Annual Environmental Management Report

2016

(SMALL MINE VERSION)

Enhance Place Mine

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1 INTRODUCTION

1.1 BACKGROUND DEVELOPMENT

Enhance Place Pty Ltd (Enhance Place) was established in 1997 to recover remnant coal from areas previously open cut mined in the 1950's. A principle objective of Enhance Place was to provide the means to improve the appearance and general amenity of the land through the rehabilitation of land previously impacted by mining.

Enhance Place operated the Enhance Place Open Cut Coal Mine (Enhance Place Mine) from 1997 until its closure in June 2005 following the extraction of all economically feasible coal reserves.

The Enhance Place Mine is located in the Western Coalfields of NSW at Blackmans Flat, 15km northwest of Lithgow on the southern side of the Castlereagh Highway. The site is approximately 3km southeast of Mount Piper Power Station (**Plan 1a & 1b**, **Appendix A**).

The Enhance Place Mine extracted coal over the abandoned Eastern Main Underground Mine workings (Eastern Main Mine). The Eastern Main Mine operated as a Board and Pillar mine until 1975. Mining activities were undertaken by six employees, being augmented for short periods by secondment of maintenance, operating or rehabilitation personnel from other areas of the contractor's operations as required.

When open cut operations ceased in June 2005 and since then, surface water control, rehabilitation of land-form with seeding and fertilisation, feral animal and weed control programmes have been implemented with final rehabilitation nearing completion.

During the 2016 reporting period, ongoing management of the site was undertaken in the form of targeted weed and livestock management, vegetation improvement (pasture and treed areas), erosion control works and soil improvement.

1.2 MINE PRODUCTION, PRODUCT AND MARKET

The mine ceased production at the end of June 2005 when all coal reserves had been extracted. There was no coal production or active mining operations undertaken at Enhance Place during the 2016 reporting period. Details of production history are detailed in **Table 1**.

Table 1
Production History

Year	Production Total (Tonnes)
1998	73,632
1999	86,007
2000	77,804
2001	77,579
2002	77,109
2003	101,851
2004	89,000
2005	27,228
Total	**609,940**

2 TITLE DETAILS

Name of Mine	Enhance Place Mine		
Mining Titles/Leases	ML 1422	**Expiry Date**	03/12/2018
Mining Titles/Leases	ML 1458	**Expiry Date**	29/11/2020
Mining Titles/Leases	ML 1520	**Expiry Date**	29/08/2023
Name of Leaseholder	Enhance Place Pty Ltd		
Name of Mine Operator	As above		
Postal Address	Enhance Place Pty Ltd		
	PO Box 202		
	Wallerawang, N.S.W, 2845		
Telephone	(02) 6355 7893		
Fax	(02) 6355 7894		
Email	Graham.goodwin@energyaustralia.com.au		

2.1 LAND OWNERSHIP AND LAND USE BOUNDARIES

Land ownership of the Enhance Place Mine consists of p rivate freehold and crown land. The current status of land ownership, tenure and pre-mining land use at the Enhance Place Mine is summarised in **Table 2** and shown on **Figure 1**.

Table 2
Land Ownership

Land Owner/Occupier	Lot/DP	Tenure (freehold leasehold)	Pre-mining land use
Mr & Mrs J. Cherry	301/751636	Freehold	Grazing
Mrs J. Cope	302/751636 303/751636	*Perpetual Lease*	Grazing
D & J Hunt	370/751651	Freehold	Grazing
State of NSW - Glen Davis Recreation Area (R. 59960)	304/751636 305/751636	Crown Land	Grazing
State of NSW	7004/1026541	Crown Land	Bush/grazing
M & L Morris	101/1145705	Freehold	Grazing

Figure 1
Land Ownership

2.2 CONSENTS AND LICENCES

Local Council Area: Lithgow City Council Development Consent 36/99

Development Consent:		
	Granted	[✓]
	Required but not granted	[ ]
	Not required	[ ]

Do licences granted by other agencies apply to the mine activities? Yes [✓] No [ ]

EPA	[✓] - EPL No.6312 surrendered 28/09/2005 after cessation of mining
NPWS	[N/A]
Dam Safety	[N/A]
Other	[N/A]

2.3 MOP AND AEMR PERIOD

MOP Commencement Date	31 May 2013	**Completion Date**	16 January 2024
AEMR Start Date	1 January 2016	**End Date**	31 December 2016

2.4 SIGNATURES

Leaseholder – Enhance Place Pty Ltd		Environmental Officer	
Signature		Signature	
Name	Malcolm Murphy	Name	BEN EASTWOOD
Date	27.2.2017	Date	22.02.2017

3 ACTIONS FROM 2015 AEMR

Action items from the Department of Industry - Resources and Energy review of the Enhance Place 2015 AEMR and site inspection are shown in **Table 3**. These items were detailed in a letter dated 13 September 2016, in response to the submission of the *Annual Environmental Management Report 2015 (Small Mine Version) Enhance Place Mine* prepared by Enhance Place Pty Ltd.

Table 3
Action Items

Item No.	*Issue/ observation*	*Action*	*Due Date*	Addressed in 2016 AEMR
1	*Recommendations outlined on page 21 of the document titled 'Enhance Place Mine Rehabilitation Monitoring Report 2015, prepared by First Field Environmental on behalf of Energy Australia' dated October 2015 are to be implemented to ensure rehabilitation achieves the required completion criteria for pasture and treed rehabilitation areas.*	*The applicable recommendations outlined in Section 7 (page 21) of the Enhance Place Mine Rehabilitation Monitoring Report 2015 have been implemented during the 2016 AEMR period.*	Dec 2016	Section 5 & Table 5
2	*The Enhance Place Mine MOP approved on 3rd February 2015 describes actions to be undertaken to improve the rehabilitation success within the treed vegetation area. The success of these actions is not clearly documented in the AEMR. A site inspection undertaken of the Enhance Place Mine on 16/05/2016 indicates there is a high mortality rate in the planted tube stock. DRE requests that Enhance Place Pty Limited investigates methods of improving the vegetation structure of shrubs and canopy trees within the treed vegetation area to make it more compatible with surrounding treed vegetation (as per the MOP objectives) and implements these methods as soon as practicable.*	*Actions undertaken during the 2016 reporting period to improve the vegetation structure of shrubs and canopy trees within the treed vegetation area to make it more compatible with surrounding treed vegetation included:* *– Weed management* *– Fertilizer & Mulch application* *– Tube stock planting* *– Re-sowing of exposed surfaces* *– Erosion control*	Dec 2016	Section 5 & Table 5

4 MINING OPERATIONS DURING THE REPORTING PERIOD

There were no mining activities undertaken at the Enhance Place Mine during the reporting period as mining ceased on 29 June 2005. The production and waste summary for 2016 is presented in **Table 4**.

Table 4
Production and Waste Summary

	Production and Waste (cubic metres)		
	Start of Reporting Period	**At end of Reporting Period**	**End of next reporting(estimated)**
Topsoil stripped	Nil	Nil	Nil
Topsoil used/spread	Nil	Nil	Nil
Waste Rock	Nil	Nil	Nil
Ore	Nil	Nil	Nil
Processing Waste	Nil	Nil	Nil
Product	Nil	Nil	Nil

5 REHABILITATION DURING THE AEMR PERIOD

The primary domain at the Enhance Place Mine is the Overburden Emplacement Area, which is subdivided into two secondary domains consisting of rehabilitated pasture areas and rehabilitated woodland (treed) areas. The location of rehabilitation domains are shown in **Plan 2**, **Appendix A**.

Rehabilitation activities are conducted in accordance with best practice management to ensure the rehabilitation completion criteria for the site is achieved. The rehabilitation activities undertaken during the 2016 AEMR reporting period included erosion management; soil stabilisation; surface drainage structure maintenance; pasture improvement; treed area improvement; weed management; and stock management. The recommendations outlined in the *Enhance Place Mine Rehabilitation Monitoring Reports (First Field Environmental, 2015 & 2016)* were implemented at the site in order to achieve the required completion criteria for both pasture and treed rehabilitation areas. A summary of the rehabilitation actions undertaken during the 2016 period is presented in **Table 5**.

5.1 EROSION MANAGEMENT

The final landform shaping and drainage control structures have previously been completed at the site and the potential for major erosion (gully or tunnel erosion; mass movement) is considered to have been mitigated as there is no evidence of significant erosion occurring. However, surface erosion may occur in areas where rehabilitation has not been successful, or as a result of overgrazing. During the 2016 reporting period active surface and rill erosion areas were identified and treated through the construction and maintenance of roll-over drains on the main access track; and the application of woody debris in the form of organic mulch and seed mixture to exposed soil in the treed rehabilitation area.

5.2 SOIL STABILISATION

Cracking soils and waterlogging may occur in areas of overgrazing; where rehabilitation has not been successful; or adjacent the highwall as a result of subsidence and soil movement. During the 2016 reporting period, several small depressions containing pooled water were observed immediately after rainfall events, however, the depth of water was less than 10cm and the seasonal waterlogging was determined to account for less than 1% of the pasture rehabilitation area (refer **Plate 1**). A soil settling event occurred in September 2016 whereby a hole opened in the western portion of the pasture area (**Plate 2**). This hole was subsequently remediated by filling with earth (**Plate 3**).

Plate 1 *Pooled water in a depression in the Pasture area.*

Plate 2 *Soil settling hole in Pasture area*

Plate 3 *Soil settling hole repaired*

5.3 SURFACE DRAINAGE STRUCTURE MANAGEMENT

Surface water pooling may also occur as a result of inappropriate or inadequate drainage structures. Sediment ponds and contour drains have previously been constructed where appropriate and there is no evidence of failure to date. Drainage structures were routinely examined during the 2016 reporting period with minor maintenance works undertaken. Maintenance works included the re-construction and maintenance of roll-over drains on sloping sections of the access track to prevent rill erosion.

5.4 PASTURE IMPROVEMENT

The study area is privately owned with stock management being the responsibility of the landowner (Morris). Enhance Place has previously installed fencing to create three fenced and watered paddocks to assist the landowner with stock management and consequently assist with rehabilitation of the pasture. A *Stock Management Plan* (First Field Environmental, April 2016) was developed and implemented during the reporting period to provide guidance in relation to stocking rates and grazing management at the Morris property (refer **section 5.2**).

During the reporting period pasture areas were treated in accordance with the recommendations of the *Enhance Place Mine Rehabilitation Monitoring Reports* (First Field Environmental, 2015 & 2016). Works undertaken included the application of fertilizer to all pasture areas (**Plate 4**) at the rates prescribed in **Section 7.1.2.**

Plate 4 *Pasture area showing white gypsum fertiliser on surface*

5.5 TREED AREA IMPROVEMENT

Maintenance of the tube stock planted within the treed rehabilitation area at the Enhance Place Mine was continued during the 2016 reporting period. A mixture of organic matter (woody debris), seed and hydromulch was applied to bare areas within the treed rehabilitation area to increase groundcover and reduce potential soil erosion (**Plates 5, 6 & 7**). Planting of additional long stem deep rooted native tree species was also undertaken during the reporting period (**Plates 8, 9 & 10**). Trees were planted into an auger hole prepped with organic soil, fertilizer and water crystals, with hardwood stakes and mesh tree guards installed on each plant. Fortnightly inspections are undertaken to determine the requirement for watering or additional fertiliser application. Fencing was also maintained to minimise adverse impacts from adjacent horse grazing.

Plate 5 *Application of organic mulch to Treed area*

Plate 6 *Organic mulch in Treed area*

Plate 7 *Hydromulch mixture applied to Treed area*

Plate 8 *Deep rooted seedlings planted in Treed area*

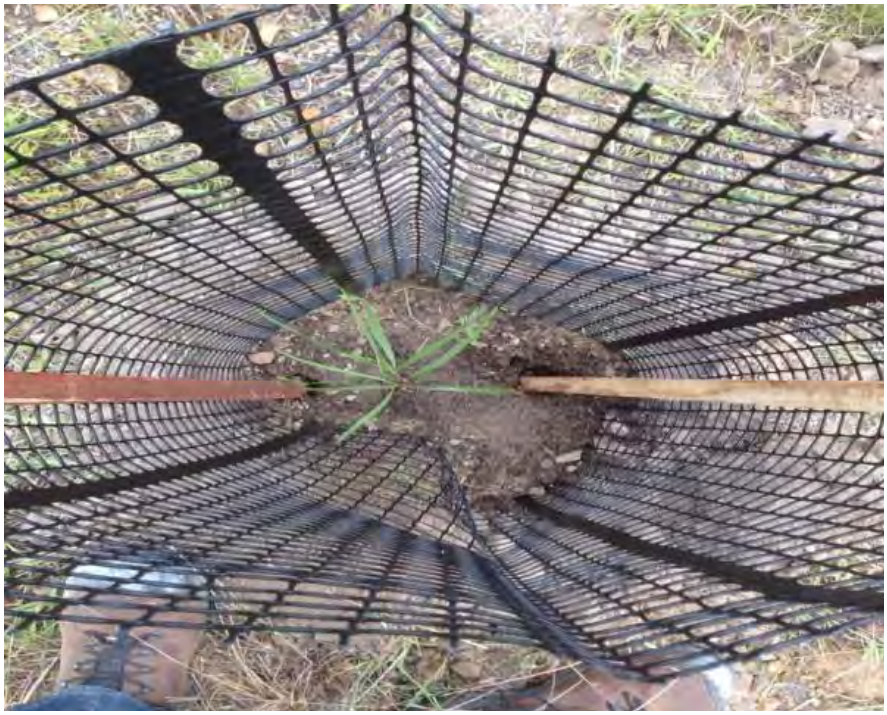

Plate 9 *Mesh guards on seedlings planted in Treed area*

Plate 10 *Seedlings in Treed area*

5.6 WEED MANAGEMENT

Management of noxious weeds at the Enhance Place Mine are controlled in accordance with the *Weed Management Plan* documented in Appendix C of the *Enhance Place Mine Stock Management Plan (First Field Environmental, 2016).* The weed management undertaken

during the reporting period consisted of spot spraying for African Lovegrass, Blackberry, St John's Wort and Sweet Briar at the frequencies presented in **Section 7.1.2,** in addition to the hand-pulling of Wild Radish plants

5.7 STOCK MANAGEMENT

A Stock Management Plan was commissioned for the Enhance Place Mine to aid in the management of the rehabilitated pasture areas which are currently affected by compaction and overgrazing by the landowners stock (refer **Appendix C**).

The *Enhance Place Mine Stock Management Plan (First Field Environmental, April 2016)* included the utilisation of the existing fencing layout to assist with time control or rotational grazing to improve pasture. A collaboration between Enhance Place Mine Pty Ltd and the landowners, Mr & Mrs Morris, led to the exclusion of grazing stock from paddock 1 of the site during the period 16 September to 8 December 2016 in an effort to improve pasture conditions. A *Monitoring and Evaluation Report into Rehabilitated Pasture (First Field Environmental, January 2017)* has since been prepared to evaluate the success of rehabilitation following the Stock Management Plan's implementation over one pasture-growing season. The findings of the *Monitoring and Evaluation Report into Rehabilitated Pasture* indicated the stock exclusion of paddock 1 was beneficial for the site's pasture rehabilitation, with pasture growth in paddock 1 increasing from <3cm in height to approximately 80cm during the exclusion period (**Plate 11**). Additionally, exposed soil patches were observed to decrease and no active erosion was evident in the exclusion paddock.

Plate 11 *Regeneration of pasture in Paddock 1 during stock exclusion*

Table 5

Rehabilitation Works Completed During 2016 AEMR Period - Summary

EP Commitments as per EP MOP 2015	Enhance Place Rehabilitation Monitoring Report Recommendations for 2015 and 2016	Rehabilitation Works Completed During 2016
Pasture Areas		
Erosion Management; Soil Stabilisation; Weed Management; & Pasture Improvement. *Erosion management (surface) – treated through planting, installation of fencing, improvement of surface drainage structures. Cracks mechanically improved and replanted. *Pasture improvement – Stock Management Plan.	• Rip along contours of poorly established pasture rehabilitation areas and re-sow pasture mix and fertiliser. Cover with a mixture of lime and gypsum as per the recommendations of SLR 2014 report (2015). • Re-sow water logged areas and exposed soils in depressions with rye grass (2016).	• Lime and gypsum was applied across all pasture areas at the recommended rate. • Waterlogged areas and depressions did not require re-sowing as water infiltrated quickly and existing pasture was still viable.
	• Increase and maintain groundcover in pasture rehabilitation areas to at least 95% to mitigate the potential for soil erosion and to ensure that groundcover is comparable to cover at the pasture analogue site (2015 & 2016).	• Fertiliser (lime & gypsum) applied over pasture areas- success is subject to horse grazing management. Pasture rehabilitation is currently between 75-90%, which satisfies the MOP completion criteria.
	• Address overgrazing through the development of a Stock Management Plan (2015). • Continue to monitor stocking rates in accordance with SMP (2016).	• Stock Management Plan (SMP) developed. • SMP implemented - paddock 1 exclusion Sep to Dec 2016. • Monitoring and Evaluation of SMP pasture rehabilitation (January 2017) indicated successful rehabilitation of pasture in paddock 1.
Treed Areas		
Erosion Management; Soil Stabilisation; Weed Management; & Treed area Improvement. *Treed area improvement by planting additional tube stock, weed management, fertiliser and mulch application.	• Re-apply a mixture of mushroom compost, lime and gypsum to treed rehabilitation areas as per the recommendations of SLR 2014 report (2015).	• Compost, lime and gypsum applied across treed areas at recommended rate.
	• Increase groundcover of grasses and broadleaf herbs at treed rehabilitation areas to >95% to mitigate the potential for soil erosion and to ensure that groundcover is comparable to cover at the treed analogue site (2015 & 2016).	• Application of organic mulch and seed mix applied. Hydromulch and seed mix of fast growing groundcover herbs and grasses then applied to the treed area.
	• Consider planting tree seedlings where soils are exposed (2016).	• Planting of deep rooted native tube stock undertaken.
	• Place additional coarse woody debris along contours above rills to reduce rate and volume of runoff (2016).	• Woody debris and organic matter sprayed over contours of treed area.
All Areas		
Erosion Management; Soil Stabilisation; & Weed Management	• Continue to spot-spray outbreaks of African lovegrass (2015). Hand pull Wild Radish plants (2016). • Revegetate exposed sediment retention basin walls (2015 & 2016). • Construct a roll-over drain above existing rill erosion on sloping trails to divert water off trail surface more effectively (2015 & 2016). • Mechanically improve the soil surface in areas where cracking is more than 20cm in depth (2015). • Address soil cracking / movement as it occurs (2016). • Monitor pest animal numbers (2016)	• Weed management undertaken as per Table 8. • Roll-over drain constructed and maintained to prevent rill erosion. • No areas of cracking greater than 20cm in depth were observed during 2016. • Soil movement (settling hole) re-filled. • Pest monitoring not required as numbers are considered low with no adverse impact on rehabilitation and final land use.

6 REHABILITATION SUMMARY

A summary of the disturbed and rehabilitated areas at the Enhance Place Mine is summarised in **Table 6.**

Table 6
Rehabilitation Summary

		Cumulative Area Affected (hectares)		
		To Date	**2016 Period**	**2017 Period (estimated)**
A: MINE LEASE AREA				
A1	**Mine Lease(s) area**	30.6	30.6	30.6
B: DISTURBED AREAS				
B1	**Infrastructure Area**	Nil	Nil	Nil
B2	**Active Mining Area**	Nil	Nil	Nil
B3	**Waste Emplacements**	Nil	Nil	Nil
B4	**Tailings Emplacements**	n/a	n/a	n/a
B5	**Shaped Waste Emplacement**	Nil	Nil	Nil
ALL DISTURBED AREAS		**Nil**	**Nil**	**Nil**
C: REHABILITATION PROGRESS				
C1	**Total Rehabilitated Area**	24.2	24.2	24.2
D: REHABILITATION ON SLOPES				
D1	**10 to 18 Degrees**	1.2	1.2	1.2
D2	**Greater than 18 Degrees**	0.5	0.5	0.5
E: SURFACE OF REHABILITATED LAND				
E1	**Pasture and Grasses**	21	21	21
E2	**Native Forest / Eucalypt**	1.2	1.2	1.2
E3	**Plantations and Crops**	Nil	Nil	Nil
E4	**Other**	2	2	2

Since mining ceased in June 2005 approximately 21 ha of the study area has been rehabilitated to pasture. Pasture was sown with *Cox's River Mix*, comprising:

- 40% Fescue;
- 25% Cocksfoot;
- 20% Subterranean clover;
- 6% Perennial rye grass;
- 5% White clover; and,
- 4% Phalaris.

An additional 1.2 ha has been planted with trees and shrubs.

7 MAINTENANCE ACTIVITIES ON REHABILITATED LAND

7.1 ONGOING REHABILITATION MAINTENANCE

An agronomist was engaged by Enhance Place Pty Ltd to inform development of quantitative rehabilitation completion criteria and provide advice and recommendations for pasture improvement strategies, including the addition of soil ameliorants for each of the rehabilitation domains at Enhance Place (*Soil Assessment and Recommendations for Rehabilitated Areas Enhance Place Mine,* SLR 2014). The agronomist recommendations have been incorporated within the Care and Maintenance MOP Rehabilitation Completion Criteria. In addition, an annual assessment of the current rehabilitation status of the pasture and treed areas at the Enhance Place Mine is provided via a Rehabilitation Monitoring Report.

Rehabilitation maintenance undertaken at the Enhance Place Mine is therefore guided by the recommendations of the agronomist report and by the recommendations of the annual rehabilitation monitoring reports which provide an assessment of the current status of the site's rehabilitation against the MOP Rehabilitation Completion Criteria.

7.1.1 Fertiliser Requirements

A fertiliser mix of Muriate of Potash (MoP), di-ammonium phosphate (DAP) and gypsum was recommended in the agronomist report for the improvement of soil nutrients and plant growth at the Enhance Place Mine. This fertilizer mixture is applied at the following rates on an as required basis.

Table 7
Enhance Place Mine Fertiliser Requirements

Site / Area	Fertiliser Requirement	Tonnes/ha	Total tonnes
Enhance Place Approx. 23 hectares	DAP	0.20	4.60
	MoP	0.25	5.75
	Gypsum	3	69

7.1.2 Weed Management Schedule

Control of weed species at the Enhance Place Mine is an integral component of pasture rehabilitation. The following weed management schedule (**Table 8**), adopted from the *Rehabilitation Monitoring Report* (First Field Environmental, 2014) and the *Enhance Place Mine Stock Management Plan* (First Field Environmental, 2016) is used at the site to provide ongoing weed maintenance on a seasonal basis.

Table 8
Enhance Place Mine Weed Maintenance Schedule

Species	Control class *	Control method	Summer			Autumn			Winter			Spring		
			December	January	February	March	April	May	June	July	August	September	October	November
African Lovegrass *Eragrostis curvula*	4	Flupropanate 745g/L (trade name *Taskforce*) 300mL per 100L of water (note 14 day stock withholding period) **Non-chemical options:** appropriate grazing management												
Blackberry *Rubus fruticosus* aggregate species	4	Triclpyr 300g/L + Picloram 100g/L + Aminopyralid 8 g/L **(trade name *Grazon Extra*)** 350 or 500mL per 100L water **Non-chemical options:** slashing of young bushes and use of biological control agents												
St. John's Wort *Hypericum perforatum*	4	Triclpyr 300g/L + Picloram 100g/L + Aminopyralid 8 g/L **(trade name *Grazon Extra*)** 500mL per 100L of water **Non-chemical options:** appropriate grazing management and use of biological agents												
Sweet Briar *Rosa rubiginosa*	4	Triclpyr 300 g/L + Picloram 100g/L + Aminopyralid 8 g/L **(trade name *Grazon Extra*)** 500mL per 100L of water **Non-chemical options:** mechanical removal or grubbing												

* noxious weed control class
Green Highlighted cells indicated the season during which maintenance is undertaken.

Maintenance activities undertaken on rehabilitated land at the Enhance Place Mine during the 2016 reporting period are presented in **Table 9**, along with maintenance activities proposed for the 2017 reporting period.

Table 9
Maintenance Activities on Rehabilitated Land

Nature of Treatment	Area Treated (ha) 2016 Reporting period	Area Treated (ha) 2017 Reporting period	Comment/control strategies/ treatment detail
Additional erosion control works (drains re-contouring, rock protection)	2	2	Repair areas of soil cracking / movement. Maintenance of roll-over drain & rill erosion on access track.
Re-covering (detail - further topsoil, subsoil sealing etc)	2	2	Application of organic mulch & hydromulch to bare earth areas in the treed rehabilitation area.
Soil treatment (detail - fertiliser, lime, gypsum etc)	2 30.6	2 0	Application of hydromulch containing fertilizer to bare earth areas within the treed rehabilitation area. Application of fertiliser mix to pasture areas.
Treatment/Management (detail - grazing, cropping, slashing etc)	30.6	30.6	Implementation of Stock Management Plan and pasture exclusion.
Re-seeding/Replanting (detail - species density, season etc)	1.2	0	Planting of 40 deep rooted native trees and seeding of groundcover species in treed rehabilitation area.
Adversely Affected by Weeds (detail - type and treatment)	17	17	Integrated weed management control for African Lovegrass, Blackberry, St. John's Wort, Sweet Briar and Wild Radish.
Feral animal control (detail - additional fencing, trapping, baiting etc)	0	0	No additional feral animal control was undertaken.

8 REHABILITATION MONITORING

During the reporting period, rehabilitation monitoring was undertaken against the rehabilitation completion criteria in the Care and Maintenance MOP (February 2015). The 2016 Rehabilitation Monitoring Report is included in **Appendix B**.

During the 2016 rehabilitation monitoring survey the following observations were made:

- Surface cracking was found to be limited to the crests of slopes adjacent to the treed revegetation area.
- Minor erosion of exposed soils was observed in both the treed and pasture areas, with rill erosion occurring on the access track. Erosion of sediment basin walls was also observed.

- Some surface water ponding was observed in depressions of the pasture area immediately after rainfall.
- Some areas of fencing were observed to be in poor condition or had been removed by landholder.
- African Lovegrass and Wild Radish was observed in both the treed and pasture areas, however recent weed treatment was deemed successful in control of the outbreak.
- The level of pest activity (rabbits and foxes) was considered low and was not considered to be an adverse impact on rehabilitation.
- Pasture areas exhibited groundcover >70% however the pasture areas were observed to be overgrazed with some areas showing sparse or no vegetation.
- Incidents of soil cracking and movement in the pasture areas were found to be monitored and addressed as they occur.
- Minor rill erosion was observed in the treed rehabilitation area.

A number of recommendations were provided in the 2016 *Enhance Place Mine Rehabilitation Monitoring Report* (First Field Environmental, 2016) which are consistent with the interventions and adaptive management measures documented in the MOP. All of the applicable recommendations provided in the 2016 rehabilitation monitoring report were implemented at the Enhance Place Mine during the 2016 AEMR period (refer **Table 5**). This table also details the recommendations made from the previous (2015) rehabilitation monitoring report, and the actions undertaken by Enhance Place Mine to implement the recommendations at the site.

Monitoring and maintenance of the final landform and stability of the site will continue while Enhance Place hold relevant mining authorities over the area.

9 METEOROLOGICAL DATA

An automatic weather station was installed at the Pine Dale Open Cut Mine project site in 2006 (located in nearby Blackmans Flat). The data is downloaded and reported by RCA Australia from Newcastle, NSW.

Meteorological monitoring parameters recorded at the Pine Dale Mine Meteorological Monitoring Station include Wind Speed, Wind Direction, Temperature at 10m height, Temperature at 2m height, Rainfall, Humidity, Solar Radiation, Sigma Theta and Evapotranspiration. Details of weather data recorded for the period January to December 2016 are summarised in **Table 10**. Windrose plots for the 2016 period are presented in **Figure 4**.

The average annual rainfall for the area is 78 6.9mm recorded at the Lithgow (Cooerwull) Station, situated approximately 15km to the south east of t he Enhance Place Mine (Source: Bureau of Meteorology, based on the rainfa ll period 18 78 – 2016) . During the 2016 reporting period Pine Dale Mine received 1167.6mm of rainfall and experienced 14 7 rainfall days. Rainfall during this period was observed to be greater than rainfall recorded in 201 5 (754.4mm and 144 rainfall days), and greater than the area's long term annual a verage. The Annual Rainfall f or the period 2006 – 2016 recorded at t he Pine D ale Mine meteorological monitoring station is shown in Error! Reference source not found., whilst the monthly rainfall for 2016 is prese nted in **Figure 2** Blackmans Flat Annual Rainfall 2006- 2016

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The maximum temperature recorded during t he reporting period occurr ed in January 2016 measuring 36.4°C and 34.4°C at 2m and 10m respectively. The lowest temperature wa s observed during May with -7.0°C recorded at 2m and -6.9°C recorded at 10m.

Predominant wind directions at the site during 2016 were observed to be from the south-east during summer and from the north-west and west-north-west during autumn, winter and spring. The maxi mum wind speed measured a t the site was 20.7m/s on the 3 Se ptember from a west-north-westerly direction.

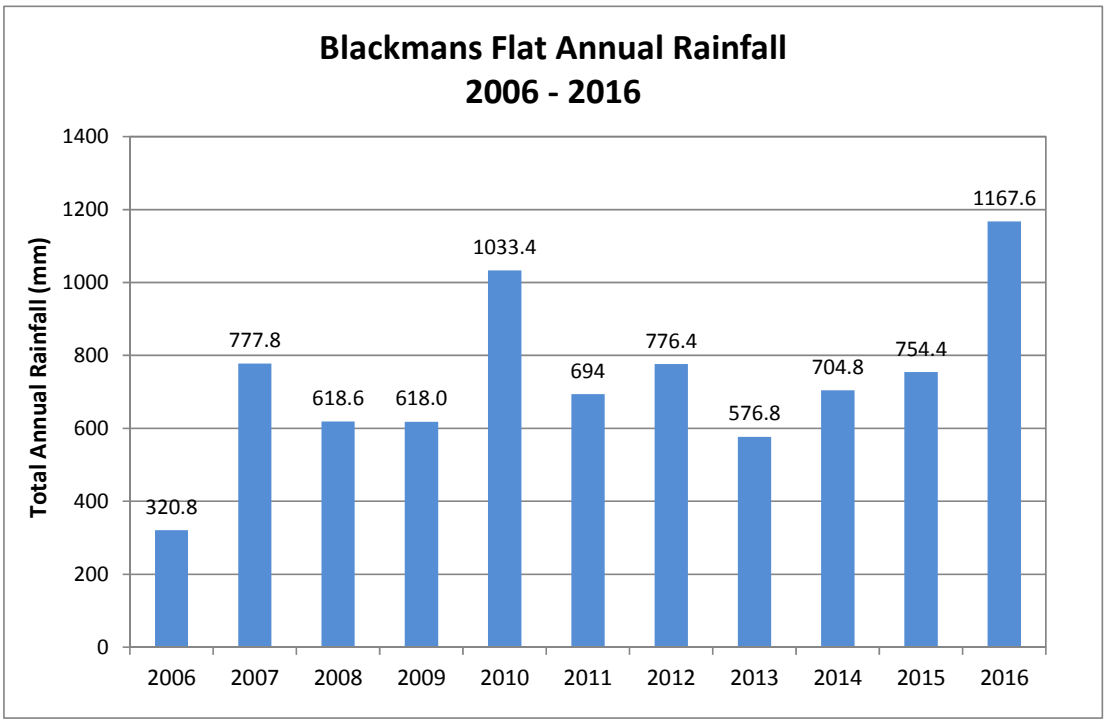


Figure 2
Blackmans Flat Annual Rainfall 2006- 2016

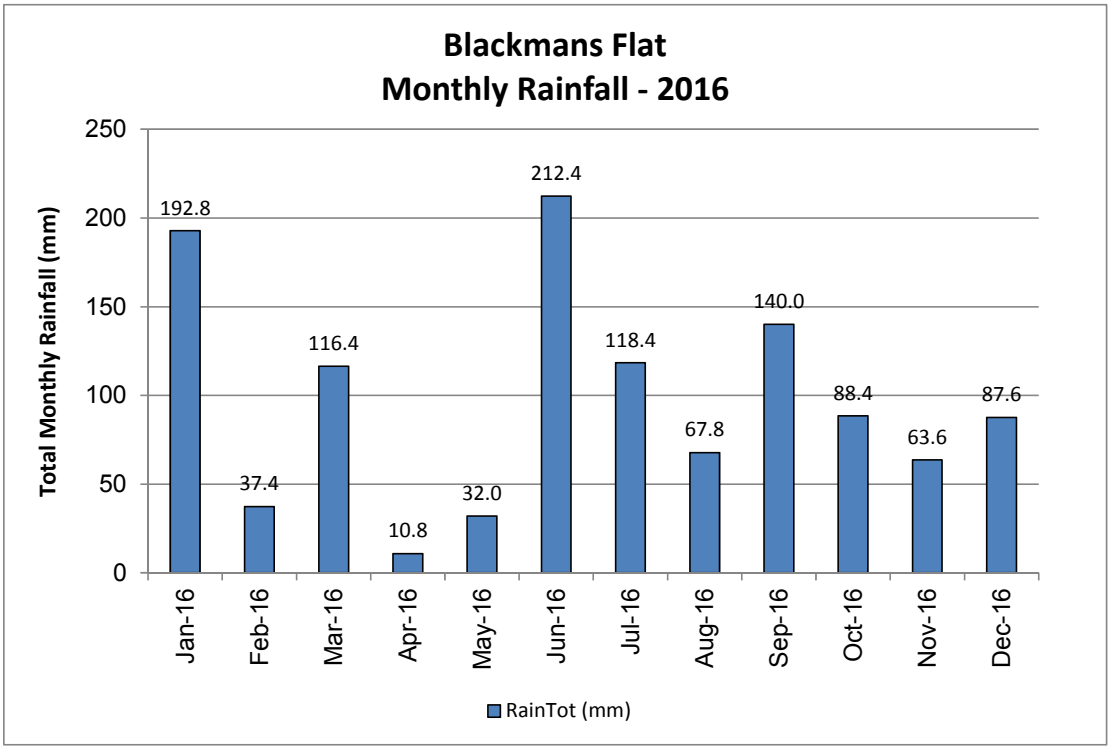


Figure 3
Blackmans Flat Monthly Rainfall 2016

Table 10
2016 Meteorological Monitoring Data Summary

Month (2016)	Rainfall (mm)	Cumulative Rainfall (mm)	Rain Days/ Month	Air Temp. @ 2m (°C)			Air Temp. @ 10m (°C)			Sigma theta (º)			Relative Humidity (%)			Wind Speed (m/s)			Modal Wind Direction
				Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	
January	192.8	192.8	13	19.1	6.6	36.4	18.5	6.7	34.4	32.1	0.0	101	69.7	12.2	96.6	1.4	0.0	14.5	SE
February	37.4	230.2	5	19.7	6.9	34.8	19.1	7.0	32.9	33.3	0.0	102	65.2	15.2	96.0	1.1	0.0	13.9	SE
March	116.4	346.6	10	17.7	4.7	34.3	17.3	4.9	32.4	32.8	0.0	103	70.4	16.6	96.7	0.9	0.0	11.5	SE
April	10.8	357.4	9	14.1	1.9	28.7	13.8	2.3	27.4	29.7	0.0	99.8	71.2	13.9	95.8	0.9	0.0	11.2	WNW
May	32.0	389.4	9	9.4	-7.0	25.8	9.4	-6.9	24.3	23.0	0.0	102	71.6	10.1	96.0	2.0	0.0	15.4	W
June	212.4	601.8	20	6.4	-6.7	16.1	6.3	-6.5	14.6	24.4	0.0	101	82.2	34.2	96.2	2.1	0.0	15.1	NW
July	118.4	720.2	19	6.5	-6.9	17.4	6.4	-6.8	17.0	23.9	0.0	104	79.4	37.2	96.6	2.1	0.0	19.4	NW
August	67.8	788.0	12	6.2	-5.8	18.9	6.1	-5.7	17.4	24.1	0.0	99.0	76.0	21.6	95.8	1.4	0.0	15.3	NW
September	140.0	928.0	20	9.2	-1.6	21.2	9.0	-1.6	19.7	23.0	0.0	97.3	76.8	26.2	96.0	2.0	0.0	20.7	NW
October	88.4	1016.4	11	11.7	-2.4	26.5	11.3	-2.3	25.1	23.3	0.0	97.7	64.3	19.8	95.7	2.5	0.0	14.9	WNW
November	63.6	1080.0	8	15.9	0.0	31.6	15.4	0.0	29.3	26.4	0.0	103	60.9	12.8	96.3	1.9	0.0	15.7	WNW
December	87.6	1167.6	11	20.0	3.6	35.0	19.2	3.8	32.5	28.7	0.0	103	65.0	15.7	95.5	1.7	0.0	13.1	NW
TOTAL	**1167.6**	**-**	**147**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Minimum	**10.8**	**-**	**5**	**-**	**-7**	**-**	**-**	**-6.9**	**-**	**-**	**0.0**	**-**	**-**	**10.1**	**-**	**-**	**0.0**	**-**	**-**
Maximum	**212.4**	**-**	**20**	**-**	**-**	**36.4**	**-**	**-**	**34.4**	**-**	**-**	**104**	**-**	**-**	**96.7**	**-**	**-**	**20.7**	**-**

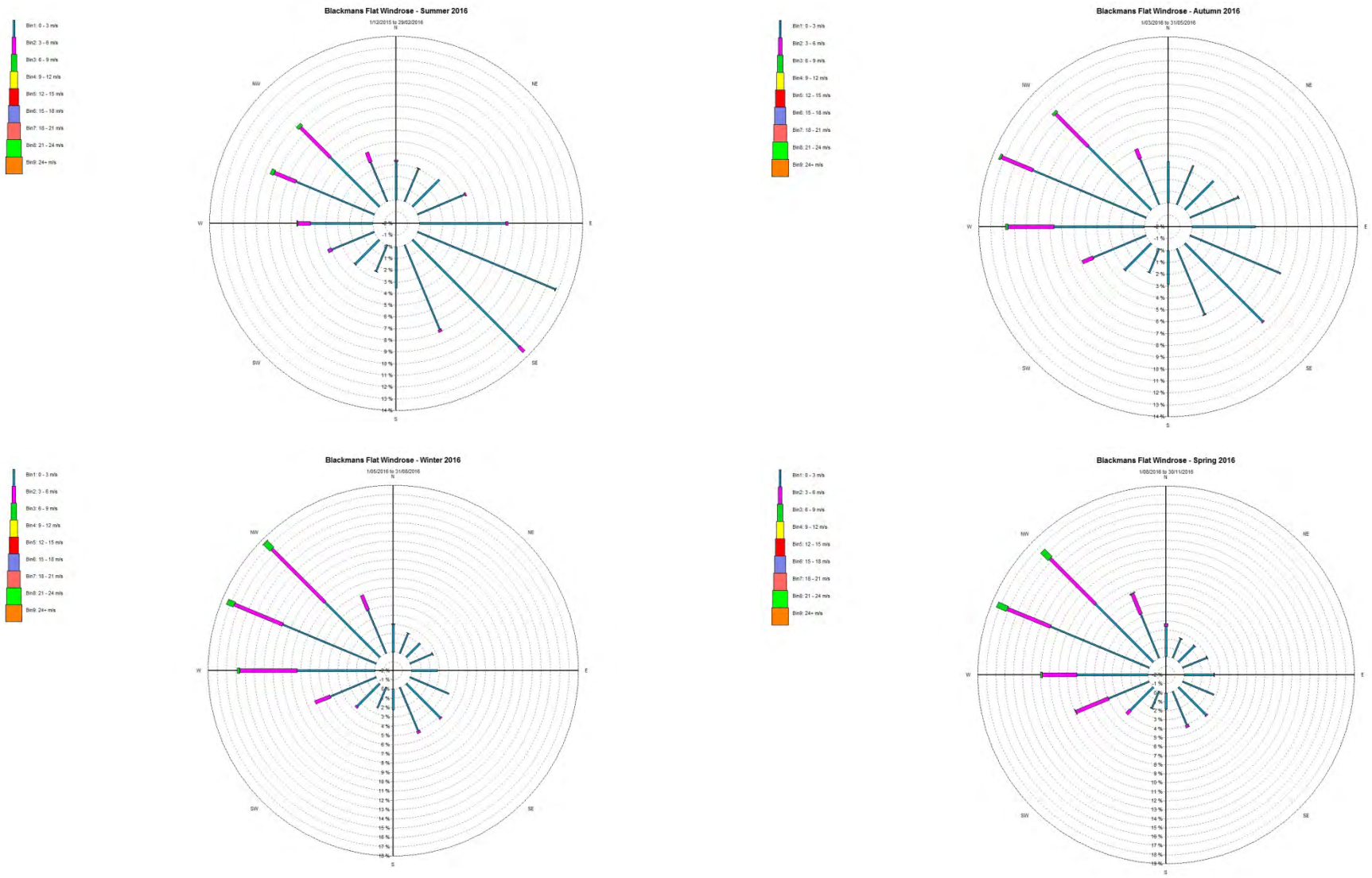


Figure 4
Blackmans Flat Seasonal Windrose Plots 2016

10 ENVIRONMENTAL PERFORMANCE

The final landform and water management structures have been completed at Enhance Place (refer **Plan 3**, **Appendix A**). These areas and structures are inspected on a monthly basis by the Mining Engineering Manager.

It should be noted that the majority of land within the leases of Enhance Place Mine is privately owned and landowner permission is required to access the site. The land is predominately used for grazing horses year round.

There were no environmental incidents reported during the 2016 reporting period.

The report required under the Enhance Place Mine Consent that presented options on the final land use and ownership of the Glen Davis Recreation Trust area at the Enhance Place Mine has been presented to the Lithgow City Council and other relevant stakeholders. This Consent Condition is now satisfied, and the final decision on land use rests with the relevant authorities.

Enhance Place will move to relinquish Mining Leases over the site following a satisfactory rehabilitation outcome. Until the relevant leases are relinquished Enhance Place will continue ongoing monitoring and maintenance of the rehabilitated area as required.

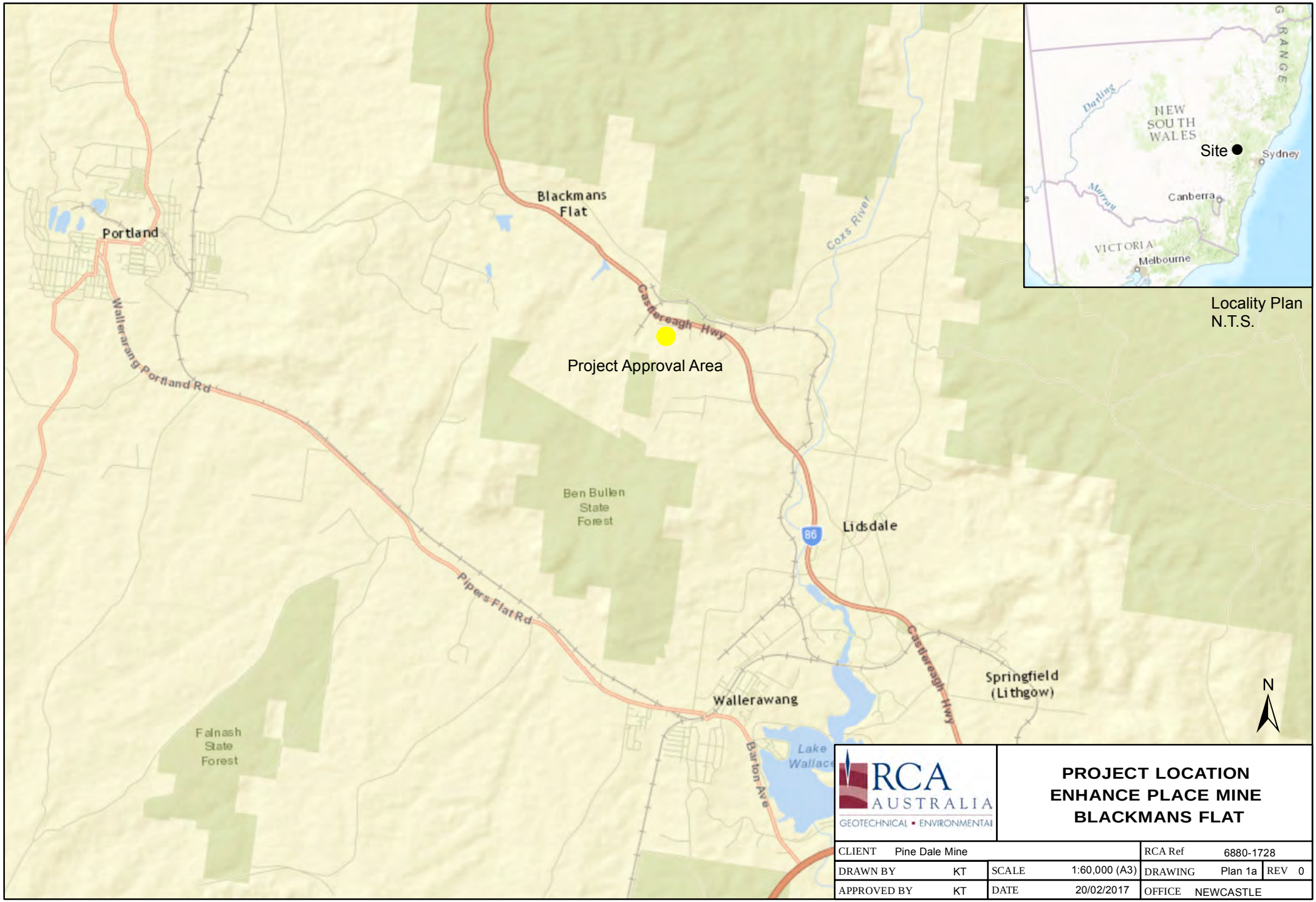
10.1 COMPLAINTS AND LIAISON

There were no environmental complaints recorded during the reporting period from the general public or near neighbours.

Discussions with key landholders were ongoing during the reporting period to ensure dialogue was maintained regarding land management matters.

Appendix A

Enhance Place Mine Plans



Locality Plan
N.T.S.

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

PROJECT LOCATION
ENHANCE PLACE MINE
BLACKMANS FLAT

CLIENT	Pine Dale Mine			RCA Ref	6880-1728
DRAWN BY	KT	SCALE	1:60,000 (A3)	DRAWING	Plan 1a REV 0
APPROVED BY	KT	DATE	20/02/2017	OFFICE	NEWCASTLE

CDT–DWG–A4H–001/1

LEGEND

H House

Natural features

0 50 100 150 200 250

metres

NOTE: Drawing adapted by plan supplied by Enhance Place Mine
Drawn by Craven, Elliston & Hayes (Lithgow) Pty Ltd
Dwg No. ENH-REH, Plan 3, 18-12-13

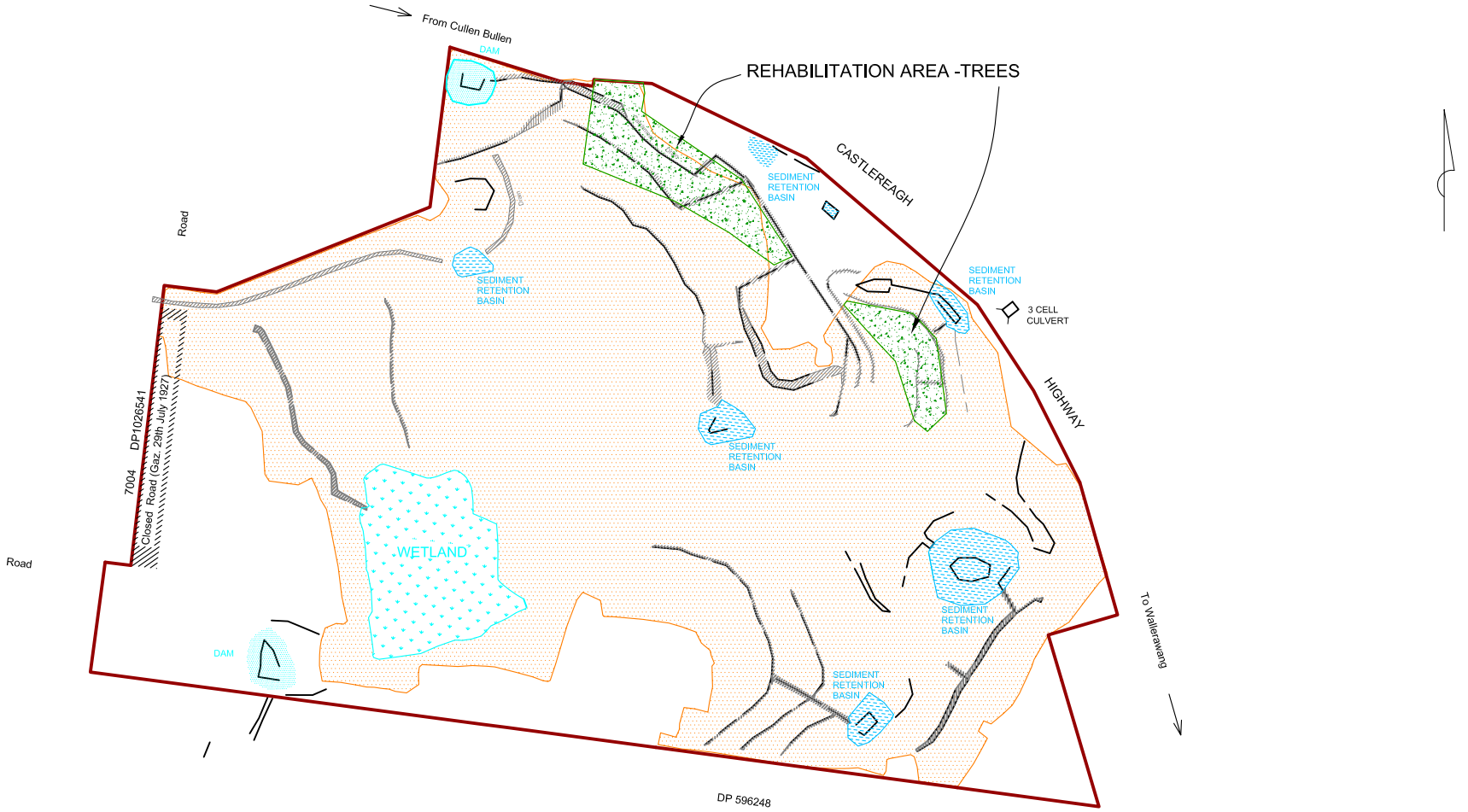
Aerial image taken from Google Earth, May 23 2006
Image position is approximate only

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

PRE MINING ENVIRONMENT
ENHANCE PLACE MINE
BLACKMANS FLAT

CLIENT	Enhance Place Mine Pty Ltd			RCA Ref	6880-1728
DRAWN BY	KT	SCALE	1 : 5000 (A4)	DRAWING No	Plan 1b REV 0
APPROVED BY	KT	DATE	20/2/2017	OFFICE	NEWCASTLE

CDT–DWG–A4H–001/1



LEGEND

- Rehabilitation Area - Pasture
- Rehabilitation Area - Treed Area
- Existing dams

NOTE: Drawing adapted by plan supplied by Enhance Place Mine
Drawn by Craven, Elliston & Hayes (Lithgow) Pty Ltd
Dwg No. ENH-REH, Plan 3, 18-12-13

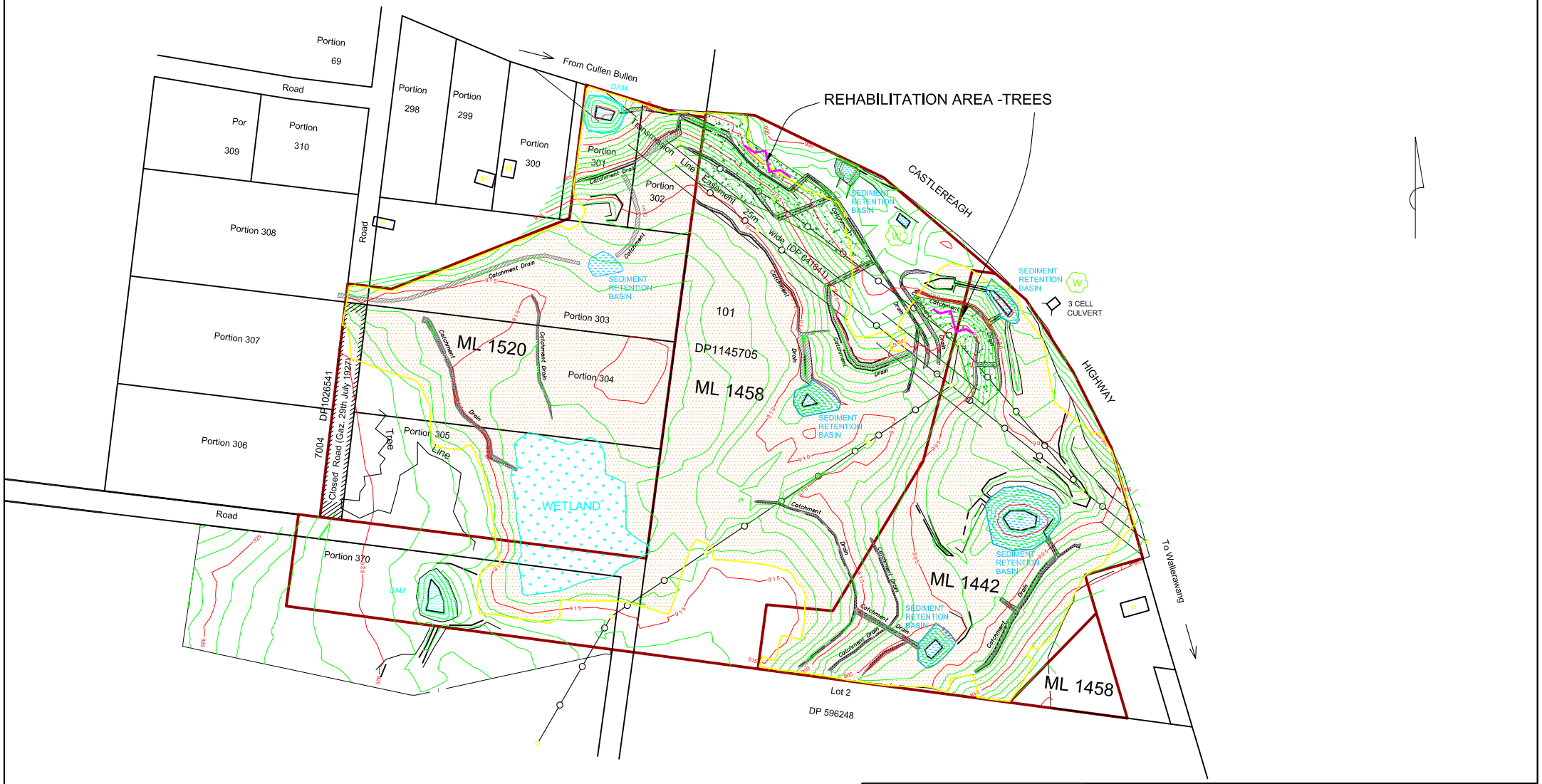
0 50 100 150 200 250
metres

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

MINE DOMAINS AT COMMENCEMENT OF MOP ENHANCE PLACE MINE BLACKMANS FLAT

CLIENT	Enhance Place Mine Pty Ltd			RCA Ref	6880-1728
DRAWN BY	KT	SCALE	1 : 5000 (A4)	DRAWING No Plan 2	REV 0
APPROVED BY	KT	DATE	20/2/2017	OFFICE	NEWCASTLE

CDT–DWG–A4H–001/1



LEGEND

- Rehabilitation Area - Trees
- Rehabilitation Area - Pasture
- Existing dams

NOTE: Drawing adapted by plan supplied by Enhance Place Mine
Drawn by Craven, Elliston & Hayes (Lithgow) Pty Ltd
Dwg No. ENH-REH, Plan 3, 18-12-13

0 50 100 150 200 250
metres

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

FINAL REHABILITATION AND POST MINING LAND USE ENHANCE PLACE MINE BLACKMANS FLAT

CLIENT	Enhance Place Mine Pty Ltd			RCA Ref	6880-1728
DRAWN BY	KT	SCALE	1 : 5000 (A4)	DRAWING No Plan 3	REV 0
APPROVED BY	KT	DATE	20/2/2017	OFFICE	NEWCASTLE

Appendix B

Enhance Place Mine

Rehabilitation Monitoring Report 2016

Enhance Place Mine

Rehabilitation Monitoring Report 2016

Report prepared by First Field Environmental
on behalf of EnergyAustralia

October 2016

Revision history		
Version	Date	Author
Draft	7 November 2016	Michelle Evans
Final	10 November 2016	Michelle Evans

This report has been prepared by First Field Environmental for EnergyAustralia. The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report.

First Field Environmental

PO Box 6318 Silverwater NSW 1811

T: 0468 708 520

E: michelle@firstfield.net.au

Contents

Appendices

Figures

Tables

1. Introduction

Enhance Place Coal Mine is located in the Western Coalfields of NSW at Blackmans Flat, 15km north of Lithgow on the southern side of Castlereagh Highway. The site is approximately 3km south west of Mount Piper Power Station and adjacent to the Springvale Coal Handling Facility.

Enhance Place Mine is managed in accordance with Mining Lease (ML) 1520, ML 1458 and ML 1422. The draft *Care and Maintenance Mining Operations Plan* dated 2014 has been prepared in accordance with ESG3: Mining Operations Plan Guidelines (2013) and describes the following rehabilitation objectives:

- *"Create a low maintenance, geotechnically stable and safe landform;*
- *Stabilise all earthworks, drainage lines and disturbed areas associated with both past and future activities in order to minimise erosion and the associated generation of sediment-laden water;*
- *Reduce the visual impact from both local or distant vantage points by means of final rehabilitation of areas of disturbance;*
- *Blend the created landform with the surrounding land fabric; and*
- *As appropriate, revegetate with native tree and shrub species and/or pasture species comparable with those on surrounding lands or which occurred in each area prior to agriculture of mining-related disturbance."*

This report aims to identify successes and failures in rehabilitation in regard to agreed performance indicators and completion criteria. Recommendations are made in areas that could be improved.

2. Performance indicators

Table 1 identifies the performance indicators and completion criteria for Enhance Place Mine as determined by the *Enhance Place Mine Care and Maintenance Mining Operations Plan* (Enhance Place Pty Ltd, 2014).

Table 1 Performance indicators and completion criteria

Performance indicator	Completion criteria
Vegetation health	• More than 75% of native forest indicator species are assessed to be healthy and growing at year 5.
Erosion	• Stable landform, suitable for grazing and horses. • No exposed highwalls and adits to underground mine workings.
Surface cracks	• Limited areas of high concentration with cracking due to soil settling.
Landform	• Shape and form is visually similar to adjacent land.
Ponding of water	• Sediment ponds constructed. • Contour drains constructed. • Relief ensures water flows as designed and directs water off site.
Access tracks, fences and gates	• Site access tracks constructed. • Fences erected. • Gates installed.
Rural land capability	• Pasture rehabilitation areas are assessed to have a Rural Land Capability Class VI or better (suitable for grazing).

Performance indicator	Completion criteria
Cattle and horses	• Area has successfully supported stock and/or horses for > 12 months at modest rates.
Species composition	• Establishment of pasture comprising approximately 70% perennial grass and 20% annual legume, representative of species at analogue sites. • Vegetation within the treed rehabilitation areas are established in accordance with the approved species mix.
Weed presence	• Weeds including African Lovegrass to comprise <10% of the pasture sward.
Vegetation distribution	• Native trees planted in designated areas as generally shown in MOP Plan 3 (ENH-REH Plan 3).
Groundcover	• Groundcover (vegetation, leaf litter, mulch) >70% at year 5.
Visual amenity	• Completion of bulk earthworks to create final landform. • Completion of seeding and tree plantings.

Source: Care and Maintenance Mining Operations Plan for Enhance Place Mine (Enhance Place Pty Ltd, 2014).

3. Weather conditions

The beginning of 2016 was characterised by sustained warmer weather and a lack of rainfall resulting in a late start to autumn. Average monthly rainfall leading up to the survey was variable, with April being unusually dry receiving significantly lower rainfall than the statistical average for that month, followed by June being Australia's second-wettest June on record. Recorded rainfall in June, July and September were higher than the average statistical rainfall for those months, and August was slightly drier than the average.

Table 2 presents regional rainfall data for the period commencing 2010.

The area received light rain (between 0.2 and 7 mm per day) during the week leading up to the survey work on the 17th of September (Bureau of Meteorology 2016).

Table 2 Rainfall (in mm) recorded at Lidsdale (Maddox Lane) January 2010 - September 2016

Year	Average	2010	2011	2012	2013	2014	2015	2016
Month								
January	86.1	76.6	63	48.2	87.4	9.2	156.2	142.0
February	78.2	107	68.2	173.8	149	85	21.2	28.8
March	65.1	60.8	78	187	43.2	155	39.4	69.6
April	43.9	37.6	23.8	31.6	26.8	63	158.2	6.2
May	49	54	42.4	40.6	23.6	14	25.2	26.0
June	51.2	39.8	41.2	70.6	87	43.2	24.8	173.4
July	51.6	87.4	18.2	48.8	19.6	25.6	44.6	91.4
August	64	84.4	54.8	23.2	22.4	56.4	43.8	52.2
September	52.4	64	65.4	40.4	44	35.2	9.8	118.6

Year	Average	2010	2011	2012	2013	2014	2015	2016
October	67.1	75.8	36.8	16.6	20.8	51.6	58.0	
November	72.5	101.6	158	39	68.6	36.8	63.6	
December	73.6	217	86	61.2	38.4	160.4	58.6	
Annual	**762.1**	**1006**	**735.8**	**781**	**630.8**	**735.4**	**703.4**	

Source: Bureau of Meteorology (2016)

4. Survey methodology

4.1 Rehabilitation monitoring

Monitoring locations - Previous studies have seen the establishment of four monitoring quadrats located within rehabilitated pastures, two transects within treed rehabilitation areas and 3 transects across areas of African lovegrass infestation. Additional transects exist as analogue sites in grazed pasture and an undisturbed naturally vegetated area of Pine Dale Mine to provide benchmarks against which the pasture and treed rehabilitation areas of Enhance Place Mine are assessed. Monitoring locations are shown in Figure 1.

Photopoint monitoring - Coordinates for each quadrat, transect and analogue site are provided in Appendix A. Each quadrat and transect area contains previously established photo monitoring points. Photos were taken from the northwest corner of each quadrat, along transects within treed rehabilitation areas and where African lovegrass presence and density was considered significant. Photos taken from these points enable a visual comparison to photos from previous surveys and are provided in Appendix D.

4.2 Erosion and sedimentation

Erosion and sedimentation - Evidence of erosion and sedimentation within each quadrat and in the vicinity of each transect has been determined in accordance with *Best Practice Erosion and Sediment Control* (IECA 2006).

Drainage impediments - Drainage structures within the rehabilitation areas were identified in the field and assessed for visible impediments and evidence of erosion and sedimentation.

Cracking soils - Soil surfaces within the rehabilitation areas were observed for surface cracking. Soil samples to a depth of 20cm were taken randomly from ten points within each pasture transect area. Soil structure, ped shape and ped surface characteristics were examined to determine whether soils are prone to cracking. Soil physical characteristics are assessed in accordance with the *Australian Soil and Land Survey Field Handbook* (CSIRO, 2009).

REHABILITATION AREA -TREES

SECONDARY DOMAINS
REHABILITATION AREA - TREES
REHABILITATION AREA - PASTURE
Transect
Willow
Quadrat
African Lovegrass infestation 2014
3 CELL CULVERT

Portion 69
Road
Portion 309
Portion 310
Portion 298
Portion 299
Portion 300
Portion 301
Portion 302
Portion 303
Portion 304
Portion 305
Portion 306
Portion 307
Portion 308
Portion 370
Lot 2 DP 596248
DP1026541
7004
Closed Road (Gaz. 29th July 1927)
From Cullen Bullen
To Wallerawang
CASTLEREAGH HIGHWAY
House
DAM
WETLAND
Tree Line
Transmission Line Easement
15m Wide (DP 64 RA)
Catchment Drain
Catchment
Drain
SEDIMENT RETENTION BASIN
Quadrat 1
Quadrat 2
Quadrat 3
Quadrat 4
ML 1520
ML 1458
ML 1442
101 DP1145705
MINE MANAGER
DATE

NOTES:

CRAVEN, ELLISTON & HAYES (LITHGOW) PTY.LTD.
CONSULTING LAND, ENGINEERING AND MINING SURVEYORS
ACN 056 544 551
"ASTROLABE" RUTHERFORD LANE, LITHGOW, 2790 PH: (02) 6351 2281, FAX: (02) 6352 1339
EMAIL : survey@ceh.com.au

DATE	18–12–13
AMENDED	
SURVEYOR	T.H./T.E
DRAWN	K.L.F./D.M.
CHECKED	

ENHANCE PLACE MINE
FINAL REHABILITATION AND
POST MINING LAND USE

SCALE - 1 : 1250 (A1 SHEET)

DWG No
ENH-REH
PLAN 3

4.3 Vegetation assessment

Pasture rehabilitation areas – Approximately 20 ha of the study area was sown with Cox's River seed mix prior to 2013 at the following rates:

- 40% Fescue *(Festuca spp.)*
- 25% Cocksfoot *(Dactylis glomerata)*
- 20% Subterranean clover *(Trifolium subterranean)*
- 6% Perennial rye grass *(Lolium perene)*
- 5% White clover *(Trifolium repens)*
- 4% Phalaris *(Phalaris aquatica)*

The proportion of perennial grasses and annual legumes currently in evidence at pasture quadrats and transects has been recorded and compared with the proportion at which these species were initially sown.

Tree rehabilitation areas – Approximately 6 ha of the study area was revegetated with trees, shrubs and herbaceous groundcover prior to 2013. Vegetation health, natural regeneration, structure and species composition have been determined in accordance with the *Australian Soil and Land Survey Field Handbook* (CSIRO 2009).

4.4 Pest animal and weed survey

Pest animal presence - Evidence of feral animal presence across the rehabilitation areas has been determined through scat and trail identification.

Noxious weeds - The location and extent of noxious weeds (as declared for the Upper Macquarie County Council area (NSW DPI, 2016) have been recorded. Target weed species, particularly African Lovegrass were identified in accordance with field guides and botanical keys.

4.5 Rural land capability assessment

Pasture rehabilitation areas have been assessed in accordance with the *Land and Soil Capability Assessment* (OEH 2007) and against *Pastures for Horses* (NSW DPI 2007). The physical effects of current grazing practices are contrasted with optimum horse stocking rates.

4.6 Stocking rates

Appropriate stocking rates have been determined in accordance with the carrying capacity of current and improved pasture conditions. Optimum stocking rates are provided in Appendix E of the *Stock Management Plan* (First Field Environmental 2016).

4.7 Access and fencing

Establishment of gates and fencing was completed prior to 2013. The condition of internal trails, fences and gates has been recorded.

5. Field survey results

Field survey was conducted on 17th September 2016 by a qualified ecologist. The survey revisited four quadrats and two transects representing rehabilitated pasture and treed areas, as well as pasture and treed analogue sites located at Pine Dale Mine.

5.1 Erosion and sedimentation

There are no significant erosion features that compromise landform stability or public safety within the rehabilitation areas. The landform is considered to be stable and is suitable for grazing. No highwalls or adits to underground mine workings are exposed.

Pasture rehabilitation areas - The pasture rehabilitation areas support evidence of minor surface erosion where groundcover is poorly established or absent. However overall combined bare surfaces do not exceed 20m^2 per hectare. The groundcover shown in Figure 2 is typical of rehabilitated pasture areas.

Figure 2 Exposed soils in quadrat 2

Figure 3 Exposed soils in transect 8

Treed rehabilitation areas – Exposed soils within the treed rehabilitation areas have been subject to wind and minor rill erosion (as shown in Figure 3).

Analogue sites – No active erosion is evident at the pasture and treed analogue sites.

Surface cracking – Soil cracking was observed along the crests of slopes adjacent to quadrat 4.

Evidence of soil settling was observed in September, as a hole opened along a portion of the fence line immediately north of quadrat 1. The hole (Figure 4) was reported to the Manager of Enhance Place Mine as soon as it was detected. The landholders were advised to remove stock from the area and arrangements were made for immediate remediation works. Figure 5 shows the area later that week following remediation works.

Figure 4 Hole north of quadrat 1

Figure 5 Results of remediation

Landform – The study area was filled and contoured prior to 2013 and the shape and form of the landscape is considered to be visually similar to the adjacent landscape.

Ponding of water – Sediment ponds and contour drains were established prior to 2013 and generally remain in good operational condition. Figure 6 shows the condition of sloping retention basin walls. Active surface erosion was observed on the sides of the sediment retention basin east of quadrat 2.

Figure 6 Sediment retention basin east of quadrat 2

Surface water pooling was evident in some areas, likely to be associated with surface erosion and sedimentation and existing land forming. It is noted that the area received light rainfall in the 48 hours preceding the survey. In all cases, water depth did not exceed 10cm. Figure 7 and Figure 8 provide examples of pooled water in the pasture area. Seasonal waterlogging accounts for less than 1% of the rehabilitated pasture area. Overall the relief ensures that water flows as designed and directs water off site and there is little evidence of surface water flow occurring outside of established contour drainage lines.

Figure 7 Pooled water in quadrat 1

Figure 8 Pooled water north of quadrat 1

5.2 Vegetation assessment

Flora species identified within and in the vicinity of quadrats and transects are listed in Appendix C.

Species composition at pasture rehabilitation areas – Pasture rehabilitation areas are established with a mix of 70% perennial grasses and 20% annual legumes and are representative of species composition at the analogue pasture site. An example of rehabilitated pasture is shown in Figure 9.

Figure 9 Pasture composition representative of rehabilitated pasture areas

Groundcover at pasture rehabilitation areas – Pasture rehabilitation areas are established with a mix of 70% perennial grasses and 20% annual legumes and are representative of species composition at the pasture analogue site (located at Pine Dale Mine). Percentage and type of groundcover is recorded in Appendix A.

Groundcover in quadrats 1 and 2 have remained stable, with 90% total living groundcover recorded in 2014, 2015 and 2016 surveys.

Quadrat 3 has continued to decrease in groundcover, from 90% total living groundcover in 2014, to 80% in 2015, and 75% in 2016.

The 2016 survey has shown Quadrat 4 has retained the 90% groundcover first achieved in 2015.

Photopoint monitoring provides a comparison of cover between 2014, 2015 and 2016 (see Appendix D).

Species composition at treed rehabilitation areas – Treed rehabilitation areas are established in accordance with an approved species mix representing local native species.

The areas of transects 7 and 8 (represented in Figure 10 and 11) support scattered juvenile trees and sparse mixed native shrub layers. The ground layers are dominated by mixed native grasses.

Groundcover at treed rehabilitation areas – Transect 7 supports groundcover of 90%. Transect 8 supports groundcover of 60%.

Figure 10 Vegetation structure and groundcover at transect 7

Figure 11 Vegetation structure and groundcover at transect 8

The treed analogue site is characterised by a canopy to 12m height with 40% canopy cover over a sparse shrubby mid-storey to 3m height and isolated shrubs to 1.5m height in the understorey. Groundcover consists of grasses and herbs with a cover of 90% (Figure 12).

Figure 12 Vegetation structure of treed analogue site (transect 7)

Canopy cover is absent in treed rehabilitation areas. A sparse mid-storey of isolated juvenile trees and shrubs exists over a sparse, low, shrubby understorey (seen in Figure 10). Groundcover is a sparse mix of broadleaf herbs and grasses. Changes in vegetation structure over time (as shown in Appendix B) are not considered significant.

Vegetation health at treed rehabilitation areas – Native forest indicator species are those that occur both in treed rehabilitation areas and the treed analogue site and provide an opportunity for comparison of growth between natural and rehabilitation conditions. Indicator species include native trees, shrubs and groundcovers.

Establishment of vegetation on treed rehabilitation areas is good and more than 75% of native forest indicator species are considered to be healthy and growing.

It is difficult to determine whether native forest indicator tree species on treed rehabilitation areas are within the height and girth measurements of trees on the treed analogue site. While there is evidence of recruitment on the treed analogue site it is not possible to determine the whether the age of juvenile trees is comparable to those establishing on the treed rehabilitation areas.

5.3 Pest animal and weed survey

The presence or evidence of pests and weeds within each quadrat and in the vicinity of each transect is recorded in Appendix A.

Pest animal presence – Rabbit and fox scats were observed across the property. Rabbit and fox numbers are considered low and do not require population reduction measures.

The European rabbit and European red fox are declared pests under the Local Land Services Act 2013. Rabbit and fox density is considered low, with some evidence of shallow soil scraping and scats across each of the monitoring locations. No holes, burrows or dens were observed. It was noted that juvenile native tree plantings within transects 7 and 8 were protected with stockings to prevent damage from rabbits.

Noxious and targeted weed species – Noxious weeds observed during field survey are listed in Table 3.

Table 3 Feral animal and noxious weed presence

Common name *Species name*	Location	Treatment
European Red Fox *Vulpes vulpes*	All locations	Landholders are obliged to control populations on their land.
European rabbit Oryctolagus cuniculus		
African Lovegrass *Eragrostis curvula*	Quadrats 1, 2, 3 and 4	The growth of the plant must be managed in a manner that reduces its numbers, spread and incidence and continually inhibits its reproduction.
Wild Radish *Raphanus raphanistrum*	All locations	Not notifiable.

Noxious weed species – Isolated patches of African Lovegrass were observed across the rehabilitated areas; however, recent weed treatment appears to have successfully controlled these outbreaks. Isolated occurrences of Wild Radish were observed along fence lines within the property.

Weeds hazardous to horses – No weeds hazardous to horses were observed on the property.

Weeds of national significance - No weeds of national significance were observed on the property.

5.4 Rural land capability assessment

Pasture rehabilitation areas are assessed as being better than Class VI Land and Soil Capability (and suitable for grazing). The pasture rehabilitation areas are assessed as being Class V and are suitable for grazing. The limiting factors for land use are generally related to wind erosion hazard (Table 4).

Table 4 Rural land capability assessment of pasture areas

Class	Quadrat 1	Quadrat 2	Quadrat 3	Quadrat 4
Water erosion hazard class	3 3 - <10% slope	3 3 - <10% slope	2 1 - 3% slope	3 3 - <10% slope
Wind erosion hazard class	5 Moderate wind erodibility class of surface soil, high winds erosive power, high exposure to wind, average annual rainfall >500mm			
Soil structural decline class	4 Fragile light textured soil - hardsetting			
Soil acidification hazard class	4 Very low texture /buffering capacity, pH 6.7 – 7.5 ($CaCl_2$)			
Salinity hazard class	1 Moderate to high recharge potential, low discharge potential, low salt store			
Waterlogging hazard class	2 0 – 0.25 months typical waterlogging duration, moderately well drained soils			
Shallow soils and rockiness hazard class	1 Nil rocky outcrop, soil depth >100cm			
Mass movement hazard class	1 No mass movement present			

5.5 Stocking rates

Stock has been temporarily excluded from paddock 1 (see *Summary Plan of Rehabilitation* (First Field Environmental 2016) for paddock locations). Paddocks 2 and 3 contain the stock numbers as listed in Table 5 below. With a combined area of approximately 6.8 ha, the number of stock grazing in paddocks 2 and 3 is considered to be in accordance with grazing capability.

Table 5 Past and current stocking rates

Date	Cows	Full-size horses	Miniature horses	Miniature ponies	Alpacas
September 2015	5	3	8	-	1
December 2015*	5	2	8	7	1
September 2016	1	3	-	5	1

* A number of these animals had been contained outside of the rehabilitated pasture area, either in stables or in the home paddock.

5.6 Access and fencing

Site access trails have been constructed, gates have been installed and fences have been erected.

Issues with fencing placement and condition are currently being addressed as part of the Stock Management Plan (First Field Environmental 2016).

Isolated areas of trail erosion are occurring due to concentrated surface water flow (as shown in Figure 13).

Figure 13 Rill erosion on main access trail

6. Rehabilitation status

The status of performance indicators and completion criteria are summarised in Table 6.

Table 6 Status of completion criteria

Performance indicator	Completion criteria	Status
Vegetation health	• More than 75% of native forest indicator species are assessed to be healthy and growing at year 5.	• **Satisfactory** – Continue to monitor native forest indicator health.
Erosion	• Stable landform, suitable for grazing and horses. • No exposed highwalls and adits to underground mine workings.	• **Satisfactory** – Continue to monitor for evidence of landform instability. • **Complete** – No highwalls or adits exposed.
Surface cracks	• Limited areas of high concentration with cracking due to soil settling.	• **Satisfactory –** Continue to monitor incidents of soil cracking.
Landform	• Shape and form is visually similar to adjacent land.	• **Complete –** Shape and form is consistent with surrounding landscape.
Ponding of water	• Sediment ponds constructed.	• **Complete –** Sediment ponds and contour drains have been constructed.

Performance indicator	Completion criteria	Status
	• Contour drains constructed. • Relief ensures water flows as designed and directs water off site.	• **Ongoing –** Manage active erosion in sediment retention basin walls. • **Ongoing -** Improve surface drainage and infiltration of affected areas.
Access tracks, fences and gates	• Site access tracks constructed. • Fences erected. • Gates installed.	• **Ongoing** – Address trail erosion. • **Complete** – Fences and gates installed.
Rural land capability	• Pasture rehabilitation areas are assessed to have a Rural Land Capability Class VI or better (suitable for grazing).	• **Satisfactory** – Continue to monitor rural land capability.
Cattle and horses	• Area has successfully supported stock and/or horses for > 12 months at modest rates.	• **Ongoing** – Manage stocking rates.
Species composition	• Establishment of pasture comprising approximately 70% perennial grass and 20% annual legume, representative of species at analogue sites. • Vegetation within the treed rehabilitation areas is established in accordance with the approved species mix.	• **Satisfactory** – Continue to monitor pasture species composition. • **Complete –** Native trees have been planted in accordance with approved species mix.
Pest and weed presence	• Weeds including African Lovegrass to comprise <10% of the pasture sward.	• **Ongoing –** Treat noxious weeds. Continue to monitor presence of noxious weeds and pests.
Vegetation distribution	• Native trees planted in designated areas as generally shown in MOP Plan 3 (ENH-REH Plan 3).	• **Complete –** Native trees are planted in appropriate areas.
Groundcover	• Groundcover (vegetation, leaf litter, mulch) >70% at year 5.	• **Satisfactory –** Continue to monitor percentage groundcover.
Visual amenity	• Completion of bulk earthworks to create final landform. • Completion of seeding and tree plantings.	• **Complete –** Final landform is appropriate. • **Ongoing** – Additional planting and management inputs required in treed areas.

7. Key findings

General

- Surface cracking is limited to the crests of slopes adjacent to treed rehabilitation areas.
- Minor surface erosion is occurring on exposed soils of all rehabilitation areas.
- Sediment basin walls remain subject to active surface erosion.
- Surface water ponding is occurring in localised depressions.
- Access trails are undergoing erosion on slopes and some rill erosion is evident.
- Isolated areas of fencing are currently in poor condition or have been removed by the landholder.
- Two Class 4 noxious weeds (as declared for the Upper Macquarie County Council area; NSW DPI 2013) were recorded in all transects and quadrats: African Lovegrass (*Eragrostis curvula*) and Wild Radish (*Raphanus raphanistrum*).
- Levels of rabbit and fox activity at each of the rehabilitation and analogue sites are low and are not considered to adversely impact the intended final land use.
- While isolated patches of African lovegrass are present at each of the pasture and treed rehabilitation areas, recent weed treatment appears to have successfully controlled these outbreaks.

Pasture rehabilitation areas

- Landform stability is monitored and incidents of soil cracking and movement are addressed as they occur.
- Pastures appear to be overgrazed.
- Groundcover in pasture rehabilitation areas is >70% however areas of sparse to no groundcover do exist.

Treed rehabilitation areas

- Isolated areas of minor rill erosion are occurring in the treed rehabilitation transects.

8. Recommendations

The following recommendations for mitigation and management are consistent with intervention and adaptive management measures contained within the *Enhance Place Mine Care and Maintenance Mining Operations Plan* (Enhance Place Pty Ltd 2014).

General

- Continue to address incidents of soil cracking and movement as they occur.
- Monitor pest animal numbers.
- Continue to spot-spray outbreaks of African lovegrass from September through to February.
- Hand pull individual Wild Radish plants.
- Revegetate exposed sediment retention basin walls.
- Reinstate roll-over drain above existing rill erosion on sloping trails to divert water off trail surface more effectively.

Pasture rehabilitation areas

- Re-sow waterlogged areas and exposed soils in depressions with Perennial rye grass. Areas containing surface water may be filled prior to being sown (see *Summary Plan of Rehabilitation*, First Field Environmental 2016).
- Increase and maintain groundcover in pasture rehabilitation areas to at least 95% to mitigate the potential for soil erosion and to ensure that groundcover is comparable to cover at the pasture analogue site.
- Continue to monitor stocking rates in accordance with the *Enhance Place Mine Draft Stock Management Plan* (First Field Environmental 2016).

Treed rehabilitation areas

- Consider planting tree seedlings where soils are exposed.
- Increase groundcover of grasses and broadleaf herbs at treed rehabilitation areas to >95% to mitigate the potential for soil erosion and to ensure that groundcover is comparable to cover at the treed analogue site.
- Place additional coarse woody debris along contours above rills to reduce the rate and volume of runoff at treed rehabilitation areas.

9. References

Bureau of Meteorology (2016) *Weather data Lidsdale NSW*, http://www.bom.gov.au/jsp/ncc/cdio/weatherData/av?p_nccObsCode=139&p_display_type=dataFile&p_startYear=&p_c=&p_stn_num=063132

CSIRO (2009) *Australian Soil and Land Survey Field Handbook*, CSIRO, Australia

Cunningham, G (2012) *Annual Environmental Management Report 2012 (Small Mine Version): Enhance Place Mine*, Geoff Cunningham Natural Resource Consultants Pty Ltd.

Enhance Place Pty Ltd (2014) *Enhance Place Mine Mining Operations Plan,* Enhance Place Pty Ltd, NSW

First Field Environmental (2014) *Enhance Place Mine Rehabilitation Monitoring Report*, First Field Environmental, NSW

First Field Environmental (2015) *Enhance Place Mine Rehabilitation Monitoring Report*, First Field Environmental, NSW

First Field Environmental (2016) *Enhance Place Mine Draft Stock Management Plan*, First Field Environmental, NSW

First Field Environmental (2016) *Summary Plan of Rehabilitation,* First Field Environmental, NSW

IECA (2008) *Best Practice Erosion and Sediment Control,* International Erosion Control Association (Australasia)

NSW DPI (2005), U*sing DSE's and carrying capacities to compare beef enterprises*, Primary Industries: Agriculture, viewed 13 May 2015, http://www.dpi.nsw.gov.au /agriculture/farm-business/budgets/livestock/beef/info/dse

NSW DPI (2007) *Pastures for Horses Primefacts,* New South Wales Department of Primary Industries, http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0011/109982/pastures-for-horses.pdf

NSW DPI (2016) *Noxious Weed Declarations for Upper Macquarie County Council*, New South Wales Department of Primary Industries, http://www.dpi.nsw.gov.au/agriculture/pests-weeds/weeds/noxweed/

OEH (2007) *Land and Soil Capability Assessment*, Office of Environment and Heritage, NSW

SLR (2014) *Soil Assessment and Recommendations for Rehabilitation Areas*, NSW

Appendix A
Survey data 2016

Pasture analogue site (Pine Dale Mine)	
Easting	Northing
228300	6304880
228317	6304925
Landform and soils	
Slope	1 - <3% slope inclining to the northwest.
Erosion	Not observed.
Cracking soils	Not observed.
Surface drainage impediments	No significant drainage impediments.
Vegetation	
Vegetation structure	Groundcover of mixed native and exotic grasses and broadleaf herbs.
Species richness	>30 herb and 15 grass species identified.
Cover classification 2015	
Total living cover	>90%
Annual living cover	40%
Perennial living cover	50%
Litter cover	<10%
Bare surface	-

Quadrat 1 Pasture rehabilitation area					
Corner peg	Easting		Northing		
Northwest	227099		6303904		
Southwest	227099		6303804		
Southeast	227199		6303804		
Northeast	227199		6303904		
Landform and soils					
Slope	Upper slope gently inclining (4-10%) to the southwest.				
Erosion	Minor wind erosion present on exposed soils.				
Cracking soils	Not observed.				
Surface drainage impediments	No significant drainage impediments. Some surface water pooling limited to localised open depressions.				
Vegetation					
Vegetation structure	Groundcover of mixed native and exotic grasses and broadleaf herbs.				
Species diversity	>33 species identified, mostly exotics.				
Cover classification	% cover at each observation				
	September 2011	November 2012	April 2014	September 2015	September 2016
Total living cover	90%	94%	90%	90%	90%
Annual living cover	22.75%	14.5%	-	-	20%
Perennial living cover	67.25%	79.5%	-	70%	70%
Litter cover	7%	6%	10%	-	-
Bare surface	3%	-	-	10%	10%
Noxious weed presence	2014		2015		2016
Eragrostis curvula	25%		25%		<10%
Hypericum perforatum	Present		Not observed		Not observed
Rubus fruiticosus sp. agg.	Present		Not observed		Not observed
Raphanus raphanistrum	Not observed		Not observed		present

Quadrat 2 Pasture rehabilitation area					
Corner peg	Easting		Northing		
Northwest	227264		6303966		
Southwest	227264		6303866		
Southeast	227364		6303866		
Northeast	227364		6303966		
Landform and soils					
Slope	Upper slope gently inclining (4-10%) to the southwest.				
Erosion	Minor wind erosion present on exposed soils.				
Cracking soils	Not observed.				
Surface drainage impediments	No significant drainage impediments. Some surface water pooling limited to localised open depressions.				
Vegetation					
Vegetation structure	Groundcover of mixed native and exotic grasses and broadleaf herbs.				
Species diversity	>33 species identified, mostly exotics.				
Cover classification	% cover at each observation				
	September 2011	November 2012	April 2014	September 2015	September 2016
Total living cover	90%	94%	90%	90%	90%
Annual living cover	22.75%	14.5%	-	-	20%
Perennial living cover	67.25%	79.5%	-	70%	70%
Litter cover	7%	6%	10%	-	-
Bare surface	3%	-	-	10%	10%
Noxious weed presence	2014		2015		2016
Eragrostis curvula	25%		25%		<10%
Hypericum perforatum	Present		Not observed		Not observed
Rubus fruiticosus sp. agg.	Present		Not observed		Not observed
Raphanus raphanistrum	Not observed		Not observed		present

Quadrat 3 Pasture rehabilitation area					
Corner peg	Easting		Northing		
Northwest	226973		6304068		
Southwest	226960		6303971		
Southeast	227060		6303962		
Northeast	227083		6304052		
Landform and soils					
Slope	Relatively flat.				
Erosion	Minor wind erosion present on exposed soils.				
Cracking soils	Not observed.				
Surface drainage impediments	No significant drainage impediments. Some surface water pooling limited to localised open depressions.				
Vegetation					
Vegetation structure	Groundcover of mixed native and exotic grasses and broadleaf herbs.				
Species diversity	>35 species identified, mostly exotics.				
Cover classification	% cover at each observation				
	September 2011	November 2012	April 2014	September 2015	September 2016
Total living cover	90%	94%	90%	80%	75%
Annual living cover	22.75%	14.5%	-	20%	10%
Perennial living cover	67.25%	79.5%	-	60%	60%
Litter cover	7%	6%	10%	-	5%
Bare surface	3%	-	-	20%	25%
Noxious weed presence	2014		2015	2016	
Eragrostis curvula	25%		50% (dead)	<10%	
Hypericum perforatum	Present		Not observed	Not observed	
Rubus fruiticosus sp. agg.	Present		Not observed	Not observed	
Raphanus raphanistrum	Not observed		Not observed	present	

Quadrat 4 Pasture rehabilitation area					
Corner peg	Easting		Northing		
Northwest	227102		6304154		
Southwest	227088		6304054		
Southeast	227188		6304054		
Northeast	227202		6304154		
Landform and soils					
Slope	Upper slope gently inclining (4-10%) to the southwest.				
Erosion	Minor wind erosion present on exposed soils.				
Cracking soils	Observed along slope crest in north eastern corner of quadrat and adjacent to treed rehabilitation area.				
Surface drainage impediments	No significant drainage impediments. Some surface water pooling limited to localised open depressions.				
Vegetation					
Vegetation structure	Groundcover of mixed native and exotic grasses and broadleaf herbs.				
Species diversity	>35 herbs and grasses identified, mostly exotics.				
Cover classification	% cover at each observation				
	September 2011	November 2012	April 2014	September 2015	September 2016
Total living cover	90%	94%	90%	90%	90%
Annual living cover	22.75%	14.5%	-	30%	30%
Perennial living cover	67.25%	79.5%	-	60%	60%
Litter cover	7%	6%	10%	-	-
Bare surface	3%	-	-	10%	10%
Noxious weed presence	2014		2015		2016
Eragrostis curvula	75%		10-20% (dead)		<10%
Hypericum perforatum	Present		Not observed		Not observed
Rubus fruiticosus sp. agg.	Present		Not observed		Not observed
Raphanus raphanistrum	Not observed		Not observed		present

Transect 7 Treed rehabilitation area					
Easting	Northing				
227325	6304082				
227362	6304060				
Landform and soils					
Slope	Transect located along contour of mid slope, moderately inclining (~30%) to the southwest.				
Erosion	Minor wind erosion present on exposed soils.				
Cracking soils	Present along crest of slope.				
Surface drainage impediments	No significant drainage impediments.				
Vegetation					
Vegetation structure	• <5% tree cover, to 4-8 m height • 15% shrub cover, mixed juvenile native trees to 1.5 m height • 90% groundcover dominated by mixed native and exotic broadleaf herbs and grasses				
Species diversity	• >6 native tree species • >5 native and exotic shrub species • Groundcover of >33 native and exotic broadleaf and grass species				
Cover classification	% cover at each observation				
	September 2011	November 2012	April 2014	September 2015	September 2016
Total living cover	90%	94%	90%	90%	90%
Annual living cover	22.75%	14.5%	-	20%	15%
Perennial living cover	67.25%	79.5%	-	70%	70%
Litter cover	7%	6%	10%	5%	5%
Bare surface	3%	-	-	5%	5%
Noxious weed presence	% cover 2014		% cover 2015		% cover 2016
Eragrostis curvula	Present		<5%		<5%
Raphanus raphanistrum	Not observed		Not observed		Present

Transect 8 Treed rehabilitation area			
Easting	Northing		
227150	6304234		
227192	6304205		
Landform and soils			
Slope	Transect located along contour of mid slope, moderately inclining (~30%) to the southwest.		
Erosion	Minor wind erosion present on exposed soils.		
Cracking soils	Present along crest of slope.		
Surface drainage impediments	No significant drainage impediments.		
Vegetation			
Vegetation structure	• <5% tree cover to 5 m height • <10% shrub cover, mixed juvenile native trees to 1 m height • 60% groundcover dominated by mixed native and exotic broadleaf herbs and grasses		
Species diversity	• >5 native tree species • Few shrub species • Groundcover of >37 native and exotic broadleaf and grass species		
Cover classification	% cover at each observation		
	April 2014	September 2015	September 2016
Total living cover	90%	60%	60%
Annual living cover	-	-	15%
Perennial living cover	-	60%	35%
Litter cover	10%	-	10%
Bare surface	-	40%	40%
Noxious weed presence	% cover 2014	% cover 2015	% cover 2016
Eragrostis curvula	Present	<5%	<5%
Raphanus raphanistrum	Not observed	Not observed	Present

Treed analogue site (transect 7, Pine Dale Mine)	
Easting	Northing
226801	6305097
226838	6305039
Landform and soils	
Slope	Transect located along contour of mid slope gently inclining to the north.
Erosion	No erosion observed.
Cracking soils	Not observed.
Surface drainage impediments	No drainage impediments.
Vegetation	
Vegetation structure	Eucalyptus dominated canopy to 12m high with a canopy cover of 40%. Sparser shrub layer to 3m height with isolated shrubs to 1.5m height. >95% groundcover to 0.5m height, dominated by native grasses with mixed native herbs.
Species richness	More than 5 tree species, dominated by *Eucalyptus* spp. Shrub layer of >7 native species. Diverse groundcover dominated by *Poa* spp. with mixed native herbs.
Cover classification	
Total living cover	90%
Annual living cover	10%
Perennial living cover	80%
Litter cover	10%
Bare surface	-
Target weed presence	
None observed.	

Appendix B
Vegetation assessment of treed areas

Vegetation assessment treed areas 2016

Transect	Treed rehabilitation area (transect 7)	Treed rehabilitation area (transect 8)	Treed analogue site Pine Dale Mine (transect 7)
Vegetation type	Rehabilitated	Rehabilitated	Dry Sclerophyll Forest (grassy)
Native plant species richness	11	8	>50
Trees	6	5	>5 species, 12-14 m height. 20% canopy cover.
Understorey	<5	<5	>7 species, 1-2 m height, 10% cover
Groundcover	Dominated by native and exotic broadleaf and grass species. 90% cover.	Dominated by native and exotic broadleaf and grass species. 60% cover.	Dominated by *Poa* spp. >95% cover. Mixed herbs and grasses also present.
Non-native species	33	34	<10
Recruitment	Not observed	Not observed	Present
Organic litter	5%	10%	Well-developed to 2 cm depth.
Logs	Present	Present	8 fallen logs of >20 cm diameter present along transect.

Vegetation assessment treed areas 2015

Transect	Treed rehabilitation area (transect 7)	Treed rehabilitation area (transect 8)	Treed analogue site Pine Dale Mine (transect 7)
Vegetation type	Rehabilitated	Rehabilitated	Dry Sclerophyll Forest (grassy)
Native plant species richness	45	40	>50
Trees	4	3	>5 species, 12-14 m height. 20% canopy cover.
Understorey	8	8	>7 species, 1-2 m height, 10% cover
Groundcover	Dominated by native and exotic broadleaf and grass species. 90% cover.	Dominated by native and exotic broadleaf and grass species. 60% cover.	Dominated by *Poa* spp. >95% cover. Mixed herbs and grasses also present.
Non-native species	<10	<10	<10
Recruitment	Not observed	Not observed	Present
Organic litter	5%	Not observed	Well-developed to 2 cm depth.
Logs	Present	Present	8 fallen logs of >20 cm diameter present along transect.

Vegetation assessment treed areas 2014

Transect	Treed rehabilitation area (transect 7)	Treed rehabilitation area (transect 8)	Treed analogue site Pine Dale Mine (transect 7)
Vegetation type	Rehabilitated	Rehabilitated	Dry Sclerophyll Forest (grassy)
Native plant species richness	45	45	>50
Trees	4	3	>5 species, 12-14 m height. 40% canopy cover.
Understorey	8	8	>7 species, 1.5 - 3 m height, 35% cover
Groundcover	95%	90%	70% cover. Dominated by *Poa* spp. with mixed native herbs.
Non-native species	<10	<10	<10
Recruitment	Not observed	Not observed	Present
Organic litter	5%	Not observed	Well-developed to >2cm depth.
Logs	Present	Present	8 fallen logs of >20 cm diameter present along transect.

Appendix C
Species list

Scientific name	Quadrat 1	Quadrat 2	Quadrat 3	Quadrat 4	Transect 7	Transect 8	Treed analogue site (Pine Dale Mine transect 7)
Acacia dealbata subsp. *dealbata*					X	X	X
Acacia rubida					X	X	X
Acacia sp.					X	X	X
Acacia ulcifolia							X
Agrostis sp.	X	X	X	X	X	X	
Ajuga australis							X
Brassica spp.	X	X	X	X			
Bursaria spinosa subsp. *lasiophylla*							X
Calandrinia calyptrata							X
Cassinia sp.					X	X	
Cerastium sp.	X	X	X	X	X	X	
Cirsium arvense	X	X	X	X	X	X	
Conyza bonariensis					X	X	
Cymbonotus sp.	X	X	X	X	X	X	
Cyperus spp.			X	X	X	X	
Dactylis glomerata	X	X	X	X	X	X	
Desmodium varians							X
Dillwynia phylicoides							X
Eragrostis curvula	X	X	X	X	X	X	
Eragrostis sp.					X	X	
Erodium cicutarium	X	X	X	X	X	X	
Erodium sp.	X	X	X	X	X	X	
Erophila verna	X	X	X	X	X	X	

Scientific name	Quadrat 1	Quadrat 2	Quadrat 3	Quadrat 4	Transect 7	Transect 8	Treed analogue site (Pine Dale Mine transect 7)
Eucalyptus dalrympleana subsp. *dalrympleana*							X
Eucalyptus dives							X
Eucalyptus macrorhyncha					X		
Eucalyptus mannifera subsp. *mannifera*							X
Eucalyptus rubida subsp. *rubida*							X
Eucalyptus sp.					X	X	
Festuca arundinacea	X	X	X	X	X	X	
Gamochaeta sp.	X	X	X	X	X	X	
Geranium sp.					X	X	X
Gompholobium huegelii							X
Goodenia hederacea							X
Hibbertia aspera subsp. *aspera*							X
Hibbertia obtusifolia							X
Hypochaeris radicata	X	X	X	X	X	X	
Juncus spp.			X	X			
Leucopogon sp.							X
Lissanthe strigosa subsp. *subulata*							X
Lolium perenne	X	X	X	X	X	X	
Lomandra filiformis							X
Malva neglecta	X	X	X	X	X	X	
Medicago sp.	X	X	X	X	X	X	
Modiola caroliniana	X	X	X	X	X	X	
Paspalum sp.	X	X	X	X	X	X	

Scientific name	Quadrat 1	Quadrat 2	Quadrat 3	Quadrat 4	Transect 7	Transect 8	Treed analogue site (Pine Dale Mine transect 7)
Persicaria maculosa	X	X	X	X	X	X	
Persoonia sp.							X
Persoonia laurina					X		
Persoonia oblongata					X		
Phalaris aquatica	X	X	X	X	X	X	
Pinus sp.					X	X	X
Plantago lanceolata	X	X	X	X	X	X	
Poa annua	X	X	X	X	X	X	X
Poa labillardierei							X
Poa spp.	X	X	X	X	X	X	X
Portulaca oleracea	X	X	X	X	X	X	
Ranunculus sp.							X
Raphanus raphanistrum	X	X	X	X	X	X	
Rumex acetosella (synonym *Acetosella vulgaris*)	X	X	X	X	X	X	
Sonchus asper	X	X	X	X	X	X	
Stellaria media	X	X	X	X	X	X	
Taraxacum officinale	X	X	X	X	X	X	
Themeda australis							X
Trifolium arvense	X	X	X	X	X	X	
Trifolium campestre	X	X	X	X	X	X	
Trifolium repens	X	X	X	X	X	X	
Trifolium subterraneum	X	X	X	X	X	X	
Veronica calycina							X

Appendix D
Photopoint monitoring to 2016

Quadrat 1 from southwest looking northeast 2012

Quadrat 1 from southwest looking northeast 2014

Quadrat 1 from southwest looking northeast 2015

Quadrat 1 from southwest looking northeast 2016

Quadrat 2 from southwest looking northeast 2012

Quadrat 2 from southwest looking northeast 2014

Quadrat 2 from southwest looking northeast 2015

Quadrat 2 from southwest looking northeast 2016

Quadrat 3 from southwest looking northeast 2012

Quadrat 3 from southwest looking northeast 2014

Quadrat 3 from southwest looking northeast 2015

Quadrat 3 from southwest looking northeast 2016

Quadrat 4 from southwest looking northeast 2012

Quadrat 4 from southwest looking northeast 2014

Quadrat 4 from southwest looking northeast 2015

Quadrat 4 from southwest looking northeast 2016

Appendix C

Enhance Place Mine

Stock Management Plan

Enhance Place Mine
Stock Management Plan

1449 Castlereagh Highway
Blackmans Flat NSW 2790

Report prepared for Mr & Mrs Morris
by First Field Environmental
on behalf of Enhance Place Mine Pty Ltd

April 2016

Revision history			
Version	**Date**	**Author**	**Authorised by**
Draft	10 February 2016	Michelle Evans /Anna Douglas Morris	
Draft revision	29 February 2016	Michelle Evans	
Final	18 April 2016	Michelle Evans	Michelle Evans

This report has been prepared by First Field Environmental for Enhance Place Mine Pty Ltd. The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report.

First Field Environmental

PO Box 6318 Silverwater NSW 1811

T: 0468 708 520

E: michelle@firstfield.net.au

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Introduction

This Stock Management Plan has been developed by First Field Environmental, on behalf of Enhance Place Mine Pty Ltd, to provide guidance in relation to stock management on the Morris property.

The Morris property is located on land formerly comprising Enhance Place Mine. The property is within Blackman's Flat on the southern side of Castlereagh Highway at Blackmans Flat, 15km north of Lithgow. The land to which this report relates is shown on Figure 1 and Figure 2 and covers an area of approximately 16.2 ha.

Enhance Place Mine operated as an open cut coal mine from 1997 until its closure in June 2005. Rehabilitation of the former Enhance Place Mine has included the importation of soil and creation of a landform similar to that of the surrounding area. Catchment drains and sediment retention basins have been installed. The land has been revegetated to pasture, internal trails have been constructed and the land is fenced and gated. The pasture area is part of a larger area which includes treed rehabilitation areas on steeper slopes of the landscape. These areas are adjacent to the pasture area but do not form part of the Stock Management Plan.

Although still under mining license to Enhance Place Mine, the land is utilised by Mr and Mrs Morris of 1449 Castlereagh Highway, Blackmans Flat. The land is currently grazed by miniature horses, horses, ponies and cows.

This report aims to provide Mr and Mrs Morris with a plan for maintaining the land as pasture for grazing and to promote appropriate stocking rates in accordance with land capability. The preliminary report will be provided to Enhance Place Mine and Mr and Mrs Morris and will facilitate discussion regarding the feasibility of land management practices in terms of desired land use. The preparation of a final Stock Management Plan will be informed by the outcomes of these discussions.

How to use this document

This document has been prepared for use in ongoing stock and grazing management for the property. **Section one** contains information about the property, including landuse and property characteristics, and provides background information related to the condition of the pasture areas.

Section two provides recommendations for achieving appropriate landuse and includes a trigger action response plan for addressing issues as they are observed. The land management schedule recommends the completion of specific activities on a regular basis. It is intended that the trigger action response plan be checked regularly and that the land management schedule be used for forward planning.

Detailed information relating to stocking rates, fertiliser application and weed control is provided in the Appendices.

1. Property information

1.1 Previous landuse

Enhance Place Mine was established in 1997 to recover remnant coal from areas previously open cut mined in the 1950's. Open cut operations ceased in June 2005 when economically feasible coal reserves were exhausted.

Rehabilitation of the land by Enhance Place Mine Pty Ltd has been conducted in accordance with completion criteria contained within the Care and Maintenance Mining Operations Plan (Enhance Place Mine 2014) and has included:

- Land forming;
- Erosion management;
- Pasture establishment;
- Soil stabilisation; and
- Weed management.

Rehabilitation of the land by Enhance Place Mine Pty Ltd is ongoing. The most recent assessment of rehabilitation completion criteria (Enhance Place Mine 2014) determined the following:

Land forming - The final landform shaping and drainage control structures have been completed. The rehabilitated landform is considered to have no greater management requirements than the surrounding landforms and land uses.

Erosion management –The potential for major erosion (gully or tunnel erosion or mass movement) is considered to have been mitigated as there is no evidence of significant erosion occurring at the site. Surface erosion may occur in areas where vegetation rehabilitation has not been successful, or as a result of overgrazing.

Pasture establishment – The current proportion of annual legume and perennial grass species within the pasture areas is representative of species composition in adjoining unmined land. Ground cover in pasture rehabilitation areas is >70% however areas of sparse to no ground cover do exist.

Soil stabilisation – Cracking soils and waterlogging may occur in areas of overgrazing or where rehabilitation has not been successful.

Weed management – Noxious weeds have been controlled in accordance with the principles of an integrated weed management plan.

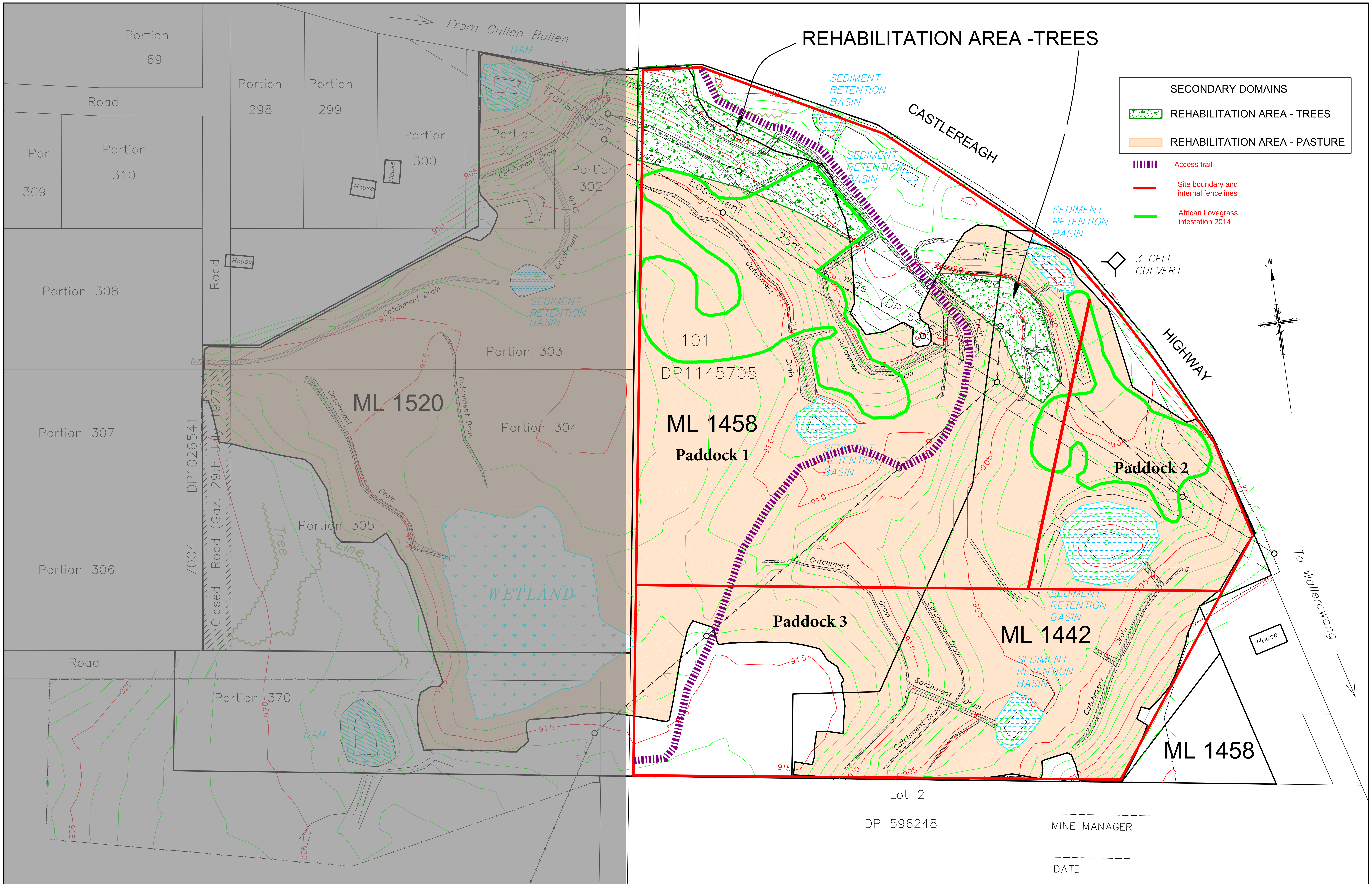
1.2 Current and future landuse

The land is currently utilised by Mr and Mrs Morris for grazing and generally supports combinations of the following livestock:

- Miniature horses;
- Horses;
- Ponies; and
- Cows.

Livestock grazing is a common activity in the Blackmans Flat region and it is the intention of Mr and Mrs Morris to continue to graze these animals in the future.

Figure 1 Rehabilitated pastures of the Morris Property



REHABILITATION AREA -TREES
SECONDARY DOMAINS
REHABILITATION AREA - TREES
REHABILITATION AREA - PASTURE
Access trail
Site boundary and internal fencelines
African Lovegrass infestation 2014
CASTLEREAGH
HIGHWAY
From Cullen Bullen
To Wallerawang
ML 1520
ML 1458
Paddock 1
Paddock 2
Paddock 3
ML 1442
ML 1458
101
DP1145705
SEDIMENT RETENTION BASIN
3 CELL CULVERT
WETLAND
DAM
Portion 69
Portion 298
Portion 299
Portion 300
Portion 301
Portion 302
Portion 303
Portion 304
Portion 305
Portion 306
Portion 307
Portion 308
Por 309
Portion 310
Portion 370
Road
Closed Road (Gaz. 29th July 1927)
DP1026541
7004
Lot 2
DP 596248
MINE MANAGER
DATE

NOTES:

CRAVEN, ELLISTON & HAYES (LITHGOW) PTY.LTD.
CONSULTING LAND, ENGINEERING AND MINING SURVEYORS
ACN 056 544 551
"ASTROLABE" RUTHERFORD LANE, LITHGOW, 2790 PH: (02) 6351 2281, FAX: (02) 6352 1339
EMAIL : survey@ceh.com.au

DATE	18-12-13
AMENDED	
SURVEYOR	T.H./T.E
DRAWN	K.L.F./D.M.
CHECKED	

ENHANCE PLACE MINE
FINAL REHABILITATION AND
POST MINING LAND USE

SCALE - 1 : 1250 (A1 SHEET)

DWG No
ENH-REH
PLAN 3

1.3 Property characteristics

1.3.1 Climate

Blackman's Flat is located within the central tablelands of NSW, a region with a temperate cool-season wet climate (Stokes & Howden 2010). The area is characterised by warm summers, cool to cold winters and generally consistent rainfall.

Mean maximum temperatures of around 23°C are experienced from November to March. Mean minimum temperatures of below 5°C are experienced from May to September.

The area received a mean annual rainfall of 700 mm in 2015. January and April received the highest monthly rainfall of approximately 157 mm per month, while September had the lowest monthly rainfall of approximately 9 mm (Bureau of Meteorology 2016).

Mean monthly temperature and rainfall statistics indicate strong seasonality in average temperatures and rainfall patterns throughout the year.

The following average rainfall and temperature data (Figure 3) has been sourced from Bureau of Meteorology records for Mount Boyce Automatic Weather Station and is considered generally indicative of conditions experienced on the property.

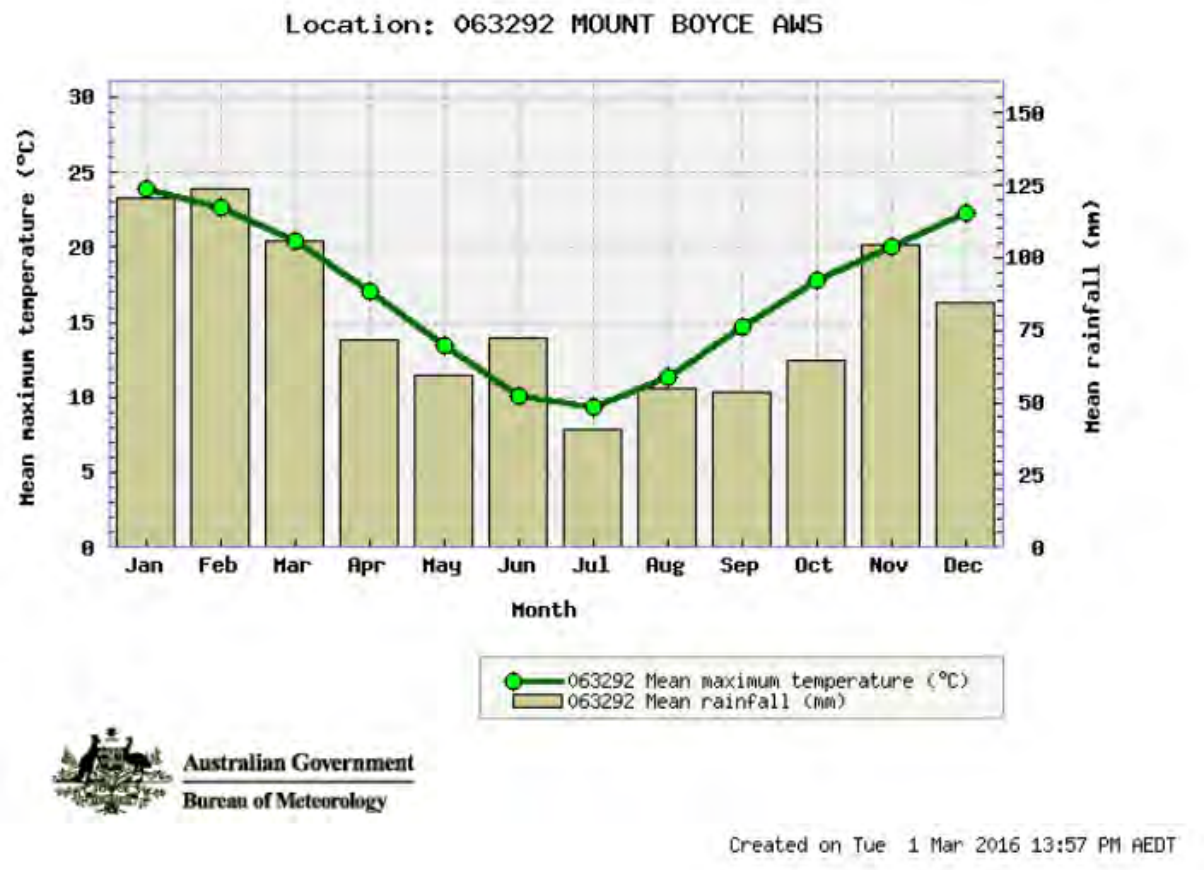


Figure 3 Mean maximum temperature and rainfall

1.3.2 Topography

Blackman's Flat is located on the western side of the Blue Mountains and is at 900 m (Australian Height Datum). The landscape is characterised by rolling hills. Slopes vary between 10% and 25% with a local relief of less than 50m. The study area was filled and contoured prior to 2014 and the shape and form of the landscape is considered to be visually similar to the adjacent landscape.

1.3.3 Soils

Soils on the property are highly disturbed, resulting from rehabilitation activities including filling of the open cut coal mine, soil importation and land forming. As a result; soil physical and chemical characteristics are not consistent with unmined soils of the region.

Unmined soils adjacent to the property are generally mapped as Cullen Bullen soil landscape (*Soil landscapes of the Wallerawang 1:100,000 sheet* King 1993).

Soil characteristics

Various soil components have been surveyed as part of rehabilitation monitoring undertaken by First Field Environmental. Soil samples to a depth of 10 cm were taken randomly from ten points throughout the pasture area, and physical characteristics including soil structure, ped shape and ped surface characteristics were assessed in accordance with the *Australian soil and land survey field handbook* (CSIRO 2009). The results of field tests have been used to determine land and soil capability (see Section 1.3.6).

SLR Global Environmental Solutions conducted soil nutrient analysis of topsoil samples (0-10cm depth) from two locations on the property in 2014. A summary of test results is provided in Table 1. Soil nutrient levels found at the test sites are compared with target levels. These target levels are a product of ideal soil nutrient ranges for pastures and actual soil nutrient levels found in unmined local pastures.

Complete test results are provided in Appendix A.

Table 1 Summary of soil test results

Soil element	Measure and test	Target Measure	Soil test location average	Target Met
pH	1:5 $CaCl_2$	>4.9	6.9	Yes
Potassium (K)	% of total CEC	>2%	2.72%	Yes
Sodium (Na)		<3%	2.75%	Yes
Aluminium (Al)		<5%	0.00%	Yes
Sulfur (S)	mg/kg KCl 40 S	>8mg/kg	6.45 mg/kg	Yes*
Nitrogen (N)	mg/kg water extract	>10mg/kg	2.30 mg/kg	No (see land management schedule (Section 2.8) for mitigation measures)
Zinc (Zn)	mg/kg DTPA	>1mg/kg	0.80 mg/kg	
Calcium (Ca)	Ca:Mg	>3	2.16	

*Sulfur levels of 6.5 mg/kg are optimal for moderately-grazed pastures (DSE 7-12 DSE/ha).

1.3.4 Drainage

Contour drains and sediment retention basins were established prior to 2014 and generally remain in good operational condition with little evidence of surface water flow occurring outside of established contour drainage lines.

Isolated areas accounting for less than 1% of the rehabilitated pasture area show evidence of seasonal waterlogging.

1.3.5 Erosion and sedimentation

There are no significant erosion features that compromise landform stability within the rehabilitation areas. The landform is considered to be stable and is suitable for grazing horses.

There is some evidence of active, minor to moderate wind erosion where pastures are poorly established or absent (see Figure 4 and Figure 5). Minor rilling is occurring on exposed soils of the sediment retention basins and can be seen in Figure 6.

Figure 4 Patchy exposed soils in south-western corner of pasture area

Figure 5 Exposed soils in southern portion of pasture area

Figure 6 Minor erosion of sediment retention basin wall

Surface cracking to 20 cm is evident along slope crests in the northern extent of the pasture area (see Figure 7). Soil samples taken to a depth of 20 cm indicate that soils are not prone to cracking through swelling and shrinking and suggest that cracking is indicative of soil settling.

Figure 7 Example of soil cracking on slope crests

1.3.6 Land and soil capability

Land capability refers to the suitability of land for particular agricultural activities and is determined by the relationship between the physical and chemical properties of soils. An assessment of these properties conducted in accordance with the *Land and Soil Capability Assessment Scheme* (NSW Office of Environment and Heritage, 2012) is summarised in Table 2.

The resulting classification indicates that the pastures are consistent with **Land and Soil Capability Class V** and are suitable for grazing.

Class V land has severe limitations for high impact land management uses such as cropping, and is generally more suitable for grazing with some limitations or very occasional cultivation for pasture establishment. It is important to minimise soil disturbance, maintain cover and maintain good organic matter levels. The limiting factors for land use are generally related to wind erosion hazard.

Table 2 Land and soil capability assessment

Class	Description
Water erosion hazard class	3 3 - <10% slope
Wind erosion hazard class	5 Moderate wind erodibility class of surface soil, high winds erosive power, high exposure to wind, average annual rainfall >500mm
Soil structural decline class	4 Fragile light textured soil - hardsetting
Soil acidification hazard class	4 Very low texture /buffering capacity, pH 5.38 – 7.17 ($CaCl_2$)
Salinity hazard class	1 Moderate to high recharge potential, low discharge potential, low salt store
Waterlogging hazard class	2 0 – 0.25 months typical waterlogging duration, moderately well drained soils
Shallow soils and rockiness hazard class	1 Nil rocky outcrop, soil depth >100 cm
Mass movement hazard class	1 No mass movement present

1.3.7 Pasture species

Pastures were established with Cox's River seed mix prior to 2014 and are representative of species composition of grazing pastures on adjacent, unmined soils.

Cox's River seed mix consists of 70% perennial grasses and 20% annual legumes, sown at the following rates:

- 40% Fescue
- 25% Cocksfoot
- 20% Subterranean clover
- 6% Perennial rye grass
- 5% White clover
- 4% Phalaris

Within this region, cold temperatures (especially in July and August) restrict pasture growth and areas are prone to severe frosts, with the frost-free period varying from 150 to 240 days per year.

In summer, evaporation exceeds rainfall, reducing pasture growth. Winter rainfall exceeds evaporation, but cooler temperatures slow pasture growth. Heavy summer rains face higher evaporation rates than rain falling mid-autumn when evaporation rates are lower.

Appendix B describes the phases of pasture growth.

1.3.8 Weeds

Weeds with the potential to occur in the region are defined as those listed under the Noxious Weeds Act 1993; Weeds of National Significance; and Environmental Weeds. Also included in this report are species harmful to horses.

The following weed species meeting this definition and observed on the property during previous surveys:

- African Lovegrass (*Eragrostis curvula*);
- Blackberry (*Rubus fruticosus* aggregate);
- St John's Wort (*Hypericum perforatum*);
- Sweet Briar (*Rosa rubiginosa*);
- Crofton Weed (*Ageratina adenophora*);
- Fireweed (*Senecio madagascariensis*);
- Wild Radish (*Raphanus raphanistrum*);
- Flatweed (*Hypochaeris radicata*); and
- Paterson's Curse (*Echium plantagineum*).

African Lovegrass infestations (shown on Figure 2) were treated in late 2015 in accordance with control methods listed in Appendix C and are currently not observed to be growing or producing seed.

Appendix D provides a full list of noxious weeds declared in the Upper Macquarie County.

1.3.9 Fencing and access

Figure 2 shows the location and extent of current fencing and access trails. All fences and gates appear to be in good condition.

Access trails within the study area are generally in good condition although minor wind and water erosion is evident in steeper areas of trails.

2. Property management

2.1 Stocking rates

The grazing area (see Figure 2) within the property is comprised of three fenced paddocks with a combined area of ~16.2 ha:

- Paddock 1 (~9.4 ha);
- Paddock 2 (~1.9 ha); and
- Paddock 3 (~4.9 ha).

The success of pastures in supporting current stocking rates has been determined in relation to the pasture and soil condition at the time the field survey was conducted (11th September 2015).

Carrying capacity refers to the 'dry sheep equivalent' (DSE) per hectare supported by the class of pasture. DSE is a standard unit used to measure the feed requirements of different animal classes. Table 3 shows the DSE ratings of different stock classes.

The paddocks have been classified as 'top-dressed pasture with some clover', which according to the NSW Department of Primary Industries (2005) has a DSE rating of 7-10.

The carrying capacity is the number of hectares required for a particular animal on a pasture type and is determined as the livestock DSE divided by the pasture DSE:

Horse – light horse in current top-dressed pastures with some clover = 10.0/(7-10) = 1.42 – 1.0

A light horse therefore requires 1.42-1.0 hectares of top-dressed pasture with some clover to survive. The current capacity of each fenced pasture area on the property is provided in Appendix E.

Table 3 DSE ratings and current carrying capacity of pasture in present and improved conditions

Livestock (DSE rating)	Number of hectares required	Fenced area 1 (9.4 ha)	Fenced area 2 (1.9 ha)	Fenced area 3 (4.9 ha)
Top-dressed pasture with some clover (present state of pasture) (average DSE /ha = 7-10)				
Horses – light horse (DSE = 10)	1.43-1.0	6-9	1-2	3-5

2.2 Grazing management

Grazing management is a cost-effective tool to obtain the most from a pasture (NSW Agriculture 2003). Benefits of good grazing management include:

- Optimisation of pasture growth;
- Maximisation of feed quality; and
- Maintenance of adequate ground cover that in turn prevents erosion and resists weed invasion.

Recent monitoring by First Field Environmental revealed an average total living ground cover of 87.5% within the established quadrats of pasture rehabilitation area. Establishing and maintaining near 100% ground cover across the paddocks can ensure that optimal rainfall is retained in the landscape and concurrently sediments (potential resources) are trapped within the farm-scape, rather than lost through erosive processes (Gleeson & Gleeson 2012).

The establishment and persistence of good ground cover will reduce various forms of soil degradation, including soil acidification, rising water tables and dryland salinisation, as well as increasing beneficial soil micro-organisms and improving soil structure, pasture composition and fertility (NSW Agriculture 2003).

2.3 Pasture management

The pastures currently support a mix of summer and winter-growing species palatable to horses and cattle. Re-sowing is required when favourable pasture cover decreases to <70%, and is addressed by both the trigger action response plan (see Section 2.7) and the land management schedule (Section 2.8). A list of summer and winter-growing pasture species is provided in Appendix F and includes the method, rate and optimal timing for sowing each species.

2.4 Nutrient availability

Soils currently exhibit a pH of 6.7-7.9. While this is within the range of adjacent, unmined soils, a decrease in availability of certain nutrients in slightly acid soils may be mitigated through appropriate fertiliser application. Other nutrients may decline as a result of the removal of biomass through grazing and may require regular application.

Soil tests indicate that the following nutrients are deficient for optimal pasture growth:

- Sulfur (S);
- Nitrogen (N); and
- Calcium (Ca).

These deficiencies may be addressed through scheduled paddock rehabilitation and stock rotation (see land management schedule, Section 2.8). Application rate, method and optimal timing relevant to the property is provided in Appendix G.

2.5 Paddock rotation

The temporary exclusion of livestock from paddocks is required in order to conduct sediment and erosion control works, re-sowing and weed treatment. Livestock may be excluded from one of three fenced paddocks in the pasture area and may also be housed temporarily in the home paddock or stables. Activities requiring the exclusion of livestock are addressed in the trigger action response plan (see Section 2.7). Regular paddock rotation is addressed in the land management schedule (Section 2.8).

2.6 Weed management

The identification and management of noxious weeds is addressed in the trigger action response plan (see Section 2.7), while the land management schedule (Section 2.8) provides for regular and long term strategies for weed management. Best practice integrated weed control methods are described in Appendix C.

2.7 Trigger action response plan

Table 4 summarises the actions required when certain triggers are observed. Whilst some of these actions need to be conducted at specific times, others can be implemented as needed. A schedule of land management actions to be conducted at regular intervals is provided in the following section.

Table 4 Trigger action response plan

Goal	Trigger	Action	Optimal timing
Appropriate stock rate	The number of stock grazing in pastures should be in accordance with the grazing capability of each pasture.	Refer to Section 2.1 for appropriate stocking rates. Match number of stock to specific paddock recommendations provided in Table 3.	Ongoing.
Weeds including African Lovegrass to comprise <10% of the pasture sward with no significant infestations.	More than 10% of the pasture sward composed of weeds. Weeds outcompeting preferred species.	Identify and map the location of noxious weeds, weeds hazardous to horses and weeds of national significance (see Appendices C and D). Treat weeds in accordance with Appendices C and D. Install temporary fencing around outbreaks to restrict grazing pressure during weed treatment and regrowth of preferred species.	As required. Determine optimal timing of weed control in accordance with Appendix C. Spray weeds during target species' growth period and when the desirable species are dormant (refer to Appendices B and C).
Maintenance of ground cover (vegetation, leaf litter, mulch, cryptograms) at or above 70%.	Less than 70% ground cover.	Rip along contours of poorly established pasture rehabilitation areas and re-sow pasture mix and fertiliser. Increase and maintain groundcover in pasture rehabilitation areas to at least 95% to minimise run-off and loss of nutrients and soil, and limit erosion.	As required. Select appropriate seasonal species for re-sowing (refer to Appendix F).
No loss of topsoil.	Presence of active surface erosion. Combined bare surfaces of more than 20 m^2 per hectare.	Remove livestock and install temporary fencing to restrict grazing pressure during regrowth. Sow a cover crop of oats or short-term rye grasses to protect the soil surface (sub-surface root system remains even after grass has died off).	As required.
Limited areas of high concentration	Broad areas of cracking soils	Mechanically improve the soil surface in areas where cracking is more than 20 cm in depth.	As required.

Goal	Trigger	Action	Optimal timing
of soil cracking due to soil settling.	associated with soil settling.		
Minimal waterlogging and ponding in pastures.	Presence of surface water pooling more than 48 hours after rainfall. Yellowing of pasture. When holes are dug 20-30 cm below the surface, water flows into them.	Intercept water upslope with earthworks and redirect into farm dams. Clear impediments from contour drains. Install temporary fencing to restrict grazing pressure and prevent damage to pasture and soil. Plant deep-rooted temperate perennial grass species in areas prone to waterlogging. Graze taller pastures (>10 cm) as it enables animals to eat their allocation quicker and will prevent the need for stock to walk in search of food.	As required. Install drains when soils are moist e.g. after summer or autumn rains.
Stable sediment retention basins.	Active erosion of sediment retention basins.	Revegetate exposed sediment retention basin walls with perennial species.	As required. Select appropriate seasonal species for re-sowing (refer to Appendix F).
Stable trail surfaces.	Water ponding, active erosion and minor rilling on trail surfaces.	Construct a roll-over drain above existing rill erosion on sloping trails to divert water off trail surface more effectively.	Install drains when soils are moist e.g. after summer or autumn rains.
No symptoms of overgrazing are evident.	Symptoms of overgrazing evident e.g. pasture grazed lower than 3 cm; ground cover below 70%.	Locate water points and fences to manipulate grazing distribution, ensure even pasture utilisation and reduce selective grazing. Keep paddock records of stock numbers and use in conjunction with land condition monitoring to help determine suitable stocking rates.	Assess available feed and adjust stocking rates at the end of the growing season (refer to Appendix E).

2.8 Land management schedule

Table 5 Land management schedule

Goal	Description	Activity	Timing	Summer			Autumn			Winter			Spring		
				December	January	February	March	April	May	June	July	August	September	October	November
Appropriate soil nutrient levels and pH range	Soils should be within a pH range of >5.0 and <8.5 to facilitate availability of soil nutrients consistent with soils on adjacent, unmined properties. Soil nutrients deficiencies (as determined by agricultural soil testing) should be balanced to within appropriate ranges as indicated in Section 2.4.	• Apply gypsum at a rate of 3t/ha. • Apply DAP at a rate of 0.20t/ha. • Apply MAP at a rate of 0.25t/ha. • Re-sow exposed soils with a seasonally appropriate pasture mix (see Appendix F). • Fence area to exclude grazing until the pasture is established and then only lightly graze the pasture in the first growing season.	As part of initial pasture regeneration activities. Note: see Appendix G for appropriate timing of gypsum and fertiliser application.												
Erosion control	Less than 20% of the pasture area should have exposed soils.	• Identify and map areas of active surface soil erosion. • Re-sow exposed soils with a seasonally appropriate pasture mix (see Appendix F). • Fence area to exclude grazing until the pasture is established and then only lightly graze the pasture in the first growing season. • Plant trees where mid-slope soils are exposed and fence area to exclude grazing until trees are established.	As part of pasture regeneration activities.												

Goal	Description	Activity	Timing	Summer			Autumn			Winter			Spring		
				December	January	February	March	April	May	June	July	August	September	October	November
Seasonally appropriate pasture growth	More than 70% favourable species in winter pastures. More than 70% favourable species in summer pastures.	• Determine % species presence in pastures (see Appendix F). • Move stock to prevent overgrazing and decline of desirable pasture species.	Seasonally.				Winter pasture species						Summer pasture species		
Weed control	No noxious weeds. No weeds hazardous to horses. No weeds of national significance. Less than 10% of pasture supporting African Lovegrass.	• Identify and map the location of noxious weeds, weeds hazardous to horses and weeds of national significance (see Appendices C and D). • Treat weeds in accordance with Appendices C and D. • Heavily graze annual weeds to remove seed heads and reduce seed set.	During seasonal periods of weed establishment (see Appendix B). As part of pasture regeneration activities. See Appendix C for appropriate timing of weed treatment. See Appendix B to determine optimal timing for grazing during seed production and set.												

Goal	Description	Activity	Timing	Summer			Autumn			Winter			Spring		
				December	January	February	March	April	May	June	July	August	September	October	November
Pasture regeneration	Maintenance of pasture comprising approximately 70% perennial grass and 20% annual legumes.	• Identify priority pasture areas for regeneration. • Exclude stock from regenerating pasture, while ensuring that stocking rates in remaining pasture areas are consistent with Section 2.1. • Only lightly graze newly sown pasture areas in the first season. • Rest pastures for seed set and re-establishment e.g. delay grazing of sub-clover in autumn until the 2-3 leaf stage where feasible.	For pasture regeneration, spelling must occur after effective rainfall has fallen, when the plants are actively growing and restoring their root reserves.												

3. Project outcomes

The project commenced in December 2015 and included a number of visits to the property. Stakeholders were identified as Mr. and Mrs. Morris who are the current landholders and Graham Goodwin, the representative of Enhance Place Mine. Consultation has incorporated a number of phone calls from Michelle Evans to each of the stakeholders, as well as two face-to-face meetings at the Morris property.

An initial meeting at the Morris property was conducted in December 2016 between Michelle Evans and Mr. and Mrs. Morris. This meeting introduced the project aims and identified a number of concerns held by the landholders. A summary of this meeting is provided in Appendix H.

Key points from the initial meeting were discussed with Graham Goodwin and subsequently informed the development of the Draft Stock Management Plan.

The second stakeholder meeting was held at the Morris property in March 2016 and was attended by each of the stakeholders. This meeting provided an opportunity to present the Draft Stock Management Plan and describe how the document may assist in determining appropriate stocking rates and ongoing land management activities. A summary of this meeting is included in Appendix H.

3.1 Ongoing activities

Many of the initial stakeholder concerns listed in Appendix H are addressed in the Stock Management Plan and have been communicated to each of the stakeholders. Those concerns not immediately addressed in the Stock Management Plan are the subject of ongoing activities and focus on two issues: the number of water-holding dams and the need to manage stocking numbers in areas undergoing rehabilitation.

Mr. and Mrs. Morris have supplied a copy of the real estate listing for the property (attached). Enhance Place Mine is currently examining the number and condition of dams on the property.

Appropriate stocking numbers have been determined in the Stock Management Plan and communicated to the landholders. There is agreement between stakeholders to exclude stock from a selected paddock to allow further rehabilitation activities to be undertaken.

3.2 Recommendations

- Assess the current condition of pastures against the land management goals in Table 4 (Section 2.7).
- Exclude stock from a selected paddock to enable further rehabilitation activities. Refer to appropriate stocking numbers provided in Appendix E for remaining paddocks.
- Conduct rehabilitation of selected paddock having regard to the property management guidelines described in Section 2.
- Monitor the success of rehabilitation activities against the land management goals of Section 2.7.
- Reopen the successfully rehabilitated paddock to grazing at appropriate rates.

References

Australian Alpaca Association (2013) *Australian Alpaca Association*, https://www.alpaca.asn.au/

Auld, B (2009) *Guidelines for monitoring weed control and recovery of native vegetation,* New South Wales Department of Primary Industries, http://www.dpi.nsw.gov.au/data/assets/pdf_file/0011/299360/Guidelines-for-monitoring-weed-control-and-recovery-of-native-vegetation.pdf

Bureau of Meteorology (2016) *Weather data Lidsdale (Maddox Street) NSW*, http://www.bom.gov.au /climate/data/stations/

CSIRO Publishing (2009) *Australian Soil and Land Survey Field Handbook* (No. 1). National Committee on Soil and Terrain (Australia) (Eds.). CSIRO Publishing.

Enhance Place Pty Ltd (2014) *Enhance Place Mine Mining Operations Plan,* Enhance Place Pty Ltd, NSW.

First Field Environmental (2014) *Enhance Place Mine Rehabilitation Monitoring Report*, First Field Environmental, NSW.

Gleeson & Gleeson (2012) *Reducing the impacts of development on wildlife.* CSIRO Publishing, Victoria.

International Erosion Control Association (2008) *Best Practice Erosion and Sediment Control,* International Erosion Control Association (Australasia).

King DP (1993) *Soil landscapes of the Wallerawang 1: 100 000 sheet.* NSW Department of Land and Water Conservation, Sydney.

Landform Research (2014) *Assessment suitability for horses, Cavallo Estate, Lot 224 Orton Road, Oakford.*

McNaught et al (2008) *A field manual for surveying and mapping nationally significant weeds*, Second Edition, Bureau of Rural Sciences, Canberra.

Natural Resource Management Ministerial Council (2006) *Australian Weed Strategy – A national strategy for weed management in Australia*, Natural Resource Management Ministerial Council for the Department of the Environment and Water Resources.

NSW Agriculture (1997) *Establishing Pastures*, DairyLink series. NSW Agriculture.

NSW Agriculture (2003) *The grazier's guide to pastures: Sowing and managing profitable pastures in the Central and Southern Tablelands, Monaro, and Upper South-West Slopes of New South Wales (Second Edition).* Information Delivery Program, NSW Agriculture, Dubbo and Orange.

NSW Department of Primary Industries (n.d.) *Calendar of growth cycle and control times for weeds of the Southern Tablelands*, New South Wales Department of Primary Industries, http://www.dpi.nsw.gov.au/data/assets/pdf_file /0019/154504/calendar-weed-south- tablelands.pdf

NSW Department of Primary Industries (2005) *Using DSEs and carrying capacities to compare beef enterprises*. NSW Department of Primary Industries, http://www.dpi.nsw.gov.au/agriculture/farm-business/budgets/livestock/beef/info/dse

NSW Department of Primary Industries (2006) *Pasture assessment and livestock production.* Primefact 323. New South Wales Department of Primary Industries, http://www.dpi.nsw.gov.au/__data/assets/pdf_file /0013/101326/pasture-assessment-and-livestock-production.pdf

NSW Department of Primary Industries (2007) *Pastures for horses*, Primefact 525. New South Wales Department of Primary Industries, http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0011/109982/pastures-for-horses.pdf

NSW Department of Primary Industries (2009) *Planning for horse establishments,* Primefact 932. New South Wales Department of Primary Industries, http://www.dpi.nsw.gov.au/agriculture/livestock/horses /management/general/establishments

NSW Department of Primary Industries (2009) *Rejuvenating Perennial Pastures*. New South Wales Department of Primary Industries.

NSW Department of Primary Industries (2011) *Noxious and Environmental Weed Control Handbook,* New South Wales Department of Primary Industries, http://www.dpi.nsw.gov.au/data/assets/pdf_file /0017/123317/Noxious-and- environmental-weed-control-handbook.pdf

NSW Department of Primary Industries (2013) *Noxious weed declarations for Upper Macquarie County Council*, New South Wales Department of Primary Industries, http://www.dpi.nsw.gov.au/agriculture/pests-weeds/weeds/noxweed/

NSW Department of Primary Industries & Dairy Australia (2004) *Successful Silage (Second Edition).* New South Wales Department of Primary Industries and Dairy Australia.

NSW Office of Environment and Heritage (2012) *The land and soil capability assessment scheme: Second approximation*, Office of Environment and Heritage, State of New South Wales.

Sainty and Associates (n.d.) *WEEDeck series*, Sainty and Associates.

SLR Global Environmental Solutions (2014) *Soil Assessment and Recommendations for Rehabilitated Areas, Pine Dale Mine and Enhance Place Mine,* SLR Consulting Australia Pty Ltd, NSW.

Stokes C & Howden M (2010) *Adapting agriculture to climate change,* CSIRO Publishing, Melbourne.

Appendix A Soil test results

SOILTEC

SOIL AND PLANT ANALYSIS

2/37 OWENS CR (PO BOX 374) ALSTONVILLE NSW 2477
PHONE 02 66251411 FAX 02 66285868 EMAIL : chemist@soiltec.com.au

Soil Test Report #s14-0897 (14)

Client: SLR
Account: EP3

Sample Received: 3.10.2014 Report Reply: 9.10.2014
SAMPLE I.D: 0-10cm **INTENDED USE:**
TEXTURE

		RESULT	OPTIMAL
Conductivity (dS/m)(1:5 water)		0.09	<0.15
pH	(1:5 $CaCl_2$)	6.80	5.2-5.5
Exchangeable Cations: (Measured)			
Calcium	(Ca)(meq/100g)	8.44	See Percentage
Magnesium:	(Mg)(meq/100g)	5.21	See Percentage
Potassium:	(K)(meq/100g)	0.35	0.5-1.0
Sodium:	(Na)(meq/100g)	0.54	Zero
Aluminium:	(Al)(meq/100g)	0.00	Zero
Total Cation Exchange Capacity (CEC):		**14.54**	
Exchangeable Cations (as a % of Total)			
Calcium:		58.05	65-80%
Magnesium:		35.83	15-20%
Potassium:		2.41	3-5%
Sodium:		3.71	<3%
Aluminium:		0.00	<5%
Phosphorus:	(mg/kg) (Bray-1)	21.0	
Sulphur	(mg/kg) (KCl 40 S)	5.9	8-10
Nitrate Nitrogen	(mg/kg) (water extract)	2.3	At least 10
Organic Carbon	(%) (Walkely & Black)	2.8	2% or more
Trace Elements			
Copper	(mg/kg) (DTPA)	0.8	
Zinc	(mg/kg) (DTPA)	0.8	
Manganese	(mg/kg) (DTPA)	25.1	
Iron	(mg/kg) (DTPA)	26.8	
Boron	(mg/kg) (Hot CaCl)	0.7	
Calculations:			
Lime Requirement (Cregan)		0.00	(see notes on page 2)
Calcium/Magnesium Ratio:		1.62	3-5

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1 of 2

SOILTEC

SOIL AND PLANT ANALYSIS

2/37 OWENS CR (PO BOX 374) ALSTONVILLE NSW 2477
PHONE 02 66281411 FAX 02 66285868 EMAIL: chemist@soiltec.com.au

Soil Test Report #s14-0897 (10)

Client: *SLR*
Account: **EP1**

Sample Received: 3.10.2014 Report Reply: 9.10.2014
SAMPLE I.D: 0-10cm **INTENDED USE:**
TEXTURE

			RESULT	*OPTIMAL*
Conductivity (dS/m)(1:5 water)			0.07	<0.15
pH	(1:5 $CaCl_2$)		7.17	5.2-5.5
Exchangeable Cations: (Measured)				
Calcium:		(Ca)(meq/100g)	6.18	See Percentage
Magnesium:		(Mg)(meq/100g)	2.39	See Percentage
Potassium:		(K)(meq/100g)	0.27	0.5-1.0
Sodium:		(Na)(meq/100g)	0.16	Zero
Aluminium:		(Al)(meq/100g)	0.00	Zero
Total Cation Exchange Capacity (CEC):			8.99	
Exchangeable Cations (as a % of Total)				
Calcium:			69.44	65-80%
Magnesium:			25.73	15-20%
Potassium:			3.03	2-8%
Sodium:			1.80	<3%
Aluminium:			0.00	<5%
Phosphorus:	(mg/kg)	(Bray-1)	14.9	
Sulphur	(mg/kg)	(KCl 40 S)	7.0	8-10
Nitrate Nitrogen	(mg/kg)	(water extract)	2.3	At least 10
Organic Carbon	(%)	(Walkely & Black)	3.2	2% or more
Trace Elements				
Copper		(mg/kg) (DTPA)	0.8	
Zinc		(mg/kg) (DTPA)	0.8	
Manganese		(mg/kg) (DTPA)	24.7	
Iron		(mg/kg) (DTPA)	26.4	
Boron		(mg/kg) (Hot CaCl)	0.9	
Calculations:				
Lime Requirement (Crogan)			0.00	(see notes on page 2)
Calcium/Magnesium Ratio			2.70	3-5

~ASPAC~

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Appendix B Phases of pasture growth

Phases of pasture growth	Characteristics
Phase 1 – Early growing season	• Short, leafy growth • Moderate pasture growth rate • High forage quality but low yield • High sensitivity to grazing pressure
Phase 2 – Mid growing season	• Well-developed leafy-tussock phase • High pasture growth rate • Good forage quality with moderate to increasing yield • Moderate sensitivity to grazing pressure
Phase 3 – Mid to late growing season	• Reproductive phase • Low pasture growth rate • Moderate to low forage quality and maximum yield has been reached • Low to moderate sensitivity to grazing pressure
Phase 4 – Beyond the growing season	• Dormant phase • Little or no growth • Low to very low forage quality and plants have withdrawn protein into their roots • Low sensitivity to grazing pressure

Source: QLD Department of Agriculture, Fisheries and Forestry (2013)

Appendix C Weed management plan

This Plan has been prepared to meet the requirements for noxious weed control in the Upper Macquarie County Council area.

Legal requirements

Individuals, landholders and Government have a responsibility to control noxious weeds on their land under the *Noxious Weeds Act* 1993, which is regulated in the area by the Upper Macquarie County Council. Weeds under this Act include Weeds of National Significance (WoNS) and Environmental Alert Weeds (EAW).

The following legislation and strategies may require consideration when undertaking various weed management activities.

Legislation relevant to weed control

Legislation	Summary
Noxious Weeds Act 1993	The *Noxious Weeds Act* 1993 defines the roles of government, councils, private landholders and public authorities in the management of noxious weeds. The Act sets up categorisation and control actions for the various noxious weeds, according to their potential to cause harm to the environment. Landowners or occupiers of land are required to control noxious weeds on the property and to prevent the spread of noxious weeds to adjoining land.
Pesticides Act 1999	The NSW Department of Environment and Conservation restricts the application of certain pesticides near or within waterways.
Work Health and Safety Act 2011	The Act is administered by Workcover NSW. There are specific requirements relating to use of pesticides and certification of pesticide operators.
Australian Weeds Strategy – A national strategy for weed management in Australia (Department of the Environment and Water Resources 2006)	The Strategy provides a national framework to complement state, territory, regional and local government strategies and industry initiatives and legislative controls; and identifies the Weeds of National Significance (WONS) for priority weed management efforts.
Threat Abatement Plans	Statutory plans under the NSW *Threatened Species Conservation Act* 1995 for control of Key Threatening Processes, which includes some weed species.

Weeds to which this Plan applies

This Plan has been developed for the control and management of Class 4 noxious weeds listed for the Upper Macquarie County Council area (Appendix D).

In addition, this Plan identifies noxious weeds for which there are specific control and notification requirements:

- Control Class 1 and 2 – Plants which must be eradicated from the land and whose presence must be notified to the local control authority;
- Control Class 3 – Plants which must be fully and continuously suppressed and destroyed; and
- Control Class 5 – Outbreaks of which must be reported to the local control authority within three days of discovery.

Weeds listed as WoNS have been determined by the Australian Government based on their invasiveness, potential for spread, and their environmental, social and economic impacts. Listed WoNS have been and continue to be responsible for significant agricultural, forestry and environmental damage.

The EAW list has been compiled by the Australian Government Department of Environment and Heritage in conjunction with other experts and complements the WONS list. Weeds that have been placed on the National Environmental Alert List have been identified as having the potential to become a significant threat to biodiversity if they are not managed in the early stages of establishment.

Weed control

Weed control on the site will include:

- Identification of noxious weeds across the property;
- Determination of control class of noxious weeds observed on the property;
- Weed management scheduling in accordance with the aims of integrated weed management; and
- Monitoring the occurrence and extent of noxious weeds.

Note: Scheduled weed treatment may be determined in accordance with:

- *Weed control in pastures and lucerne 2010* (NSW Industry and Investment, 2010)
- *Noxious and environmental weed control handbook: a guide to weed control in non-crop, aquatic and bushland situations* (NSW DPI, 2011);
- *Calendar of growth cycle and control times for weeds of the Southern* Tablelands (NSW DPI, n.d); and
- *Weed Alerts* (NSW DPI, n.d.).

Integrated weed management

Weed competition is a major cause of pasture establishment failure and may lead to a loss of pasture production. Cultivation, cropping, slashing, herbicides and pasture manipulation can all be effectively used to control weeds (NSW Agriculture 2003). When using herbicides, it is important to remember that selection and correct use of herbicide is crucial.

Grazing by livestock may also be used as a form of weed control, by helping to suppress and reduce weed growth and seed production and/or prevent weed domination (Gleeson & Gleeson 2012).

However this technique varies in effectiveness depending on the palatability of the weed species. A combination of grazing and weed control (through the use of a herbicide application or other techniques to remove unpalatable weeds) can be an effective solution.

Integrated weed management control methods have been sourced from the *Noxious and environmental weed control handbook: A guide to weed control in non-crop, aquatic and bushland situations* (NSW DPI 2011). Chemical control methods may differ between life stages and application method for each species.

Integrated weed management of Control Class 4 noxious weeds

Note: species in **bold** have been recorded on the property

Common name ***Scientific name***	**Physical**	**Biological**	**Cultural**	**Chemical**
African boxthorn *Lycium ferocissimum*	Mechanically remove the top growth and as many of the roots as possible when soil is wet (winter) and burn the removed material.			A number of herbicides may be used for treatment. Regrowth should be sprayed.
African lovegrass ***Eragrostis curvula***			Pasture improvement and grazing management will reduce re-establishment. Main control principle is to ensure it is replaced by better species.	
Arrowhead *Sagittaria montevidensis*	Excavation with machinery or manual digging by hand from waterways. Steam application.		Maintain good hygiene and containment during physical control.	Use of a herbicide registered to control arrowhead. Herbicide treatment will often only suppress infestations and regeneration will occur.

Common name *Scientific name*	Physical	Biological	Cultural	Chemical
Asparagus weeds *Asparagus* species	Carefully dig out the entire crown of *A. aethiopicus*, leaving the roots and tubers in situ; the crown and any fruiting stems should be bagged and burnt. The entire plant (including root system) of *A. declinatus* can be dug out in small to medium sized infestations. Sheep grazing may be effective on *A. asparagoides.*	Biological control agents are available for *Asparagus asparagoides.*		A number of herbicide options are available, most of which require a permit for use.
Bathurst/Noogoora/ Hunter/ South American/ Californian/ Cockle burr *Xanthium* species	Hoe, chip or slash before flowering or seed set.	Biological control agents are available.	Maintaining ground cover in pastures to reduce burr germination and seedling survival. Prevent overgrazing of pastures in spring and summer. Seedling form is toxic to livestock.	A range of foliar and residual herbicide options are available.
Blackberry ***Rubus fruticosus* species *aggregate***	Slashing of juvenile bushes and use of goats (and potentially sheep depending on availability of other feed) will give some control, however these techniques are best used in a combination with herbicides (due to the root structure of the blackberry).	Biological control agents are available.	Improve pastures with a vigorous perennial species. Strong, actively growing pasture will help prevent invasion from weeds.	Herbicides are the most reliable method for achieving local eradication of blackberry, and a number of herbicides are registered for use on this weed.

Common name *Scientific name*	Physical	Biological	Cultural	Chemical
Chilean needle grass *Nassella neesiana*			Good grazing management combined with a pasture improvement program to reduce the soil seed bank.	Herbicide application may be used in combination with other management techniques.
Lippia *Phyla canescens*		The *National Lippia Working Group* is currently investigating biological control options.	Requires an integrated approach of suppression, pasture improvement and pasture maintenance.	Herbicide application should be used in conjunction with cropping, pasture improvement and grazing management where appropriate.
Long-leaf willow primrose *Ludwigia longifolia*	Small plants may be manually removed, taking care not to spread seed.			
Nodding thistle *Carduus nutans* subsp. *nutans*	Grubbing on scattered plants. Remove at least the top 10 cm of the root system and invert the sod to expose the plant roots and prevent regrowth.	Biological control agents are available.	Good perennial pastures with sound grazing management to prevent invasion.	Herbicide application at the early seedling stage or when passing from the seedling to the rosette stage.
Pampas grass *Cortaderia* species	Mechanical removal where possible. Remove the seed heads of large plants and slash before grubbing.	Readily grazed by stock when it is young (which prevents the development of flowers and seed set), before it becomes too abrasive.		May be treated with a Glyphosate-based herbicide such as Roundup.

Common name *Scientific name*	Physical	Biological	Cultural	Chemical
Prickly pear *Opuntia* species		*Cochineal* and *Cactoblastis* biological control agents are available.		
Prickly pear *Cylindropuntia* species	Small plants can be carefully mechanically removed.			
Sagittaria *Sagittaria platyphylla*	Isolated plants can be manually removed.			
Scotch broom *Cytisus scoparius*		Biological control agents may be available.	Use of goats as grazing management tool.	
Scotch, Stemless, Illyrian and Taurian thistles *Onopordum* species	Grub out single plants, removing at least 50 mm of root.	Biological control agents are available.	Establish a strong, perennial, grass-based pasture.	
Serrated tussock *Nassella trichotoma*	Grub out single plants.		Establish perennial pasture with good grazing management.	
Silverleaf nightshade *Solanum elaeagnifolium*			Use strong, competitive crops or pasture.	Seedlings are readily controlled by all registered

Common name *Scientific name*	Physical	Biological	Cultural	Chemical
			Quarantine infestation and prevent seeding. Do not cultivate.	herbicides.
Spiny burrgrass *Cenchrus incertus* */Cenchrus longispinus*			Establish a strong, competitive summer pasture. Ensure equipment hygiene is used to prevent seed dispersal. Quarantine infestations.	Herbicides are best used in a strategy incorporating cultivation, crop rotation and pasture improvement.
St. John's wort ***Hypericum perforatum***		Biological control agents are available.	Prevent invasion. Establish perennial pasture with good grazing management.	Spot-spraying using a registered herbicide can be used on isolated infestations.
Star thistle *Centaurea calcitrapa*	Hoe or chip individual plants or small infestations, removing at least 50 mm of the root.		Improve pasture stand.	Foliar application of a registered herbicide at seedling or rosette stage for best results.
Sweet briar ***Rosa rubiginosa***	Remove mechanically or grub out established plants. Graze with goats. Young seedlings may be grazed with sheep to help prevent establishment.		Vigorous perennial pastures provide competition to reduce invasion.	Registered herbicide may be applied by foliar spray, basal bark treatment, cut stump treatment or root application.

Common name *Scientific name*	Physical	Biological	Cultural	Chemical
Wild radish ***Raphanus raphanistrum***	Young plants may be easily removed by hand. Older plants develop a taproot that makes physical removal difficult. Slashing may reduce seed production but won't destroy the plant.	Biological control is risky as the plant is closely related to many agricultural and horticultural species.	Maintain a well-balanced pasture with good grazing management. Stock should be removed from Wild Radish infested areas.	Herbicide treatment may be used, however some populations have developed herbicide resistance.
Willows *Salix* species	Seedlings may be pulled by hand.			Registered herbicides may be applied by foliar spray, cut stump application or stem injection.

Chemical weed control methods

Species	Weed type /Noxious weed control class	Control method	Effect on grazing	Summer			Autumn			Winter			Spring		
				December	January	February	March	April	May	June	July	August	September	October	November
African Lovegrass *Eragrostis curvula*	4	Flupropanate 745 g/L **(*Taskforce*)** 300 mL per 100 L of water. **Non-chemical options:** appropriate grazing management.	4 month stock withholding period for boom spraying. 14 day stock withholding period for spot spraying.	✓	✓	✓							✓	✓	✓
Blackberry *Rubus fruticosus* aggregate species	4	Triclpyr 300 g/L + Picloram 100 g/L + Aminopyralid 8 g/L **(*Grazon Extra*)** 350 or 500 mL per 100 L water. **Non-chemical options:** slashing of young bushes and use of biological control agents.	No stock withholding period required.	✓	✓	✓	✓								
Crofton Weed *Ageratina adenophora*	Weed of horse pastures	MCPA 340 g/L + Dicamba 80 g/L **(Banvel M, Kamba M)** 2.8 L or 4 L per 100 L water. **Non-chemical options:** small plants can be dug out with mattock, slashing, and biological control agents.	7 days stock withholding period. The slashed and dried plant is still attractive and toxic to horses. Keep horses away until the plant has been completely removed from the paddock.	✓	✓	✓	✓						✓	✓	✓
Fireweed *Senecio madagascariensis*	Weed of horse pastures	Bromoxynil 200 g/L **(Various trade names)** 1.4 L or 2.8 L per 100 L water.	Bromoxynil has 14 days stock withholding period.				✓	✓	✓						

Species	Weed type /Noxious weed control class	Control method	Effect on grazing	Summer			Autumn			Winter			Spring		
				December	January	February	March	April	May	June	July	August	September	October	November
		Diflufenican g/L + Bromoxynil 250 g/L **(Jaguar, Barracuda)** 500 mL per 100 L water. Paraquat 250 g/L **(Gramoxone 250, Paraquat 250, Nuquat 250)** 1.2 L per 100 L water. Paraquat 135 g/L + Diquat 115 g/L **(Spray Seed 250)** 1.6 or 2.4 L per 100 L water. MCPA 250 g/L + Diflufenican 25 g/L **(Tigrex, Nugrex)** 1 L per 100 L water. Triclopyr 300 g/L + picloram 100 g/L **(Grazon Extra)** 350 mL per 100 L water. **Non-chemical options:** slashing, hand weeding, and biological control agents.	Diflufenican + Bromoxynil has 56 days stock withholding period. Paraquat has 7 days stock withholding period for horses. MCPA + Diflufenican has 7 days stock withholding period. No stock withholding period required for Triclopyr + picloram.												
Flatweed *Hypochaeris radicata*	Weed of horse pastures	Bromoxynil 200 g/L **(Various trade names)** 1.4 L or 2 L per 100 L water. Paraquat 250 g/L **(Gramoxone, Paraquat, Nuquat)** 1.2 L. Paraquat 135 g/L + Diquat 115 g/L **(Spray Seed)** 1.6 L to 2.4 L.	Bromoxynil has 14 days stock withholding period. Paraquat has 7 days stock withholding period for horses.										✓	✓	✓

Species	Weed type /Noxious weed control class	Control method	Effect on grazing	Summer			Autumn			Winter			Spring		
				December	January	February	March	April	May	June	July	August	September	October	November
Paterson's Curse *Echium plantagineum*	Weed of horse pastures	2,4-D dma amine 625 g/L **(Amicide 625, Amicide Lo-625A)** 1.1 L or 1.7 L per 100 L water. Glyphosate 450g/l **(Glyphosate ct, Roundup ct)** 800 mL or 1.6 L per 100 L water. Glyphosate 540 g/L **(Roundup Power Max)** 630 mL or 1.37 L per 100 L water. Glyphosate 500 g/L **(Touchdown, Hitech)** 660 mL or 1.32 L per 100 L water. Paraquat 250 g/L **(Gramoxone, Paraquat, Nuquat)** 1.2 L. Paraquat 135 g/L + Diquat 115 g/L **(Spray Seed)** 1.6 L to 2.4 L. Bromoxynil 200 g/L **(Various trade names)** 2 L per 100 L water *(Add 1.5–2.0 L/ha 2,4-DB (500 g/L)* Flumetsulam 800 g/L **(Broadstrike)** 25 g *(Add 0.7 L/ha bromoxynil (200 g/L); Add wetter + 0.1 L/ha diuron (500 g/L); Add 0.3 L/ha terbutryn (500 g/L) + wetter).* 2,4-DB 500 g/L trifolamine **(Buttress)** 1 L or 3.2 L per 100 L water.	2,4-D dma amine has 7 days stock withholding period. No stock withholding period required for Glyphosate. Paraquat has 7 days stock withholding period for horses. Bromoxynil has 14 days stock withholding period. Flumetsulam has 3 days stock withholding period. 2,4-DB has 7 days stock withholding period. Diflufenican + Bromoxynil has 14 days stock withholding period. Imazethapyr has 14 days stock withholding period.				✓	✓	✓						

Species	Weed type /Noxious weed control class	Control method	Effect on grazing	Summer			Autumn			Winter			Spring		
				December	January	February	March	April	May	June	July	August	September	October	November
		Diflufenican g/L + Bromoxynil 250 g/L **(Jaguar, Barracuda)** 500 mL or 750 mL per 100 L water. Imazethapyr 700 g/kg **(Spinnaker, WDG)** 70 g or 140 g. **Non-chemical options:** slashing and hand weeding, burning, grazing management, and biological control agents.													
St. John's Wort *Hypericum perforatum*	4	Triclpyr 300 g/L + Picloram 100 g/L + Aminopyralid 8 g/L **(*Grazon Extra*)** 500 mL per 100 L of water. **Non-chemical options:** appropriate grazing management and use of biological agents.	No stock withholding period required.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
				Twiggy flowering growth stage.			Spindly stem growth stage.						Twiggy flowering growth stage.		
Sweet Briar *Rosa rubiginosa*	4	Triclpyr 300 g/L + Picloram 100 g/L + Aminopyralid 8 g/L **(*Grazon Extra*)** 500 mL per 100 L of water. **Non-chemical options:** mechanical removal or grubbing.	No stock withholding period required.	✓	✓	✓							✓	✓	✓

Source: NSW WeedWise, NSW Dept. Primary Industries, <http://weeds.dpi.nsw.gov.au/>

Appendix D Noxious Weeds declared in the Upper Macquarie County Council

Class 4 noxious weeds

Note: Species in **bold** have been recorded within the property.

Common Name	Scientific Name	Control Class
African boxthorn	*Lycium ferocissimum*	4; WoNS
African lovegrass	***Eragrostis curvula***	**4**
Arrowhead	*Sagittaria calycina* var. *calycina*	4
Asparagus - climbing asparagus fern	*Asparagus plumosus*	4
Asparagus - ground asparagus	*Asparagus aethiopicus*	4
Asparagus weeds	*Asparagus* species	4
Blackberry	***Rubus fruticosus* species aggregate**	**4; WoNS**
Bridal creeper	*Asparagus asparagoides*	4; WoNS
Burr - Bathurst burr	*Xanthium spinosum*	4
Burr - Californian burr	*Xanthium orientale*	4
Burr - Italian cockleburr	*Xanthium italicum*	4
Burr - Noogoora burr	*Xanthium occidentale*	4
Burr - South American burr	*Xanthium cavanillesii*	4
Chilean needle grass	*Nassella neesiana*	4; WoNS
Columbus grass	*Sorghum x almum*	4
Fireweed	***Senecio madagascariensis***	**4**
Flax-leaf broom	*Genista linifolia*	4

Common Name	Scientific Name	Control Class
Giant reed	*Arundo donax*	4
Golden dodder	*Cuscuta campestris*	4
Harrisia cactus	*Harrisia* species	4
Illyrian thistle	*Onopordum illyricum*	4
Johnson grass	*Sorghum halepense*	4
Leafy elodea	*Egeria densa*	4
Lippia	*Phyla canescens*	4
Mother-of-millions	*Bryophyllum* species	4
Nodding thistle	*Carduus nutans* subsp. *nutans*	4
Pampas grass	*Cortaderia* species	4
Prickly pear - common pear	*Opuntia stricta*	4; WoNS
Prickly pear - Hudson pear	*Cylindropuntia rosea*	4; WoNS
Prickly pear - smooth tree pear	*Opuntia monacantha*	4; WoNS
Prickly pear - tiger pear	*Opuntia aurantiaca*	4; WoNS
Prickly pear - velvety tree pear	*Opuntia tomentosa*	4; WoNS
Privet - broad-leaf	*Ligustrum lucidum*	4
Privet - narrow-leaf	*Ligustrum sinense*	4
Rhus tree	*Toxicodendron succedaneum*	4
Sagittaria	*Sagittaria platyphylla*	4; WoNS
Scotch broom	*Cytisus scoparius* subsp. *scoparius*	4

Common Name	Scientific Name	Control Class
Scotch thistle	*Onopordum acanthium*	4
Serrated tussock	*Nassella trichotoma*	4; WoNS
Silverleaf nightshade	*Solanum elaeagnifolium*	4; WoNS
Spiny burrgrass - longispinus	*Cenchrus longispinus*	4
Spiny burrgrass - spinifex	*Cenchrus spinifex*	4
St. John's wort	***Hypericum perforatum***	**4**
Star thistle	*Centaurea calcitrapa*	4
Stemless thistle	*Onopurdum acaulon*	4
Sweet briar	***Rosa rubiginosa***	**4**
Taurian thistle	*Onopurdum tauricum*	4
Tree-of-heaven	*Ailanthus altissima*	4
Wild radish	***Raphanus raphanistrum***	**4**
Willows	*Salix* species	4; WoNS

Plants requiring eradication

Note: Species in **bold** have been recorded within the property

Common Name	Scientific Name	Control Class
Alligator weed	*Alternanthera philoxeroides*	2; WoNS
Anchored water hyacinth	*Eichhornia azurea*	1
Black knapweed	*Centaurea X moncktonii*	1
Black willow	*Salix nigra*	2
Boneseed	*Chrysanthemoides monilifera* subsp. *monilifera*	1; WoNS
Bridal veil creeper	*Asparagus declinatus*	1
Broomrapes	*Orobanche* species	1
Cat's claw creeper	*Dolichandra unguis-cati*	2
Chinese violet	*Asystasia gangetica* subsp. *micrantha*	1
Eurasian water milfoil	*Myriophyllum spicatum*	1
Frogbit	*Limnobium laevigatum*	1
Grey sallow	*Salix cinerea*	2
Hawkweeds	*Hieracium* species	1
Horsetails	*Equisetum* species	1; EAW
Hydrocotyl	*Hydrocotyle ranunculoides*	1
Hymenachne	*Hymenachne amplexicaulis* and hybrids	1; WoNS
Karroo thorn	*Vachellia karroo*	1
Kidney-leaf mud plantain	*Heteranthera reniformis*	1

Common Name	Scientific Name	Control Class
Kochia	*Bassia scoparia*	1
Koster's curse	*Clidemia hirta*	1
Lagarosiphon	*Lagarosiphon major*	1
Mesquite	*Prosopis species*	2; WoNS
Mexican feather grass	*Nassella tenuissima*	1
Miconia	*Miconia* species	1
Mikania vine	*Mikania micrantha*	1
Mimosa	*Mimosa pigra*	1; WoNS
Parkinsonia	*Parkinsonia aculeata*	2; WoNS
Parthenium weed	*Parthenium hysterophorus*	1; WoNS
Pond apple	*Annona glabra*	1; WoNS
Prickly acacia	*Vachellia nilotica*	1; WoNS
Rubber vine	*Cryptostegia grandiflora*	1; WoNS
Salvinia	*Salvinia molesta*	2; WoNS
Senegal tea plant	*Gymnocoronis spilanthoides*	1; EAW
Siam weed	*Chromolaena odorata*	1
Spongeplant	*Limnobium spongia*	1
Spotted knapweed	*Centaurea stoebe* subsp. *micranthos*	1
Tropical soda apple	*Solanum viarum*	1
Water caltrop	*Trapa* species	1

Common Name	Scientific Name	Control Class
Water hyacinth	*Eichhornia crassipes*	2
Water lettuce	*Pistia stratiotes*	1
Water soldier	*Stratiotes aloides*	1
Witchweeds	*Striga* species	1
Yellow burrhead	*Limnocharis flava*	1

Plants requiring full and continuous suppression

Common Name	Scientific Name	Control Class
Cape broom	*Genista monspessulana*	3
Gorse	*Ulex europaeus*	3; WoNS
Green cestrum	*Cestrum parqui*	3
Long-leaf willow primrose	*Ludwigia longifolia*	3

Plants requiring full and continuous suppression

Common Name	Scientific Name	Control Class
Athel pine	*Tamarix aphylla*	5; WoNS
Cabomba	*Cabomba caroliniana*	5; WoNS
African feather grass	*Cenchrus macrourus*	5
African turnip weed - eastern	*Sisymbrium thellungii*	5
African turnip weed - western	*Sisymbrium runcinatum*	5
Annual ragweed	*Ambrosia artemisiifolia*	5
Artichoke thistle	*Cynara cardunculus*	5
Bear-skin fescue	*Festuca gautieri*	5
Burr ragweed	*Ambrosia confertiflora*	5
Cayenne snakeweed	*Stachytarpheta cayennensis*	5
Clockweed	*Oenothera curtiflora*	5
Corn sowthistle	*Sonchus arvensis*	5
Dodder	*Cuscuta* species	5
Espartillo - broad kernel	*Amelichloa caudata*	5
Espartillo - narrow kernel	*Amelichloa brachychaeta*	5
Fine-bristled burr grass	*Cenchrus brownii*	5
Fountain grass	*Cenchrus setaceus*	5
Gallon's curse	*Cenchrus biflorus*	5
Gamba grass	*Andropogon gayanus*	5

Common Name	Scientific Name	Control Class
Glaucous starthistle	*Carthamus leucocaulos*	5
Golden thistle	*Scolymus hispanicus*	5
Mexican poppy	*Argemone mexicana*	5
Mossman River grass	*Cenchrus echinatus*	5
Red rice	*Oryza rufipogon*	5
Smooth-stemmed turnip	*Brassica barrelieri* subsp. *oxyrrhina*	5
Soldier thistle	*Picnomon acarna*	5
Texas blueweed	*Helianthus ciliaris*	5
Yellow nutgrass	*Cyperus esculentus*	5

Control requirements

Control Class	Legal requirements	Notifiable
1	The plant must be eradicated from the land and the land must be kept free of the plant	All outbreaks must be reported to the local control authority and NSW DPI (phone 1800 680244) within three days of discovery
2		
3	The plant must be fully and continuously suppressed and destroyed	Not notifiable
4	The growth of the plant must be managed in a manner that reduces its numbers, spread and incidence and continually inhibits its reproduction	
5	The requirements in the *Noxious Weeds Act* 1993 for a notifiable weed must be complied with	All outbreaks must be reported to the local control authority and NSW DPI (phone 1800 680 244) within three days of discovery

Appendix E Recommended stocking rates

Livestock (DSE rating)	Number of hectares required	Fenced area 1 (9.4 ha)	Fenced area 2 (1.9 ha)	Fenced area 3 (4.9 ha)
Top-dressed pasture with some clover (present state of pasture) (average DSE /ha = 7-10)				
Horses – light horse (DSE = 10)	1.43-1.0	6-9	1-2	3-5
Horse – under light work (DSE = 13.5)	1.93-1.35	5-7	1	2-4
Pony (DSE = 6)	0.86-0.6	11-15	2-3	5-8
Miniature horse (DSE = 3.5)	0.5-0.35	19-27	4-5	10-14
Cow – dry stock (450 kg) (DSE = 6)	0.86-0.6	11-15	2-3	5-8
Cow – bull (800 kg) (DSE = 10)	1.43-1.0	6-9	1-2	3-5
Alpaca – wether (DSE = 1)	0.14-0.1	67-94	13-19	35-49
Alpaca – pregnant (DSE = 1.5)	0.21-0.15	44-62	9-12	23-32
Alpaca lactating (DSE = 2)	0.29-0.2	32-47	6-9	17-24
Improved pasture, paspalum, kikuyu and clover on good fertility soils + fertiliser (average DSE /ha = 14-24)				
Horses – light horse (DSE = 10)	0.71-0.42	13-22	3-4	7-11
Horse – under light work (DSE = 13.5)	0.96-0.56	10-17	2-3	5-9
Pony (DSE = 6)	0.43-0.25	22-37	4-7	11-21

Livestock (DSE rating)	Number of hectares required	Fenced area 1 (9.4 ha)	Fenced area 2 (1.9 ha)	Fenced area 3 (4.9 ha)
Miniature horse (DSE = 3.5)	0.25-0.15	37-62	7-12	21-32
Cow – dry stock (450 kg) (DSE = 6)	0.43-0.25	22-37	4-7	11-21
Cow – bull (800 kg) (DSE = 10)	0.71-0.42	13-22	3-4	7-11
Alpaca – wether (DSE = 1)	0.07-0.04	134-235	27-47	70-122
Alpaca – pregnant (DSE = 1.5)	0.1-0.06	94-156	19-31	3-81
Alpaca lactating (DSE = 2)	0.14-0.08	67-117	13-24	35-61

Appendix F Pasture sowing guide

Summer pasture species	Winter fodder species	Sowing method[1]	Sowing rate[2]	Sowing period											
				Summer			Autumn			Winter			Spring		
				December	January	February	March	April	May	June	July	August	September	October	November
Fescue		Sow 5–15 mm deep. Broadcast and harrow or drill into a clean, firm seedbed.	4-5 kg/ha										✓	✓	✓
Cocksfoot (European type)	Cocksfoot (Mediterranean type)	Sow into a clean seedbed, no more than 2 cm deep.	1-3 kg/ha				✓	✓	✓				✓	✓	✓
	Subterranean clover	Sow in the better drained parts of the paddock (sow white clover separately in wetter areas to reduce competition).	4 kg/ha				✓	✓	✓						

[1] From Rejuvenating Perennial Pastures (NSW Department of Primary Industries 2009)
[2] From Graziers' Guide to Pastures (NSW Agriculture 2003)

Summer pasture species	Winter fodder species	Sowing method[1]	Sowing rate[2]	Sowing period											
				Summer			Autumn			Winter			Spring		
				December	January	February	March	April	May	June	July	August	September	October	November
	Perennial ryegrass	Direct-drill after suppression of existing growth by herbicide. Drill or broadcast following mulching or into a clean seedbed (NSW Agriculture 1997).	3-20 kg/ha. Restrict sowing rate of annual ryegrass to no more than 7 kg/ha when sown with perennial ryegrass										✓	✓	✓
	Annual ryegrass	Broadcast or drill into clean seedbeds. Direct-drill into clean seedbeds or after suppression of summer pasture growth with herbicides.	15 kg/ha when sown alone or 5-10 kg/ha in mixture				✓								

Summer pasture species	Winter fodder species	Sowing method[1]	Sowing rate[2]	Sowing period											
				Summer			Autumn			Winter			Spring		
				December	January	February	March	April	May	June	July	August	September	October	November
	White clover	Sow on the surface, cover and roll. Avoid sowing too deep Sow in wetter areas of the paddock (sow sub clover in the better drained parts to reduce competition).	0.5-1 kg/ha										✓	✓	✓
	Phalaris		2 kg/ha				✓	✓	✓				✓		
Japanese Millet		Sow into clean seedbed.	8-10 kg/ha	✓	✓									✓	✓
	Cereal Rye										✓	✓	✓	✓	
Red Clover			1-4 kg/ha				✓	✓	✓				✓	✓	✓

Summer pasture species	Winter fodder species	Sowing method[1]	Sowing rate[2]	Sowing period											
				Summer			Autumn			Winter			Spring		
				December	January	February	March	April	May	June	July	August	September	October	November
Rhodes Grass		Sow into a clean seed bed.	1-4 kg/ha			✓	✓						✓	✓	✓
	Oats	Drill or broadcast into a clean seedbed. Direct-drill early sowings after suppression of summer pasture with herbicides.	80-120 kg/ha; reduce rate when sowing with Annual ryegrass			✓	✓	✓							
	Triticale		100-120 kg/ha				✓	✓	✓						
	Barley	Ideal depth is 3-6 cm. Seed should always be sown into moist soil.	Up to 100 kg/ha or reduced rates in a mix with forage legumes.					✓	✓	✓					

Appendix G Fertiliser application

Fertiliser (including lime)	Application rate	Application method	Summer			Autumn			Winter			Spring		
			December	January	February	March	April	May	June	July	August	September	October	November
SULFUR (S)														
Superphosphate	An application of 91 kg of superphosphate per hectare is required to achieve a rate of 10 kg of sulfur per hectare and will include 8 kg of phosphorus and 18 kg of calcium.	Apply when pastures are actively growing. Avoid applying in autumn if pastures are not actively growing.			✓	✓	✓							
Gypsum (calcium sulfate)	An application of 69 kg of gypsum per hectare is required to achieve a rate of 10 kg of sulfur per hectare and will include 69 kg of phosphorus and 13 kg of calcium.				✓	✓	✓							
Note: S-deficient plants accumulate N which may cause N poisoning in livestock.														
CALCIUM (Ca)														
Agricultural lime (calcium carbonate)	An application of 25-29 kg of agricultural lime per hectare is required to achieve a rate of 10 kg of calcium per hectare.	Surface spread or incorporate into the soil to a depth of 10 cm. Incorporate into seed bed when sowing a new pasture or forage crop.	Apply approximately once every ten years. Can be applied at any time of year.											

Fertiliser (including lime)	Application rate	Application method	Summer			Autumn			Winter			Spring		
			December	January	February	March	April	May	June	July	August	September	October	November
Note: Blanket applications of nitrogen fertiliser every 6–8 weeks for perennial ryegrass – clover pastures are not recommended as they will alter the balance between grasses and clovers. **Do not apply lime and nitrogen fertilisers at the same time (the lime will cause freshly applied nitrogen to be lost as gas).**														
POTASSIUM (K)														
Potassium chloride (KCl) (MOP - muriate of potash)	Apply 15 kg of potassium per hectare annually (for dry pasture with 0.2-0.3 meq/100g). An application of 40 kg of potassium chloride (muriate of potash) is required to achieve a rate of 20 kg of potassium.	Apply to moist soils.			✓	✓	✓							
Note: Do not graze pastures within 28 days of potassium application.														
NITROGEN (N)														
Urea	Apply up to 400 kg of nitrogen per hectare per year. An application of 88 kg of urea per hectare is required to achieve 40 kg of nitrogen per hectare.	Best applied within 3 days of last grazing or slashing. Apply to actively growing pasture. Soils must be moist - coincide application with rain or irrigation.								✓	✓	✓		

Fertiliser (including lime)	Application rate	Application method	Summer			Autumn			Winter			Spring		
			December	January	February	March	April	May	June	July	August	September	October	November
	A subsequent application of 72 kg per hectare of lime is required to reduce soil acidity.	Avoid applying when soils are either waterlogged or dry, or if substantial rain is predicted.												
Notes: Urea will only last 6 weeks in the soil. **Do not graze pastures between for 14 days after nitrogen application.** **Increasing the cover and abundance of legumes (clovers, medics) which fix nitrogen from the air is another means to supply the pasture with nitrogen.**														
PHOSPHOROUS (P) (including mixed nutrients)														
Mono ammonium phosphate (MAP)	An application of 364 kg of MAP per hectare is required to achieve a rate of 40 kg of nitrogen per hectare and will include 80 kg of phosphorus. A subsequent application of 216 kg per hectare of lime is required to reduce soil acidity.	Phosphorus can be applied to dry soil. Avoid applying if substantial rain is predicted.			✓	✓	✓							
Di ammonium phosphate (DAP)	An application of 224 kg of DAP per hectare is required to achieve a rate of 40 kg of nitrogen per hectare and will include 44 kg of phosphorous.				✓	✓	✓							

Fertiliser (including lime)	Application rate	Application method	Summer			Autumn			Winter			Spring		
			December	January	February	March	April	May	June	July	August	September	October	November
	A subsequent application of 144 kg per hectare of lime is required to neutralise acidity.													
Do not apply phosphorous fertilisers to holding yards or effluent treated paddocks.														
Mushroom compost	An application of 1000 kg of mushroom compost per hectare is required to achieve a rate of 18 kg of nitrogen per hectare and will include 8 kg of phosphorous and 16 kg of potassium. Also includes manganese, copper and zinc. pH neutral.	Incorporate into top 10-30cm of soil before rain.	Apply approximately once every three to five years. Can be applied at any time of year.											

Appendix H Record of stakeholder liaison

December 5, 2015

Present: Mr. Michael Morris, Mrs. Lorraine Morris and Michelle Evans

1. Background

Michelle Evans of First Field Environmental has been engaged by Enhance Place Mine Pty Ltd (EPM) to facilitate liaison between EPM and the landholders of rehabilitated land under mining lease to EPM. The land is currently used for grazing and it is the intention of EPM that a Stock Management Plan be prepared by First Field Environmental and provided to Mr. and Mrs. Morris (the landholders) and EPM. This document is a summary of initial conversations between Michelle Evans and Mr. and Mrs. Morris, conducted on 5 December 2015 at the property.

2. Discussion

a. Mr. and Mrs. Morris were concerned with the lack of topsoil and subsequent effects on vegetation establishment and sustainability. Surface soil erosion has been ongoing and has been particularly noticeable during extended dry periods. It has not been uncommon to find general waste such as household garbage held within exposed soils.

b. A number of holes have opened up in the rehabilitated area, including cracks associated with slope crests. Mr. and Mrs. Morris reported that one of their horses recently became injured due a hole in the grazing area, and that veterinary care was required.

c. Vegetation damage and surface soil loss is evident at a number of mid-slope locations throughout the grazing area. Mr. and Mrs. Morris and Michelle Evans shared the opinion that this damage is the result of slope and poor vegetation establishment and not overgrazing, as stock will preferentially graze flat areas before slopes of this degree. Mr. and Mrs. Morris suggested that trees could be planted mid-slope to mitigate the effects of soil slippage, loss of surface vegetation and surface soils. Mr. and Mrs. Morris have observed stock congregating beneath existing tree plantings and believe that additional planting would increase available shade and decrease potential soil damage under existing trees.

d. Mr. and Mrs. Morris indicated that there is an obvious difference in pasture health and resilience between the rehabilitated area and pastures adjacent to their property and that they would like their land rehabilitated to resemble adjacent land capability.

e. When suggested, Mr. and Mrs. Morris agreed that areas of grazing land can be closed to exclude grazing and allow for further rehabilitation works to be undertaken by EPM.

f. Mr. Morris identified a number of newly established weeds within the rehabilitated area, namely St John's Wort, Blackberry, Patterson's Curse and Wild Radish. Both Mr. and Mrs. Morris agreed that Scotch Thistle occurs occasionally and that African Lovegrass is present but well controlled as a result of recent chemical application by EMP.

g. There appears to be confusion regarding the number of dams initially prescribed for the property and the actual number of dams present. Mr. and Mrs. Morris believe that a description of the property given to them around the time of purchase stated that there were five dams on their portion of the property. Previous conversations between the landholders and a representative of EPM (no longer involved with the property) indicated to Mr. and Mrs. Morris that the two sediment retention basins would be relined for use as water storage dams.

h. It was ascertained from Mr. and Mrs. Morris that the property currently supports:

- 5 x cows;
- 8 x miniature horses;
- 7 x miniature ponies;
- 2 x horses; and
- 1 x alpaca.

A number of these animals are contained outside of the rehabilitated pasture area and are either stabled or kept in the home paddock. The rehabilitated grazing area generally supports:

- 5 x cows;
- 1 x miniature horse;
- 3 x miniature ponies; and
- 2 x horses.

i. During these conversations Mr. and Mrs. Morris indicated that the development of a Stock Management Plan would be beneficial in providing clarity regarding planned rehabilitation works, pasture and stock management.

3. Actions required

- Provide Mr. and Mrs. Morris with aerial imagery on which they can confirm the location of current fence lines and gates.
- Clarify EPMs position regarding the sediment basins against Mr. and Mrs. Morris's understanding that there be five dams on the property. Mr. and Mrs. Morris to provide original agreement.
- Schedule a meeting between Mr. and Mrs. Morris, Graham Goodwin (EPM representative) and Michelle Evans to agree on optimal outcomes of a Stock Management Plan for the property.

March 20, 2016

Present: Mr. Michael Morris, Mrs. Lorraine Morris, Graham Goodwin and Michelle Evans

1. Background

These records summarise conversations between Michelle Evans, Mr. and Mrs. Morris, and Graham Goodwin conducted on 20 March 2016 at the property.

2. Discussion

a. Michelle Evans presented Mr. and Mrs. Morris with a hard copy of the Draft Stock Management Plan. Discussion included the suggested use and layout of the Plan.

b. Mr. and Mrs. Morris and Graham Goodwin have agreed on the optimal outcomes for the property as reflected in the Draft Stock Management Plan.

c. Information sources for Section 1 of the Plan were discussed and the resulting characteristics of the property as described in the Plan were confirmed.

d. Specific land management goals in Section 2 of the Plan were identified along with methods for addressing potential immediate and long term land management issues.

e. Mr. and Mrs. Morris were provided with aerial imagery on which they confirmed the location of current fence-lines and gates.

f. It was explained to Mr. and Mrs. Morris that the current land capability of the study area is consistent with the land capability class of surrounding agricultural land.

g. Agreement was reached that rehabilitation work may commence immediately and that the closure of one paddock and subsequent exclusion of stock would be acceptable.

h. Mr. and Mrs. Morris provided a copy of the real estate listing for the property (attached below) which stated that the property contained five dams.

3. Actions required

- Clarify EPMs position regarding the sediment basins against Mr. and Mrs. Morris's understanding that there be five dams on the property.
- Undertake an assessment of the site to identify a suitable paddock for rehabilitation activities.
- Exclude grazing from the selected paddock for at least six months to allow rehabilitation works and pasture reestablishment.
- Commence rehabilitation activities as consistent with this Stock Management Plan.
- Audit rehabilitation effectiveness in mid Spring 2016.

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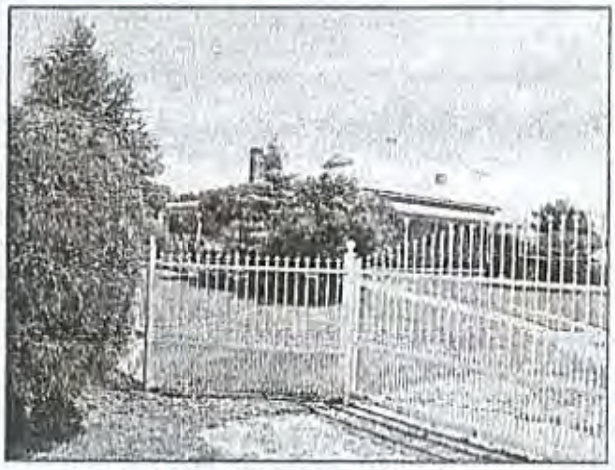

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