by Mehlich No 3 - method S42
Sal_soil	(1:5)	Calculated salinity (TDS) from Electrical conductivity (1:5) at 25 deg C by method S02
Sand	(S07)	2.0 to 0.02 mm by method S07
Se	(M3)	Selenium, Se extracted by Mehlich No 3 - method S42
Silt	(S07)	0.02 to 0.002 mm by method S07
Stones	(>2mm)	Stones greater than 2 mm.
Zn	(M3)	Zinc, Zn extracted by Mehlich No 3 - method S42

The results apply only to samples as received. This report may only be reproduced in full.

Unless otherwise advised, the samples in this job will be disposed of after a holding period of 30 days from the report date shown below.

EMERSON CLASS CLASSIFICATION

The swelling and dispersive properties of the clays were tested by placing natural peds and samples re-moulded at or near field capacity moisture content in deionised water. Based on their slaking and dispersive behaviour, the samples were classified into one of 8 classes according to the Emerson Classification scheme as described in Australian Standard AS 1289.C8.1-1980.

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Summary of classification scheme:

Class 1 Soil slakes, air-dried crumbs are strongly dispersive
Class 2 Soil slakes, air-dried crumbs show slight to moderate dispersion
Class 3 Soil slakes, air-dried crumbs do not disperse, re-moulded soil disperses
Class 4 Soil slakes, air-dried crumbs do not disperse, calcium carbonate or calcium sulphate are present.
Class 5 Soil slakes, air-dried and re-moulded soil do not disperse, 1:5 soil:water extract remains dispersed after 5 minutes.
Class 6 Soil slakes, air-dried and re-moulded soil do not disperse, 1:5 soil:water extract begins to flocculate within 5 minutes
Class 7 Soil does not slake, air-dried crumbs remain coherent and swell.
Class 8 Soil does not slake, air-dried crumbs remain coherent, but do not swell.

Multi-Element Soil Extraction
Universal Extractants (Mehlich No.3)

The Mehlich No.3 Test is an alternate soil test using universal extractants for multi-elemental analysis. Results obtained using the Mehlich 3 extractant are highly correlated with the standard "single element" soil tests currently used for a wide range of Western Australian soil types. The test provides information on the amount of plant-available nutrients including phosphorus, potassium, sulphur, calcium, magnesium, sodium, boron, cobalt, copper, iron, manganese and zinc, in the soil. It is also capable of measuring concentrations of toxic metals such as cadmium and nickel in soil. It may be useful for acid and neutral soils in which case the amounts of nutrients extracted are similar to those of other soil tests used in WA.

Particle size analysis data of these soils, in the form of an Excel spreadsheet, are attached. The silt and clay components were determined by sedimentation using Stokes' Law principles whereas the sand fractions were determined by dry sieving the >0.075 mm fraction.
Note: the fraction in the "Diff." column is 100 - (sum of all other fractions). This fraction will include any soluble salts and most of the organic matter in the sample.

Samples requiring preparation are prepared by drying at less than 40°C and sieving to remove stones (material >2 mm).

Unless otherwise specified, all analytes (except Stones) are reported in the listed concentrations and on a dry, less than 2 mm basis. Stones are reported on a dry, whole sample basis.

Total dissolved solids (Sal_Soil) were estimated by applying an empirical factor to the EC results. As the nature of the soluble salts in the soil will change from location to location the TDS value is provided as an estimate only.

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02/07/2010