

Monitoring of Rehabilitation Areas and Analogue Site

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**New Hope Coal-
Australia Pty Ltd**

NEW OAKLEIGH MINE



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1.0 Introduction

BTEQ have been commissioned by New Hope Coal Australia to conduct monitoring of the status of current and historic mine rehabilitation and nearby unmined analogue sites at and near New Hope's Oakleigh Colliery. The monitoring is conducted twice annually in Spring/Summer and again in Autumn/Winter. The monitoring event summarised in this report is the first monitoring conducted since the rehabilitation acceptance criteria for this site were put in place. The acceptance criteria are listed in **Appendix 1**.

The Oakleigh operation is located near Rosewood, Qld and is approximately 20 kilometres Southwest of Ipswich. The location of the mine is depicted in **Figure 1**.

2.0 Aims

The aims of the investigation were to:

- Provide a “snapshot” of the current status of the historic mine rehabilitation works at Oakleigh,
- Provide an assessment of the state of pasture growth and productivity at the “Analogue” site Lot 566 on CH31740,
- Compare progress of the rehabilitation areas in terms of meeting the agreed acceptance criteria.

FIGURE 1 Site Location

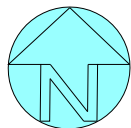
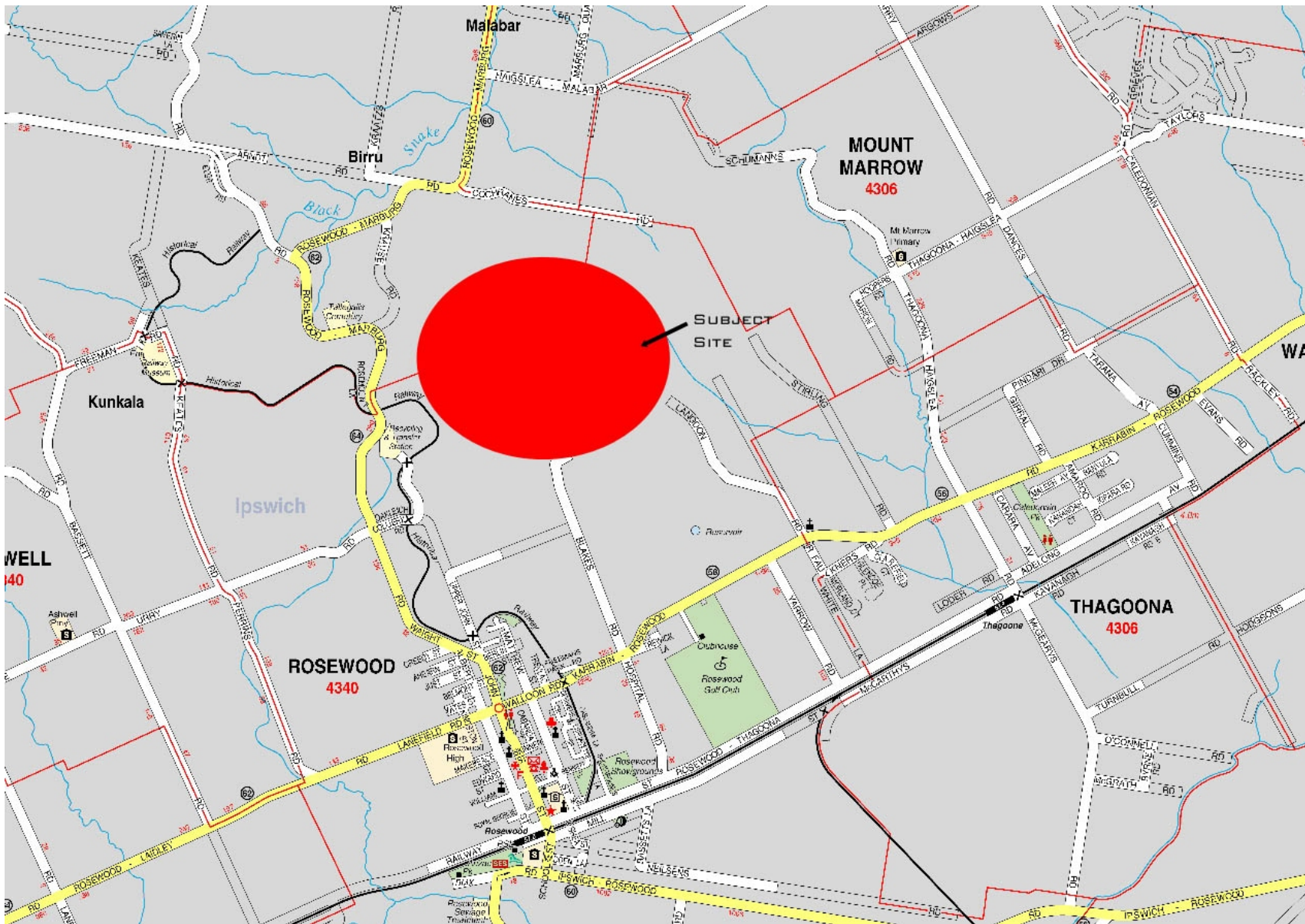


Figure 1
Site Location

Drawing Number:

Scale: 1:10000 Approx

Date: 30/8/04

Source : UBD 2002

Drawn By: JA

Checked By: KT

3.0 Methods

3.1 Field Assessment

Two areas of rehabilitation were sampled at the Oakleigh mine site and an analogue site chosen previously in consultation with the EPA was also assessed. The location of these sites is depicted in **Figure 2**.

A series of 20m x 20m plots were placed at random in the rehabilitation areas. Ten (10) plots were placed in the analogue site Lot 566 on CH31740 and ten (10) in the areas of historic rehabilitation at Oakleigh.

At each 20m x 20m plot the following measurements and information were recorded:

- **Plot location** – AMG eastings and northings measured with hand held GPS
- **Site orientation** – measured in degrees with hand held compass and verified with GPS
- **Slope** – measured in degrees with hand held clinometer
- **Photo** – a reference photo was taken of each plot from the intersection of the tapes used to measure the plot boundaries (**see Plates 1 – 4 for examples**)
- **Foliage Projective Cover (FPC)** – understorey FPC was measured at 0.5 metre intervals along a transect within the plot and vegetation was classified as either Live, Dead or, if no vegetation was present, Bare. The 40 FPC records taken at each site were then converted to a percentage figure to allow easy analysis and comparison with other sites. Only understorey FPC was recorded at each transect as the rehabilitation areas and the are largely devoid of shrubs and trees (**see Plates 1 - 4**).
- **Species list** – all flora species encountered were recorded. Most species were able to be identified in the field however any species not able to be identified on site were collected for later identification. A cumulative species list for the sites is included as **Appendix 2**.
- **Standing Dry Matter** – Standing Dry Matter was calculated using a comparative photo reference standard method (Cambell and Hacker, 2002)

FIGURE 2 Rehabilitation Sites

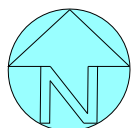
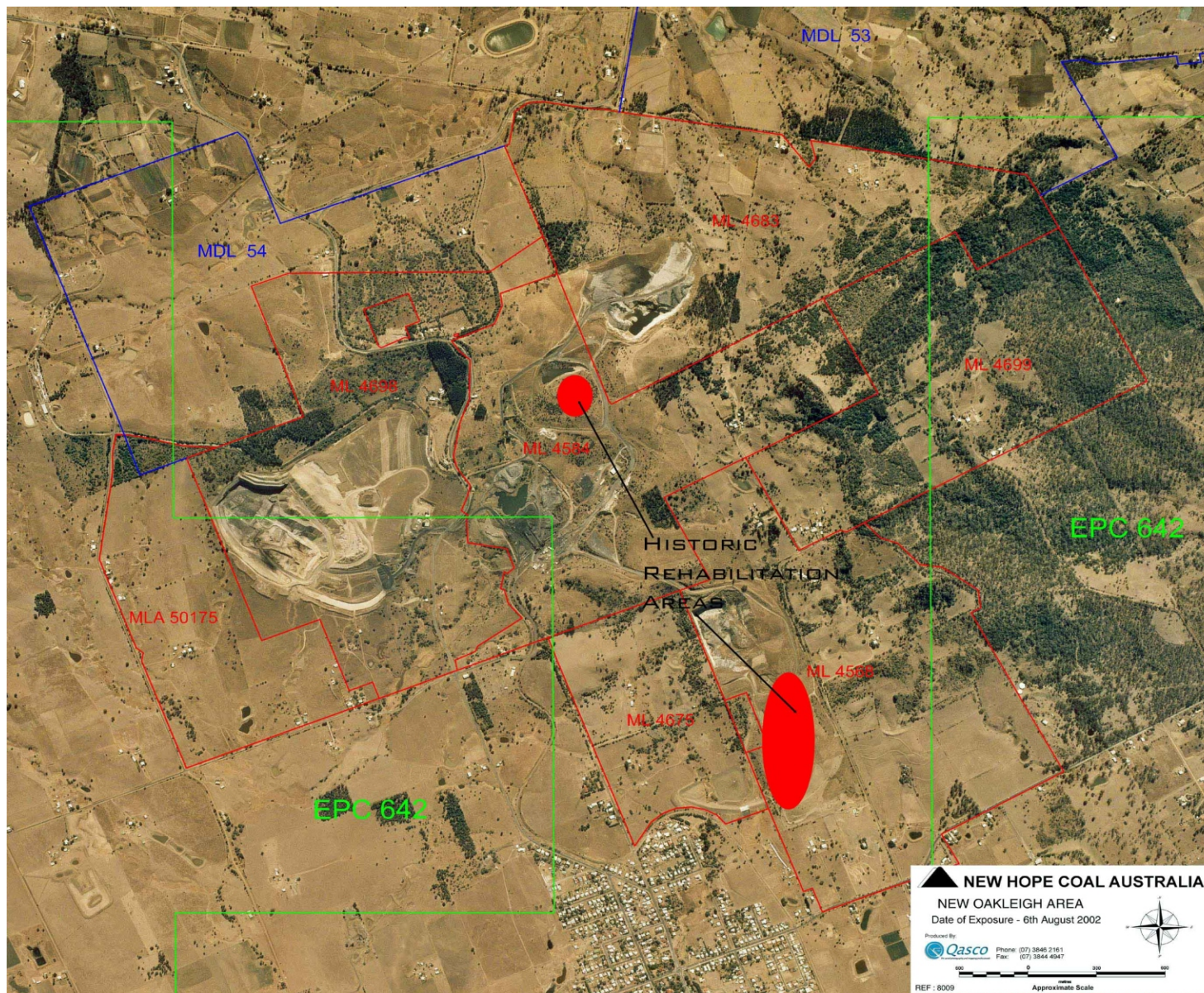


Figure 2
Rehabilitation Site Locations

Drawing Number:

Scale: As Above

Date: 30/08/04

Source: New Hope Coal

Drawn By: JA

Checked By: KT



Plate 1 – Plot 1 Oakleigh Analogue (Lot 566 on CH31740)



Plate 2 – Plot 3 Oakleigh Analogue (Lot 566 on CH31740)



Plate 3 – Plot 1 Oakleigh Mine site (Near Normanton Pit)

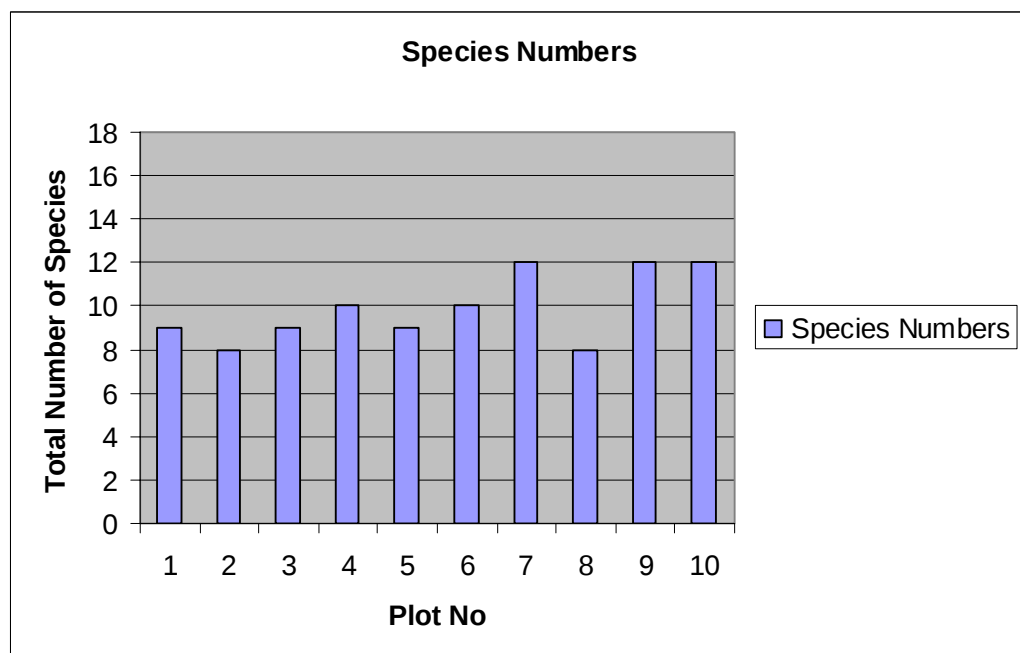
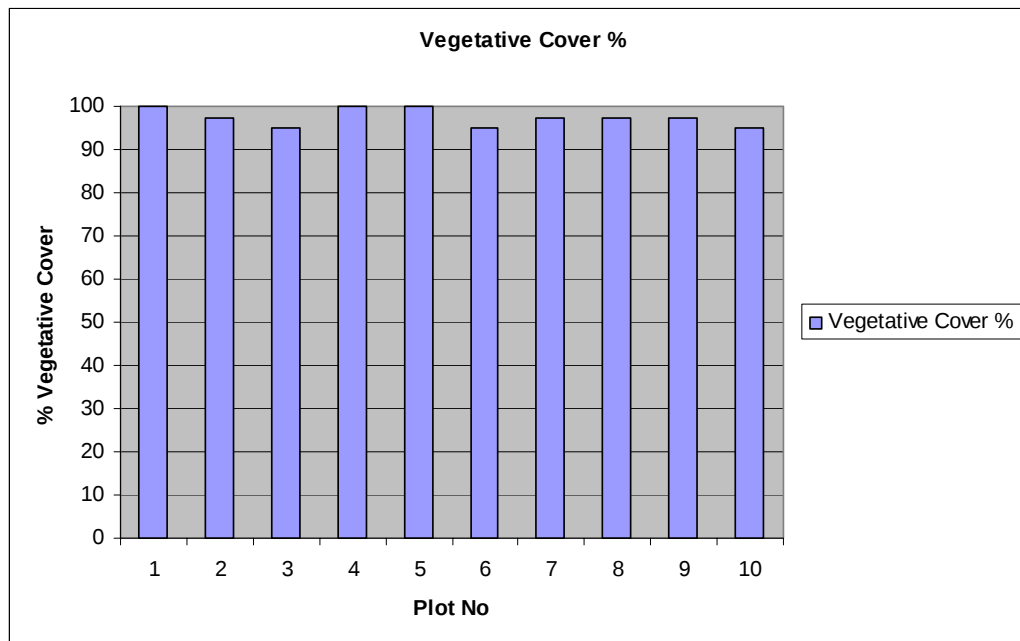


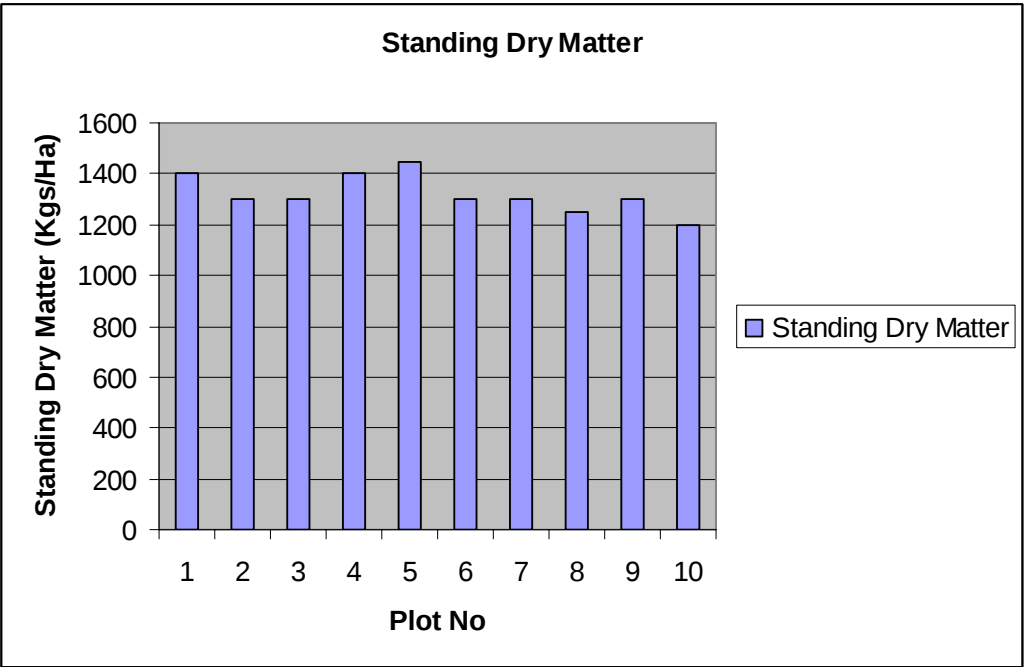
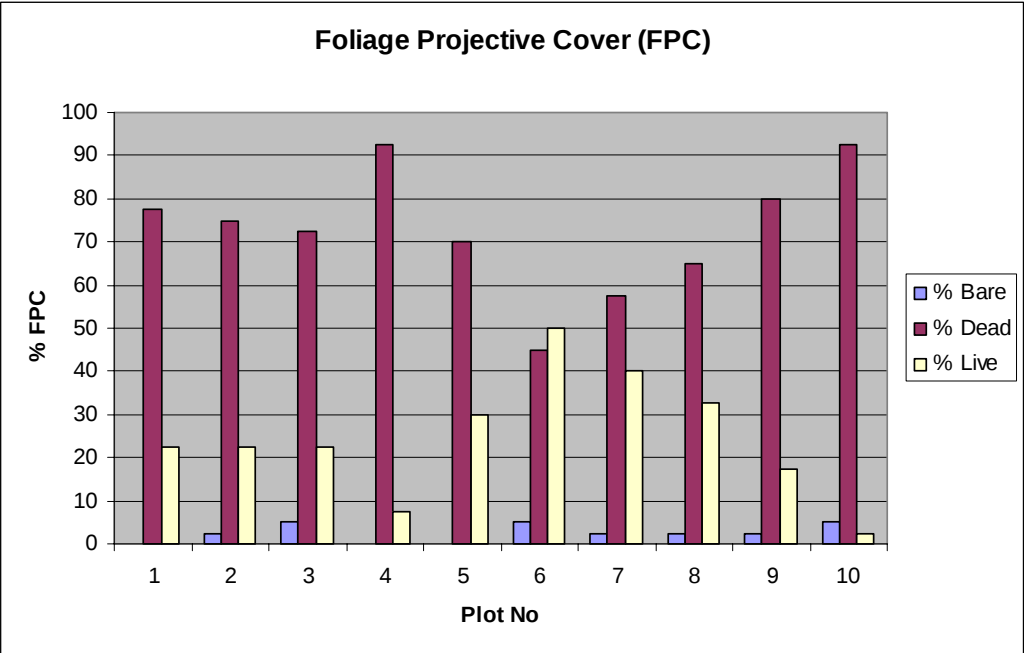
Plate 4 – Plot 5 Oakleigh Mine site (Near Normanton Pit)

4.0 Results

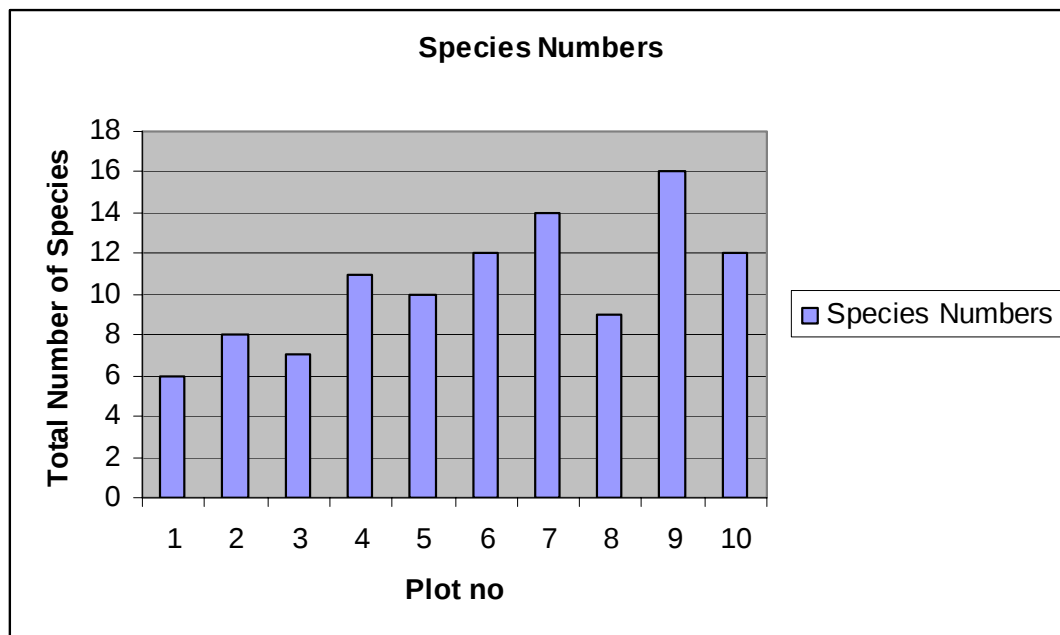
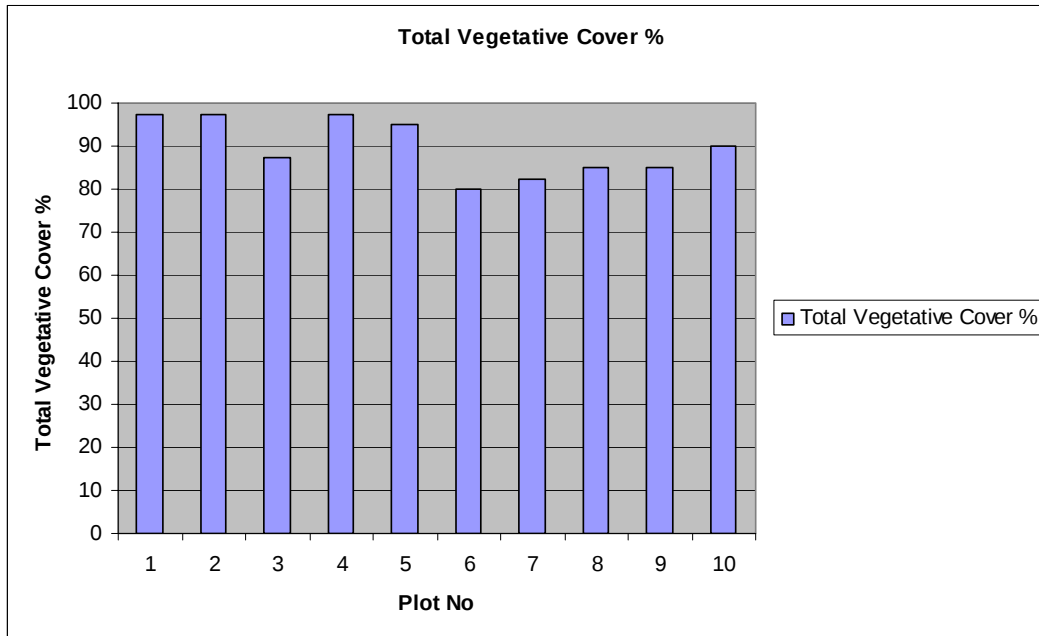
The results of the investigation are summarised in the following series of graphs. Raw data is included as **Appendix 3**.

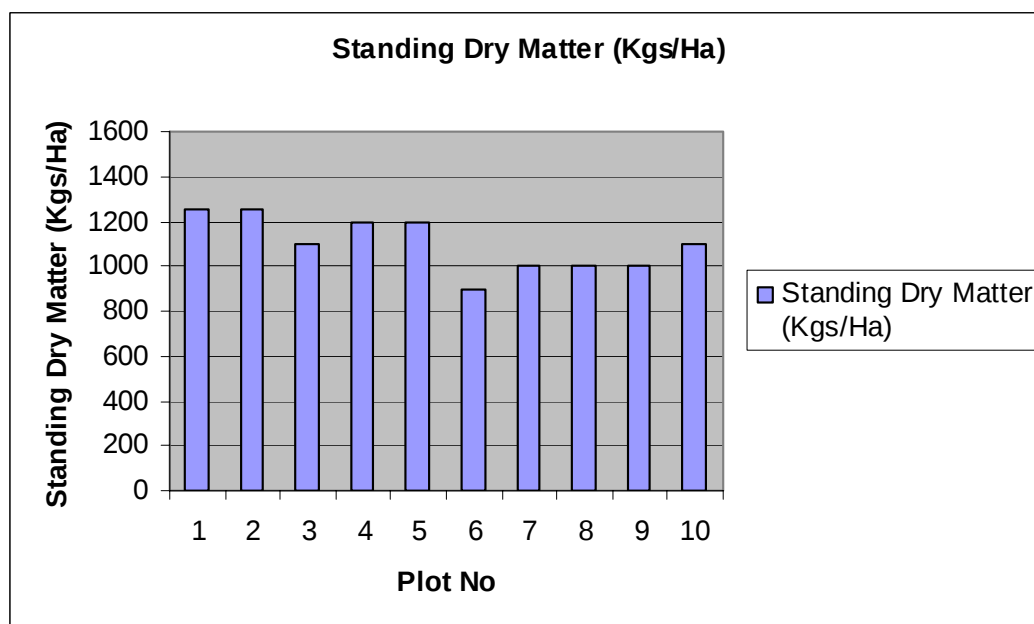
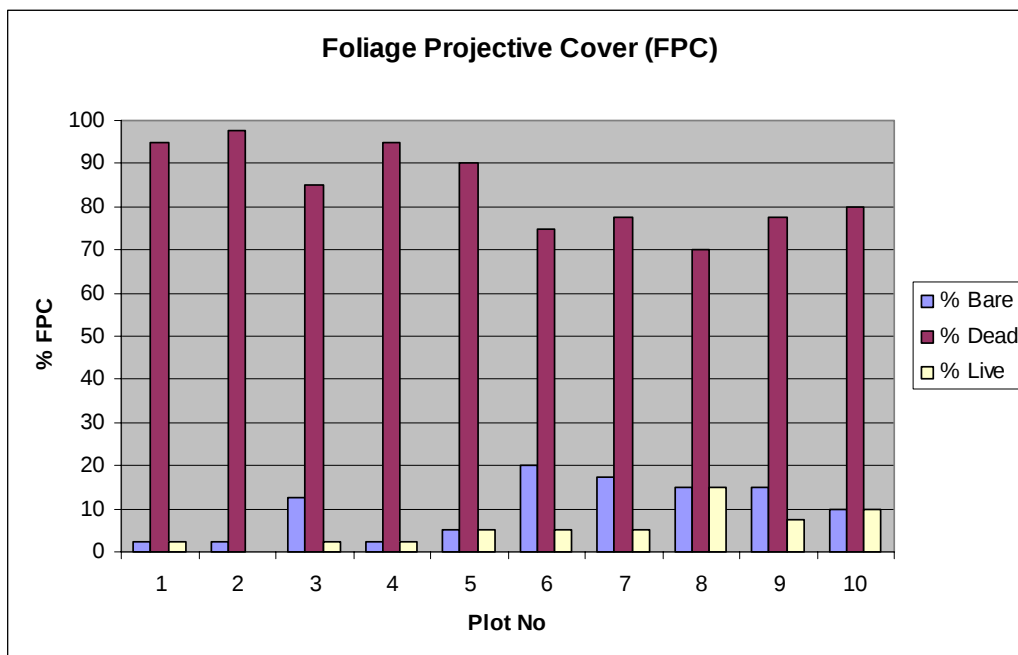
4.1 Analogue Site Results





4.2 Oakleigh Mine Site Results





5.0 Comparison of Results

The results indicate that the progress of the rehabilitation in comparison with the analogue site is generally within the agreed acceptance criteria.

Total vegetative cover was marginally higher on average at the analogue site than at the mine site (97.5 % vs 89.75%) however both sites have been recently grazed, making direct comparison of this factor difficult to assess meaningfully.

Species numbers were on average higher on the mine rehabilitation site than at the analogue site.(10.5 species per plot vs 9.9 species).

Comparison of the foliage projective cover showed that FPC was high at all sites sampled and well within the generally accepted (>70%) range for grazing pastures.

Standing Dry Matter was generally higher at the analogue site than in the rehabilitation areas but variation in grazing intensity may account for this deviation.

Comparison of the data used as input data for the Revised Universal Soil Loss Equation (RUSLE) showed that input data for the two areas was identical (Brough et. al 2004). This is a reflection of the two sites close proximity to one another and similarity of landform, vegetative cover, soil type and land use. Erosion rates for the two sites would be shown to be similar if not identical with only variables such as Slope length and intensity of landuse having an impact on the RUSLE's results.

6.0 Discussion

Generally the results gained in this assessment suggest that the historic rehabilitation which has been undertaken at the site has produced a “grazing outcome” standard pasture which compares favourably with the current state of the analogue site.

Variation in grazing pressure is an uncontrolled variable at this stage. Some monitoring/management of stock numbers and grazing time between the monitoring areas will be required to enable meaningful comparison of factors such as FPC and Standing Dry Matter.

7.0 References

Brough.D., Lawrence.P., Fraser.G., Rayner. D.and Le Grand .J. (2004) *Improved inputs of Regional Scale Soil Erosion potential for Queensland*. Proceedings of the 13th International Soil Conservation Organisation Conference – Brisbane, July 2004.

Cambell. T. and Hacker. R. (2002) *Tactical Grazing Management for the Semi - Arid Woodlands*. NSW Agriculture, Sydney

Renard. K.G., Laflen, J.M., Foster.G.R.and McCool. D.K. (1994). *The Revised Universal Soil Loss Equation*. Soil Erosion Research Methods, 2nd edition, Soil and Water Conservation Society and St Lucie press, pp104-124, USA

Soilloss: A Program to Assist in the Selection of Management Practices to Reduce Erosion, by Colin J Rosewell. 2nd ed. Soil Conservation Service of NSW, Sydney, 1993.

Appendix 1.

Acceptance Criteria New Oakleigh Mine

Proposed Acceptance Criteria (Grazing Outcome)

The following acceptance criteria and associated monitoring practices are proposed for the New Oakleigh mine rehabilitation areas.

Acceptance Criteria 1

- ❖ FPC of Monitoring rehabilitation sites is at or above 70% understorey FPC

Monitoring

Biennial monitoring of randomly selected plots within mine rehabilitation areas proposed for the “grazing outcome” and the analogue site using methods described in section 3.

Acceptance Criteria 2

- ❖ Standing Dry Matter to be within +/- 10% of the analogue sites production rate over a period of 12 months

Monitoring

Biennial monitoring of randomly selected plots within mine rehabilitation areas proposed for the “grazing outcome” and the analogue site using methods described in Campbell and Hacker (2002).

Acceptance Criteria 3

- ❖ Grazing species diversity on the mine rehabilitation sites to be on average within +/- 20% of the analogue site.

Monitoring

Biennial monitoring of randomly selected plots within mine rehabilitation areas proposed for the “grazing outcome” and the analogue site using methods described in section 3.

Acceptance Criteria 4

- ❖ Erosion rates of the mine rehabilitation areas, as determined by the Revised Universal Soil Loss Equation (RUSLE) (Renard et. al. 1994), to be within +/- 10% of the rates of the analogue site.

Monitoring

Biennial monitoring of randomly selected plots within mine rehabilitation areas proposed for the “grazing outcome” and the analogue site using methods described in Renard et. al. 1994

Appendix 2.

Cumulative Species List

Analogue Sites

Pasture Species

Grasses

Species Name	Common Name
<i>Cynodon nlemfluensis</i>	African star grass
<i>Cynodon plectostachyus</i>	African star grass
<i>Dichanthium annulatum</i>	Angleton
<i>Panicum coloratu</i>	Bambatsi
<i>Cenchrus ciliaris</i>	Buffel
<i>Cynodon dactylon</i>	Couch, green
<i>Bothriochloa insculpta</i>	Creeping Bluegrass
<i>Pennisetum clandestinum</i>	Kikuyu
<i>Panicum coloratum</i> var. <i>mararikariense</i>	Makarikari
<i>Panicum maximum</i> var. <i>trichoglume</i>	Green Panic, Gatton Panic
<i>Paspalum plicatulum</i>	Plicatulum
<i>Setaria incrassata</i>	Purple Pigeon
<i>Dichanthium sericum</i>	Queensland bluegrass
<i>Chloris gayana</i>	Rhodes grass
<i>Setaria sphacelata</i>	Setaria
<i>Themeda australis</i>	Kangaroo Grass

Legumes

Species Name	Common Name
<i>Desmanthus virgatus</i>	Desmanthus
<i>Lablab purpureus</i>	Lablab

<i>Leucaena leucocephala</i>	Leucaena
<i>Medicago sativa</i>	Lucerne
<i>Medicago truncatula</i>	Barrel Medic
<i>Medicago polymorpha</i>	Common Burr Medic
<i>Medicago scutellata</i>	Snail Medic
<i>Macroptilium atropurpureum</i>	Siratro
<i>Vicia villosa</i>	Woolly pod vetch

Other Species

Species Name	Common Name
<i>Sida cunninghamii</i>	Paddys Lucerne
<i>Desmodium variens</i>	
<i>Desmodium brachypodium</i>	Slender Treefoil
<i>Crisium vulgare</i>	Scotch Thistle
<i>Sidgesbeckia orientalis</i>	Sidgesbeckia
<i>Lantana camara</i>	Lantana
<i>Lantana montevidensis</i>	Lantana

Rehabilitation Sites

Pasture Species

Grasses

Species Name	Common Name
<i>Dichanthium annulatum</i>	Angleton
<i>Panicum coloratu</i>	Bambatsi
<i>Cenchrus ciliaris</i>	Buffel
<i>Cynodon dactylon</i>	Couch, green
<i>Bothriochloa insculpta</i>	Creeping Bluegrass
<i>Pennisetum clandestinum</i>	Kikuyu
<i>Panicum maximum</i> var. <i>trichoglume</i>	Green Panic, Gatton Panic
<i>Paspalum plicatulum</i>	Plicatulum
<i>Setaria incrassata</i>	Purple Pigeon
<i>Dichanthium sericum</i>	Queensland bluegrass
<i>Chloris gayana</i>	Rhodes grass
<i>Setaria sphacelata</i>	Setaria
<i>Themeda australis</i>	Kangaroo Grass

Legumes

Species Name	Common Name
<i>Desmanthus virgatus</i>	Desmanthus
<i>Medicago truncatula</i>	Barrel Medic
<i>Medicago polymorpha</i>	Common Burr Medic
<i>Medicago scutellata</i>	Snail Medic
<i>Vicia villosa</i>	Woolly pod vetch

Other Species

Species Name	Common Name
<i>Sida cunninghamii</i>	Paddys Lucerne
<i>Desmodium variens</i>	
<i>Eucalyptus crebra</i>	Narrow leaf – Iron Bark
<i>Corymbia tessellaris</i>	Morton Bay Ash
<i>Crisium vulgare</i>	Scotch Thistle
<i>Sidgesbeckia orientalis</i>	Sidgesbeckia
<i>Trema aspera</i>	Poison Peach
<i>Lantana camara</i>	Lantana
<i>Lantana montevidensis</i>	Lantana

Appendix 3.

Raw Data

Oakleigh Analogue Sites		Plot 1	Plot 2	Plot 3	Plot 4	Plot 5	Plot 6	Plot 7	Plot 8	Plot 9	Plot 10
Eastings		45 65 34	45 64 63	45 63 87	45 64 39	45 66 20	45 65 74	45 65 34	45 64 51	45 65 02	45 65 21
Northings		694 51 35	694 51 18	694 50 82	694 49 55	694 52 26	694 53 61	694 54 65	694 54 56	694 52 96	694 49 27
0.5	D	D	D	B	D	L	L	L	D	D	D
1	D	D	D	D	D	L	D	D	D	D	D
1.5	L	D	D	D	D	D	D	L	L	D	D
2	L	D	D	L	D	D	L	D	L	D	D
2.5	D	D	D	D	D	D	L	D	D	D	D
3	D	D	D	L	D	L	L	D	D	D	D
3.5	D	D	D	D	D	D	D	L	D	D	D
4	D	L	D	D	D	L	L	L	D	D	D
4.5	L	L	D	D	L	D	D	L	D	D	D
5	D	B	L	D	D	L	D	L	L	D	D
5.5	D	D	D	D	D	D	D	D	L	D	D
6	L	D	L	D	D	D	L	B	D	L	D
6.5	D	D	L	D	D	D	D	L	D	B	D
7	D	L	D	D	D	L	B	D	D	L	D
7.5	L	L	D	D	D	L	D	D	D	D	D
8	D	D	L	D	D	L	L	L	L	D	B
8.5	D	D	D	D	L	L	L	L	D	D	D
9	D	D	D	D	D	L	L	D	B	L	D
9.5	D	D	L	D	D	D	D	D	D	D	D
10	D	D	D	D	D	D	D	D	L	D	B
10.5	D	D	B	D	D	D	L	L	D	D	D
11	D	D	D	D	D	D	D	L	D	L	D
11.5	D	D	D	D	D	D	D	D	D	D	D
12	D	L	D	D	D	L	L	L	L	D	D
12.5	D	D	D	D	D	L	D	D	L	L	D
13	D	D	L	D	D	D	L	L	D	D	D
13.5	D	D	D	D	D	L	D	D	L	D	D
14	L	D	D	D	D	L	L	D	D	D	D
14.5	D	D	D	D	D	L	B	D	D	D	D
15	D	L	D	D	D	L	D	D	L	D	L
15.5	L	D	D	D	D	D	D	D	L	D	D

	16	D	D	D	D	L	L	D	D	D	D
	16.5	L	D	D	D	L	L	L	D	D	D
	17	D	D	D	L	L	D	L	D	D	D
	17.5	D	L	D	D	L	L	D	L	D	D
	18	D	D	L	D	L	L	D	L	D	D
	18.5	L	D	D	D	L	L	D	D	D	D
	19	D	L	D	D	D	L	D	D	D	D
	19.5	D	L	D	D	D	L	L	D	L	D
	20	D	D	D	D	D	D	D	D	L	D
total											
Live		9	9	9	3	12	20	16	13	7	1
Dead		31	30	29	37	28	18	23	26	32	37
Bare		0	1	2	0	0	2	1	1	1	2
% Bare		0	2.5	5	0	0	5	2.5	2.5	2.5	5
% Dead		77.5	75	72.5	92.5	70	45	57.5	65	80	92.5
% Live		22.5	22.5	22.5	7.5	30	50	40	32.5	17.5	2.5
Vegetative Cover											
%		100	97.5	95	100	100	95	97.5	97.5	97.5	95
Species Numbers		9	8	9	10	9	10	12	8	12	12
Standing Dry											
Matter		1400	1300	1300	1400	1450	1300	1300	1250	1300	1200

		Normanton Pit						North Pit		
Oakleigh										
Rehabilitation Site	Plot 1	Plot 2	Plot 3	Plot 4	Plot 5	Plot 6	Plot 7	Plot 8	Plot 9	Plot 10
Eastings	45 99 45	46 00 00	46 00 34	45 99 60	45 98 47	45 90 39	45 89 85	45 89 39	45 89 53	45 90 35
Northings	694 41 17	694 40 60	694 41 59	694 45 14	694 47 11	694 58 44	694 58 07	694 57 57	694 56 94	694 57 13
0.5	D	D	B	D	D	L	D	D	B	D
1	D	D	D	D	D	D	L	D	D	D
1.5	D	D	D	D	D	D	B	D	D	D
2	D	D	D	D	D	B	D	D	D	L
2.5	D	D	D	D	D	L	D	D	D	L
3	D	D	L	D	D	D	D	D	B	D
3.5	D	D	D	D	D	D	D	D	D	D
4	D	D	D	L	D	D	B	L	D	D
4.5	D	D	D	D	L	D	D	D	D	L
5	D	D	D	D	D	D	D	L	D	D
5.5	D	D	D	D	D	D	D	D	D	D
6	D	D	D	D	D	D	D	L	D	L
6.5	L	D	D	D	D	B	D	L	D	D
7	D	D	D	D	D	D	L	D	D	D
7.5	D	D	D	D	D	D	D	D	D	D
8	D	D	D	D	D	D	D	D	D	D
8.5	D	D	D	D	D	D	D	B	D	D
9	D	D	B	D	D	D	D	D	B	D
9.5	D	D	D	D	D	D	D	D	B	D
10	D	D	D	D	D	D	D	D	D	D
10.5	D	D	D	D	D	D	D	D	D	D
11	D	D	D	D	B	D	B	D	D	D
11.5	D	D	D	D	D	D	B	D	L	D
12	B	D	B	D	D	D	D	L	L	D
12.5	D	D	D	D	D	B	D	D	D	D
13	D	D	D	D	D	B	D	D	D	D
13.5	D	D	D	D	D	B	D	D	D	D
14	D	D	D	D	L	D	D	B	D	D
14.5	D	D	D	D	D	D	D	B	D	D
15	D	D	D	D	D	D	D	D	D	D

	15.5	D	D	D	D	D	D	B	B	D	D	
	16	D	D	B	D	D	D	D	B	D	D	
	16.5	D	D	D	D	D	D	D	D	B	D	
	17	D	D	D	D	D	D	B	D	L	B	
	17.5	D	D	D	D	D	D	B	D	D	B	
	18	D	D	B	D	D	D	D	L	D	D	
	18.5	D	D	D	D	D	B	D	D	B	D	
	19	D	D	D	D	B	B	D	D	D	B	
	19.5	D	B	D	B	D	B	D	B	D	D	
	20	D	D	D	D	D	D	D	D	D	B	
Total Live			1	0	1	1	2	2	2	6	3	4
Dead			38	39	34	38	36	30	31	28	31	32
Bare			1	1	5	1	2	8	7	6	6	4
% Bare			2.5	2.5	12.5	2.5	5	20	17.5	15	15	10
% Dead			95	97.5	85	95	90	75	77.5	70	77.5	80
% Live			2.5	0	2.5	2.5	5	5	5	15	7.5	10
Total Vegetative Cover %			97.5	97.5	87.5	97.5	95	80	82.5	85	85	90
Species Numbers			6	8	7	11	10	12	14	9	16	12
Standing Dry Matter (Kgs/Ha)			1250	1250	1100	1200	1200	900	1000	1000	1000	1100