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DRAFT M2G Seeding (Plot) Monitoring Report

Construction Corridor (Spring 2014)

Prepared for
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ABBREVIATION	DESCRIPTION
BGGW	Box Gum Grassy Woodland
KPT	Key Performance Targets
LLPS	Low Lift Pump Station
LRMP	Landscape Rehabilitation Management Plan (superseded by the LRTEMP)
LRTEMP	Landscape Rehabilitation and Terrestrial Ecology Management Plan
M2G	Murrumbidgee to Googong Water Transfer Project
NTG	Natural Temperate Grassland
ORMP	Offset Rehabilitation Management Plan
PCS	ACT Parks and Conservation Service
TEMP	Terrestrial Ecology Management Plan (superseded by the LRTEMP)

1 Executive Summary

This report presents the results of the spring 2014 plot monitoring survey for the seeding rehabilitation of the M2G pipeline construction project. Current surveys were conducted during October 2014.

Floristic data was collected within 22 monitoring plots (each 400 m^2) across 12 km of construction corridor. In addition, two control plots situated in moderate to high diversity box gum grassy woodland were also sampled.

A total of 145 herbaceous species (70 native and 75 non-native) were recorded across all plots. Total species richness ranged from 33 species to 58 species at an average of 45 species per plot.

Five plots associated with non-native vegetation (Plot 07, 08, 13, 11 and 14) have met the KPT and associated sections of the corridor either have been or will be returned to landowners. However, no plot in the native vegetation category (categories 2 and 3) has met the required KPT.

Although no plot associated with native vegetation has yet met the required KPT seven plots (04, 05, 09, 10, 16, 18 and 20) achieved total native species cover scores in the 25-50% range and Plot 17 is near the required target. This signifies a slight increase in total native species cover in plots associated with native vegetation. However, competition from exotic annual grasses and broad-leaf weeds may be inhibiting the recruitment of native species.

The highest native species cover abundance score was 2 (5-25% cover range) attained by *Rytidosperma* sp., *Bothriochloa macra*, *Microlaena stipoides* and *Themeda australis* across ten plots. In contrast, some areas of native vegetation displayed a relatively high cover of exotic annual species with *Bromus* spp. obtaining a classification of 4 (50-75% cover range) in two plots and 3 (25-50% cover) in seven plots. Another three exotic species recorded cover scores in the 25-50% range across three plots.

Seven noxious species were recorded within the construction corridor. While most infestations were minor and considered manageable larger out breaks of *Echium vulgare* (Vipers Bugloss), *Eragrostis curvula* (African Lovegrass) and *Hypericum perforatum* (St John's Wort) could manifest into far more serious infestations and should be attended to. It is acknowledged, however, that these species have widespread local distributions and are not restricted to the construction corridor.

The main recommendations are:

- continue chemical weed control though care should taken to minimise the impact on non-target species;
- 'pulse' grazing should be repeated in the central section of the construction corridor in late summer/autumn and again in late winter with consideration given to adopting a similar approach in other sections of the corridor that contain high biomass and/or broadleaf weed infestations;
- undertake re-seeding in areas where native germination has been poor subsequent to effective weed management; and,
- consider a trial application of carbohydrate (sugar) in the ACT sections of the corridor where native germination and recovery has been particularly poor and non-native grasses and broad-leaf weeds are well established.

2 Introduction

2.1 Background

This report provides the results and analysis of the spring 2014 plot monitoring survey for the seeding rehabilitation of the Murrumbidgee to Googong Water Transfer Project (M2G) construction corridor. This is the sixth in a series of bi-annual reports examining the post-construction vegetation recovery of the M2G construction corridor.

Floristic data was collected from twenty-two[1] permanent sampling plots and compared against previous results and measured against predetermined Key Performance Targets (KPTs). In addition, two control plots (established in moderate to good condition Box Gum Grassy Woodland) were surveyed.

Of the original twenty-five monitoring plots ten are located in the ACT and fifteen in NSW. Both control plots are situated in the ACT.

Background documents and information required for this study were presented in the initial M2G Rehabilitation Monitoring Autumn 2012 Report (Blue Gum Ecological Consulting, July 2012).

2.2 Study area

The M2G construction corridor (study area) extends from Angle Crossing on the Murrumbidgee River to Burra Creek at the intersection of Williamsdale and Burra Roads, a distance of about 12km.

The study area falls entirely within the Williamsdale (8726-4N) 1:25,000 Map Sheet.

2.3 Study aims

The main purpose of the study is to monitor the post-construction vegetation recovery within the M2G construction corridor and compare the results against specific KPTs for each vegetation category (**Table 1**).

Table 1: Key performance targets (KPTs) for each vegetation category within the M2G construction corridor. This table is reproduced from Table 3.2 in the Landscape Rehabilitation and Terrestrial Ecology Management Plan (LRTEMP), January 2014.

Vegetation Category	Key Performance Targets
1. Non-native vegetation	**Ground cover -** > 70% vegetation cover of the species sown. **Weeds** – better than or equal to the current presence of declared weeds and < 20% cover of exotic species not sown
2. Native vegetation (low diversity)	**Ground cover -** > 70% vegetation cover of the native species sown. **Weeds** – better than or equal to the current presence of declared weeds and < 20% cover of exotic species not sown

[1] A total of 25 sample plots were originally established, three of which (Plots 08, 13 and 14) have since met the required KPT and are no longer monitored.

Vegetation Category	Key Performance Targets
3. High conservation value grassland and grassy woodland	**Ground cover -** > 70% vegetation cover of the native species sown and survival of native ground and tree species. **Weeds** - better than or equal to the current presence of declared weeds and < 20% cover of exotic species not sown. **Native species** (planting success) - all species listed for seeding and planting are present.

3 Methods

3.1 Monitoring regime

Sample plots are monitored on a bi-annual basis (autumn and spring/summer periods). The current surveys were conducted during October 2014.

3.2 Monitoring plots

All sample plots are 400m^2 in size and were placed at selected locations within the M2G construction corridor (see **Figures 1 – 3** in Appendix 1). Plots 08, 13 and 14 in the non-native category (Category 1) met the required KPT and were not sampled during the current monitoring period. Plot 07 (Category 1) met the KPT during the previous monitoring session (Autumn 2014) and was re-sampled during the current session to confirm this status.

All remaining plots, including both control plots, were sampled during the current monitoring session (**Table 2**).

Table 2: Monitoring plots listed in order of chainage from the LLPS. Also shown are pre-construction vegetation types in which plots were placed, seeding regime for each plot, KPT for each plot and whether or not these were met and when.

Plot ID	Chainage (m)	Jurisdiction	Original vegetation	Seeding regime	KPT category	Was KPT achieved ?	When KPT was achieved
16	250	ACT - PCS	NTG	N	3	**Mid range**	
15	530	ACT - PCS	NTG	N	3	No	
21	700	ACT - PCS	NTG	N	3	No	
19	1020	ACT - PCS	Degraded BGGW	N	2	No	
20	1200	ACT - ACTEW	Degraded BGGW	N	2	**Mid range**	
18	1450	ACT - ACTEW	Degraded BGGW	N	2	**Mid range**	
23	1740	ACT - ACTEW	Degraded BGGW	N	3	No	
22	2150	ACT - ACTEW	BGGW	N	3	No	
24	2650	ACT - ACTEW	BGGW	N	3	No	
25	2800	ACT - Locke	BGGW	N	3	No	
01	3030	NSW – Smith	Low to moderate diversity secondary grassland	N	3	No	
02	3220	NSW – Smith	Low to moderate diversity *E. dives* - *E. mannifera* dry forest	N	2	No	
03	3320	NSW - Smith/McDonald	Degraded BGGW	N	2	No	
09	3600	NSW - McDonald	Low to moderate diversity secondary grassland	N	3	**Mid range**	

Plot ID	Chainage (m)	Jurisdiction	Original vegetation	Seeding regime	KPT category	Was KPT achieved ?	When KPT was achieved
04	4025	NSW - McDonald	Moderate to high diversity secondary grassland	N	3	**Mid range**	
05	4300	NSW - McDonald	Low diversity native pasture	N	2	**Mid range**	
06	4900	NSW - Lonergan	Low diversity native pasture	N	2	No	
07	5200	Lonergan	Low diversity mixed pasture	M	1 [B]	**Yes**	**Autumn 2014**
08	5680	NSW - Lonergan	Poor quality mixed pasture	E	1	**Yes**	**Spring 2013**
10	6030	NSW - Codd/Howarth	Low diversity native pasture	N	2 [A]	**Mid range**	
11	6450	NSW - Johanson	Poor quality mixed pasture	E	1 [B]	**Yes**	**Spring 2014**
17	7600	NSW - Devitt	Moderate to high diversity BGGW	N	3	**Near**	
12	8300	NSW - Bos	Poor quality mixed pasture	E	1 [B]	**Near**	
14	9850	NSW - Borgia	NNP	E	1	**Yes**	**Spring 2012**
13	10950	NSW - Johnston	NNP	E	1	**Yes**	**Spring 2012**

[A] KPT was revised upwards from category 1 to category 2 on the basis of the landscape seeding and planting regime in these paddocks.

[B] KPT was revised downwards from category 2 to category 1 on the basis of the landscape seeding and planting regime in these paddocks.

Key to Original Vegetation

NTG = Natural Temperate Grassland. **BGGW** = Box Gum Grassy Woodland. **NNP** = Non-native Pasture

Key to Seeding Regime

N = native seed mix – *Rytidosperma* (Syn. *Austrodanthonia) carphoides, Austrostipa scabra, Bothriochloa macra, Elymus scaber, Microlaena stipoides, Chloris truncata and Themeda australis*.

E = exotic seed mix - As for native seed mix combined with *Lolium perenne, Phalaris aquatica, Dactylis glomerata* and *Trifolium subterraneum.* The Johanson property (Plot 11) was seeded with an 'Alpaca Pasture Mix' comprising: Tall Fescue and Au Triumph Fescue, (*Fescue* sp.), Kara Cocksfoot (*Dactylis glomerata*), Leura Sub-clover (*Trifolium subterraneum*), Prestige White Clover (*Trifolium repens*), Tonic Plantain (*Plantago lanceolata*) and Grouse Chickory (*Cichrium intybus*).

M = a mixed combination of native & exotic seed.

3.3 Control plots

Two control plots were established within moderate to high quality BGGW adjacent to the construction corridor (**Table 3**). For practical reasons (i.e. presence of stock and access restrictions) both plots were located in the ACT (**Figure 1** in Appendix 1).

Table 3: Location of control plots.

Plot	Jurisdiction	Plot configuration (m)	Easting	Northing	Vegetation type/condition
Control 1	ACT	20 x 20	692162	6060624	Moderate to high floristic diversity BGGW
Control 2	ACT	20 x 20	693379	6060670	Moderate to high floristic diversity BGGW

3.4 Survey techniques

Estimates of species presence, richness and cover abundance within sample plots were determined using a modified Braun-Blanquet scale, as shown below:

- r = < 5% cover and solitary (1-3 individuals)
- + = < 5% cover and few (4-15 individuals)
- 1 = < 5% cover and numerous/scattered (>15 individuals)
- 2 = 5% – 25% cover
- 3 = 25% – 50% cover
- 4 = 50% – 75% cover
- 5 = > 75% cover.

3.5 Limitations and observations

Some sections of the construction corridor, including a number of sampling plots (particularly in the ACT and McDonald property in NSW) were affected by repeated vehicle traffic resulting in varying degrees of soil compaction and poor seed germination. This effect, though still evident, has diminished.

4 Results

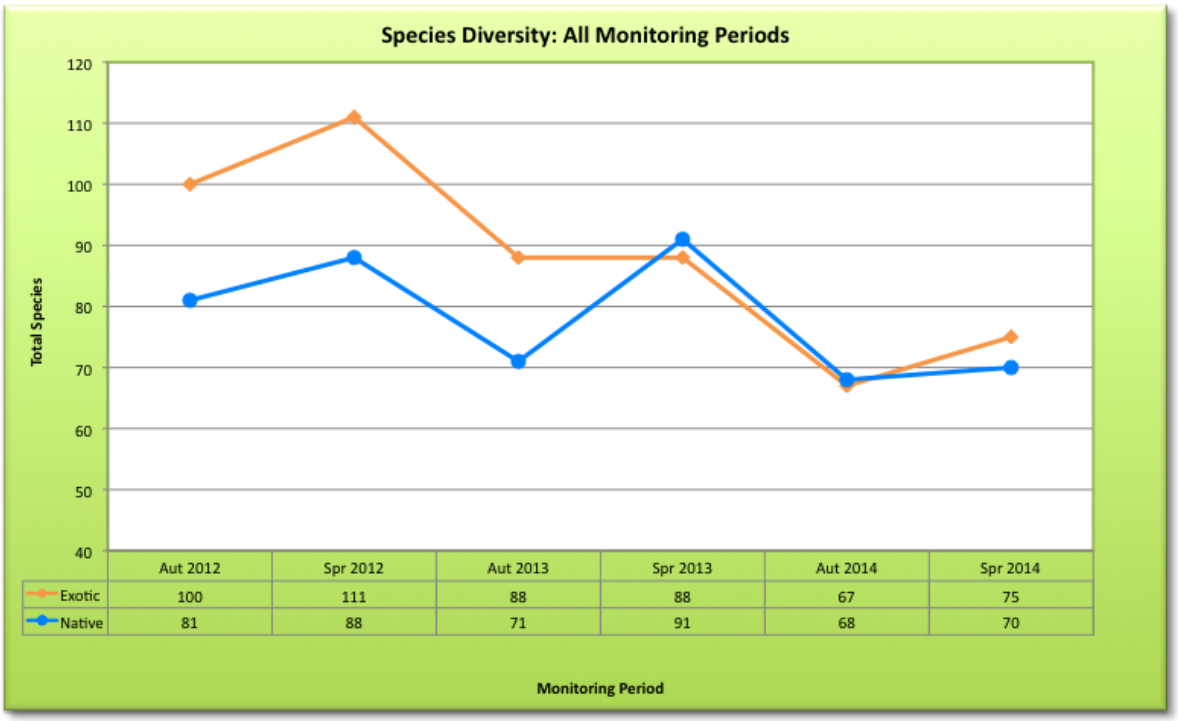
An analysis of the spring 2014 monitoring survey is provided in the following sections. Plot data sets are provided in **Table 9** and **10** in **Appendix 2**.

4.1 Overview: Monitoring plots

A total of 145 herbaceous plants comprising 70 native species and 75 exotic species (ratio of 1:1.13)[2] were recorded from twenty-two monitoring plots during the current sampling period. Results for each sampling period are plotted in **Chart 1** and a full data set for the current session is provided in **Table 10** in **Appendix 2**.

Species diversity is responding to seasonal change with relative declines in autumn and increases in spring, though the current spring results suggest a weakening of this pattern. This may be a response to lower than average rainfall between July and October or it may merely suggest a temporal stabilising due to competitive attrition (**Chart 1**).

Chart 1: Total species counts during all monitoring periods.



[2] Previous native/exotic species ratios were: 1:1.23 (autumn 2012); 1:1.27 (spring 2012); 1:1.25 (autumn 2013); 1:0.98 (spring 2013) and 1:0.99 in autumn 2014.

4.1.1 Species Frequency

Floristic data was evaluated to determine the most common species across the plots surveyed. The surveys recorded 17 native species and 21 exotic species present in 10 or more monitoring plots.

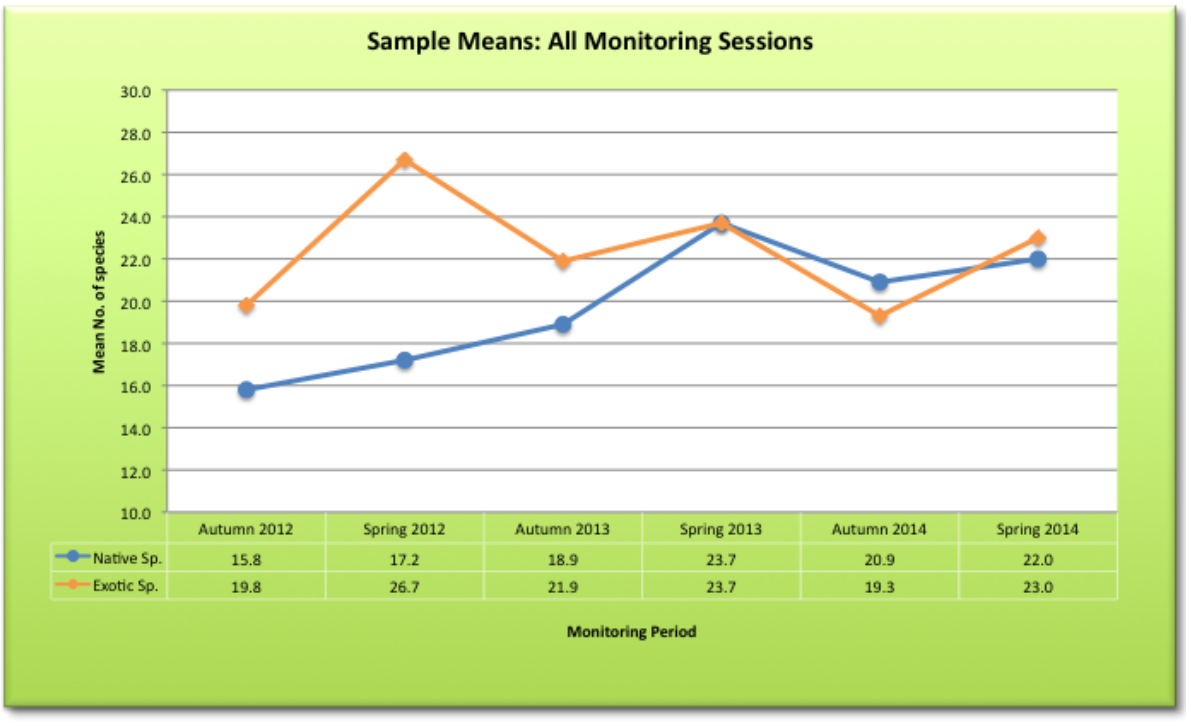
Of the ten most commonly recorded species, six were native and four exotic (this compared with eight native and two exotic in autumn 2014). The most commonly recorded native species were *Austrostipa scabra* (Speargrass) and *Rytidosperma* sp. (Wallaby Grass) in 22 plots; *Chloris truncata* (Windmill Grass) in 21 plots; *Themeda australis* (Kangaroo Grass); *Microlaena stipoides* (Weeping Grass); and *Bothriochloa macra* (Red Grass) in 20 plots. Among the exotic species the most commonly distributed species included *Vulpia* sp (Rat's Tail Fescue), which was present in 22 plots and *Bromus* spp. (21 plots), followed by Flatweed *Hypochaeris radicata* (20 plots) and *Trifolium* sp (Clover) (19 plots) (**Table 10** in **Appendix 2**).

4.1.2 Species Diversity (Richness)

Native species richness ranged from 11 to 36 species per plot and for non-native species richness ranged from 17 to 29 species. (**Table 10** in **Appendix 2**).

Native species average per plot increased each session up to spring 2013 (when it peaked at **23.7** sp./plot), declined in autumn 2014 and increased again during the current survey period (**Chart 2**). Non-native species averages have fluctuated in line with seasonal influences.

Chart 2: Species means (per plot) during all monitoring periods.



4.1.3 Cover Abundance - native vegetation

Of the nineteen plots located in former native vegetation (KPT categories 2 and 3) six plots (04, 16, 19, 21, 22 and 25) exhibited modest increases in native vegetation cover, eight maintained native cover and five plots (03, 05, 06, 10, and 20) exhibited declines in cover relative to the previous monitoring period**.**

The best performing plots in the ACT were: 16, 18 and 20, all of which obtained native species cover scores in the 25-50% range. In NSW, four plots (04, 05, 09 and 10) also had 25-50% native species cover and one plot (17) in the 50-75% cover range. All remaining plots had native species cover scores of 5-25%.

Estimated cumulative native species cover remained in the 25-50% range, with a marginal increase in cover compared to the previous sampling session. The estimated cover for exotic species within native vegetation plots (categories 2 and 3) has risen from 25-50% to the low end of the 50-75% range (**Table 4**). The increase in exotic species cover is associated with an increase in annual pasture grasses, particularly *Bromus* spp. and clover *Trifolium* spp.

4.1.4 Cover Abundance – non-native vegetation

Of the six plots associated with non-native vegetation, four (07[3], 08, 13 and 14) met the required KPT. Current results indicate that Plot 11 has also met the KPT with Plot 12 near the target (**Table 4).**

Table 4: Estimated cover abundances from all plots for autumn 2014 and spring 2014 monitoring periods. Red text indicates an increase in cover and blue a decrease.

			Cumulative vegetation cover					
			Native		Exotic			
Plot No.	Chainage	Location	Autumn 2014	Spring 2014	Autumn 2014	Spring 2014	KPT Category	Was KPT met?
16	250	ACT	5-25+	25-50-	5-25-	5-25	3	**Mid Range (slight increase)**
15	530	ACT	5-25	5-25	25-50+	25-50	3	No
21	700	ACT	5-25	5-25+	50-75-	25-50	3	No
19	1020	ACT	5-25	5-25+	5-25	5-25+	2	No
20	1200	ACT	25-50+	25-50-	50-75-	50-75	2	**Mid range (slight decline)**
18	1450	ACT	25-50-	25-50-	25-50+	50-75	2	**Mid Range**
23	1740	ACT	25-50-	5-25+	5-25	25-50	3	No
22	2150	ACT	5-25	5-25+	5-25-	25-50	3	No
24	2650	ACT	5-25	5-25	5-25-	5-25	3	No
25	2800	ACT	5-25	5-25+	25-50-	25-50	3	No
01	3030	Smith	5-25+	5-25	<5	5-25+	3	No
02	3220	Smith	5-25+	5-25+	5-25	5-25	2	No
03	3320	MacDonald	5-25+*	5-25+	25-50*	25-50+	2	No
09	3600	MacDonald	25-50**	25-50	5-25**	50-75-	3	**Mid range**
04	4025	MacDonald	5-25+**	25-50	5-25**	25-50	3	**Mid range**
05	4300	MacDonald	25-50+*	25-50-	25-50*	50-75	2	**Mid range**
06	4900	Lonergan	25-50	5-25+	25-50	25-50+	2	**No**

[3] The KPT for Plot 07 has been revised downwards from category 2 to category 1 on the basis of the high component of non-native perennial pasture grasses (i.e. *Phalaris aquatica, Lolium perenne* and *Dactlyis glomerata*) that were included in landscape seeding mix.

			Cumulative vegetation cover					
			Native		Exotic			
Plot No.	Chainage	Location	Autumn 2014	Spring 2014	Autumn 2014	Spring 2014	KPT Category	Was KPT met?
07	5200	Lonergan	5-25	**5-25**	50-75-	**50-75+**	1[B]	**Yes**
08	5680	Lonergan	-	-	-	**-**	1	**Yes**
10	6030	Codd-Howarth	25-50	25-50-	5-25	**25-50**	2[A]	**Mid range**
11	6450	Johanson	5-25	5-25-	50-75	**50-75+**	1[B]	**Yes**
17	7600	Devitt	50-75-	**50-75-**	5-25-	**5-25**	3	**Near**
12	8300	Bos	5-25	<5%	50-75+	50-75	1[B]	**Near**
14	9850	Borgia	-	-	-	-	1	**Yes**
13	10950	Johnston	-	-	-	-	1	**Yes**
Total cover estimate all plots			**25-50-**	**25-50**	**25-50**	**50-75**		

[A] KPT was revised upwards from category 1 to category 2 on the basis of the landscape seeding and planting regime in these paddocks.

[B] KPT was revised downwards from category 2 to category 1 on the basis of the landscape seeding and planting regime in associated paddocks.

** heavily grazed prior to autumn 2014 sample

* moderately grazed prior to autumn 2014 sample

+ cover estimated at the upper end of range

- cover estimated at the lower end of range

4.2 Control plots

Control plots (**Plate 1**) contained a moderate to high native species richness with 37 and 33 herbaceous species in Control Plot 1 and Control Plot 2, respectively. Cumulative native cover abundance in both plots exceeded 90%. There was a slight increase in exotic species (17 and 15 sp.) though their cumulative cover abundance is less than 5% (see **Table 9 in Appendix 2)**.

While there were comparable numbers of native species in some monitoring plots (i.e. 02, 17 and 20) their total cover abundance was well below that observed in control plots.

Plate 1: Control Plots. Left column shows control plot 1 and the right control plot 2 during the period between spring 2013 and spring 2014.

Spring 2014

Control Plot 1

Control Plot 2

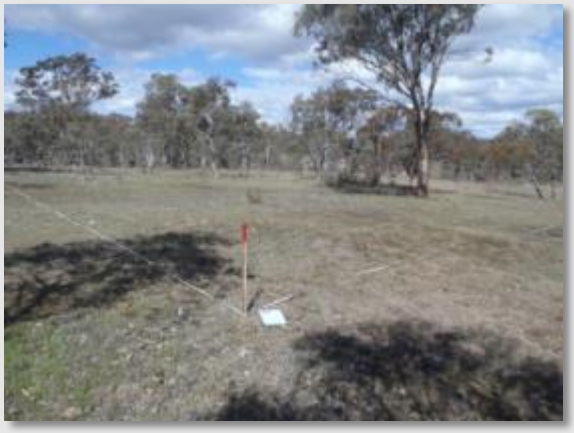
Autumn 2014

Control Plot 1

Control Plot 2

Spring 2013

Control Plot 1



Control Plot 2

4.3 Plots in high-diversity native vegetation (KPT category 3)

Eleven plots (01, 04, 09, 15, 16, 17, 21, 22, 23, 24 and 25) were established in areas of former high conservation value vegetation and were set the highest KPT (see **Table 1**). Summaries of category 3 results are provided in **Table 5**, below, with additional descriptions of each plot presented in the succeeding sub-sections.

While no plot associated with category 3 met the required KPT Plot 17 had a native species cover score of 4 (50-75% cover) and was near the required target. Three plots (04, 09 and 16) had native species cover scores of 3 (25-50%) and are in the mid-range of the KPT (**Table 5**).

Species diversity

Native species diversity ranged from 14 to 35 sp. at an average of 23.6 sp./plot – an increase of 2.9 from the previous autumn sampling period. Non-native species diversity ranged from 17 to 28 at an average of 22.9 sp./plot – an increase of 4.4 sp./plot over the same period.

Individual species cover abundance scores

The highest individual native species cover score was 2 (5-25%) obtained by *Bothriochloa macra* (four plots), *Rytidosperma* sp. and *Themeda australis* (three plots) and *Microlaena stipoides* (one plot). The number of species with a cover score of 1 (<5% cover & >15 individuals) ranged from 6 to 16 sp./plot.

The highest individual cover score for non-native herbaceous species (or genus) in this category was 3 (25-50% cover range) obtained by *Bromus* sp. (four plots), followed by *Trifolium* sp. and *Verbena bonariensis* (one plot each).

Cumulative cover abundance scores

Cumulative native cover increased in five plots, remained constant in four plots and declined in two (**Table 5**). *Overall there was a slight increase in total native species cover in this category (towards the lower end of 25-50% range) from the previous autumn 2014 sampling period.*

Cumulative non-native cover increased in nine plots and declined in two plots (**Table 5**). *Overall, there was a slight increase in total non-native species cover in this category.*

Table 5: Summary of category 3 plot results for spring 2014. Table gives: species richness per plot and change from the previous autumn 2014 survey; native species cover scores (1 = <5% and 2 = 5-25%); and cumulative cover abundance estimates for both native and exotic species. Parentheses ( ) enclose results from autumn 2014. Red text identifies an increase and blue a decrease.

Plot No.	Chainage	Location	Native sp.	Exotic sp.	Total sp.	Change native sp.*	Change exotic sp.*	Native sp. with cover score of 1	Native sp. with cover score of 2 or >	% native sp. cover	% exotic sp cover
16	250	ACT	26	25	51	**6** (-8)	**2** (-2)	**8** (7)	**3** (2)	**25-50-**	**5-25**
15	530	ACT	20	28	48	**1** (-4)	**0** (-3)	**12** (11)	**0** (0)	**5-25**	**25-50**
21	700	ACT	22	25	47	**6** (-5)	**0** (1)	**10** (8)	**0** (0)	**5-25+**	**25-50**
23	1740	ACT	28	21	49	**7** (-6)	**8** (-15)	**7** (10)	**1** (1)	**5-25+**	**25-50**
22	2150	ACT	28	20	48	**2** (-1)	**3** (-10)	**10** (9)	**0** (0)	**5-25+**	**25-50**
24	2650	ACT	14	25	39	**2** (-8)	**12** (-15)	**7** (8)	**0** (0)	**5-25**	**5-25**
25	2800	ACT	15	27	42	**-5** (2)	**1** (-4)	**6** (9)	**1** (0)	**5-25+**	**25-50**
01	3030	NSW-Smith	23	22	45	**3** (-9)	**8** (-7)	**8** (9)	**0** (1)	**5-25**	**5-25+**
09[P]	3600	NSW-McDonald	29	17	46	**6** (-10)	**2** (-6)	**11** (9)	**2** (2)	**25-50**	**50-75-**
04[P]	4025	NSW-McDonald	20	21	41	**2** (-9)	**10** (-7)	**10** (12)	**2** (0)	**25-50**	**25-50**
17	7600	NSW-Devitt	35	21	56	**2** (-4)	**0** (-1)	**16** (18)	**2** (2)	**50-75-**	**5-25**
Av spring 2014			**23.6**	**22.9**	**46.5**						
Av autumn 2014			**20.7**	**18.5**	**39.2**						
Av spring 2013			**26.4**	**24.7**	**51.1**						
Av. autumn 2013			**20.4**	**22.4**	**42.9**						
Av. spring 2012			**19.9**	**29.2**	**49.1**						

* Change in species richness in the period between autumn 2014 and spring 2014.

[P] pulse grazed prior to autumn 2014 sampling period

+ cover estimated at the upper end of range

- cover estimated at the lower end of range

4.3.1 Monitoring Plot 16

Jurisdiction	ACT
Native sp. cumulative cover %	**25-50-** (5-25+)
No. Native sp. with cover score of 1	**8** (7)
No. Native sp. with cover score of 2 or more	**3** (2)
Non-native cover %	**5-25** (5-25-)
Bare Ground %	**30-40** (40-50)
Mulch Cover %	<5
KPT	High Conservation Vegetation
Was KPT met	**No**

Monitoring plot 16 is situated 250 m east of the LLPS in the Murrumbidgee River corridor ACT within former high conservation value natural temperate grassland. Cumulative native cover was at the high end of 5-25% range. Native sp. increased from **20** to **26**. Non-native species increase from **23** to **25**.

Noxious species: *Carthamus lanatus*, *Hypericum perforatum* and *Echium vulgare* in low densities

Recommendation: Eliminate noxious species and undertake detailed management of exotic weeds e.g. broad leaved weeds.

Plate 2: Monitoring Plot 16 - left autumn 2014, right spring 2014.

4.3.2 Monitoring Plot 15

Jurisdiction	ACT
Native sp. cumulative cover %	**5-25** (5-25)
No. Native sp. with cover score of 1	**12** (11)
No. Native sp. with cover score of 2 or more	**0** (0)
Non-native cover %	**25-50** (25-50+)
Bare Ground %	**20-30** (20-30)
Mulch Cover %	<5
KPT	High Conservation Vegetation
Was KPT met	**No**

Monitoring plot 15 is situated 530 m east of the LLPS in the Murrumbidgee River Corridor ACT within former high conservation value natural temperate grassland. Native sp. increased from **19 to 20**. Non-native species remained on **28**. **Broad-leaf weeds remained dominant.**

Noxious species: *Echium vulgare* at moderate densities and *Hypericum perforatum* at low density.

Recommendation: Eliminate noxious species and undertake detailed management of exotic weeds e.g. broad-leaf weeds.

Plate 3: Monitoring Plot 15 - left autumn 2014, right spring 2014.

4.3.3 Monitoring Plot 21

Jurisdiction	ACT
Native sp. cumulative cover %	**5-25** (5-25)
No. Native sp. with cover score of 1	**10** (8)
No. Native sp. with cover score of 2 or more	**0** (0)
Non-native cover %	**25-50** (50-75-)
Bare Ground %	**10** (5-10)
Mulch Cover %	<5
KPT	High Conservation Vegetation
Was KPT met	**No**

Monitoring plot 21 is located 700 m east of the LLPS in the Murrumbidgee River Corridor ACT within former high conservation value natural temperate grassland. Native species increased from **16 to 22**. Non-native species remained on **25**. **Broad-leaf weeds and annual pasture grasses remained dominant.**

Noxious species: *Echium vulgare* and *Hypericum perforatum* at high densities

Recommendation: Eliminate noxious species and undertake detailed management of exotic weeds e.g. broad-leaf weeds..

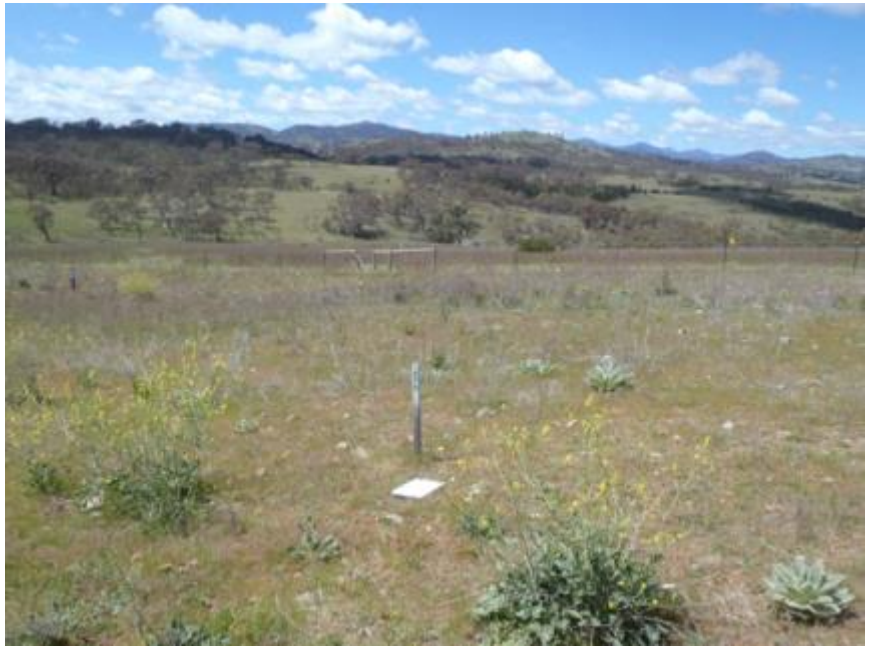


Plate 4: Monitoring Plot 21 - left autumn 2014, right spring 2014.

4.3.4 Monitoring Plot 23

Jurisdiction	ACT
Native sp. cumulative cover %	**5-25+** (25-50-)
No. Native sp. with cover score of 1	**7** (10)
No. Native sp. with cover score of 2 or more	**1** (1)
Non-native cover %	**25-50** (5-25)
Bare Ground %	**10** (10)
Mulch Cover %	<1
KPT	High Conservation Vegetation
Was KPT met	**No**

Monitoring plot 23 is situated 1740 m east of the LLPS in the ACT within former high conservation value Box Gum Grassy Woodland. Native species increased from **27** to **28.** Non-native species also increased from **13 to 21**.

Significant increase in *Bromus* spp.

Noxious species: *Hypericum perforatum* at low density

Recommendation: Eliminate noxious species, re-seed and undertake detailed management of exotic weeds e.g. broad-leaf weeds.

Plate 5: Monitoring Plot 23 - left autumn 2014, right spring 2014.

4.3.5 Monitoring Plot 22

Jurisdiction	ACT
Native sp. cumulative cover %	**5-25+** (5-25)
No. Native sp. with cover score of 1	**10** (9)
No. Native sp. with cover score of 2 or more	**0** (0)
Non-native cover %	**25-50** (5-25-)
Bare Ground %	**10** (10-15)
Mulch Cover %	<1
KPT	High Conservation Vegetation
Was KPT met	**No**

Monitoring plot 22 is situated 2150 m east of the LLPS in the ACT within former high conservation value Box Gum Grassy Woodland. Native species increased from **26 to 28**. Non-native species also increased from **17 to 20**.

Significant increase in Brome sp.

Note: Poor quality top-soil.

Noxious species: *Hypericum perforatum* and *Rosa rubiginosa* at low densities

Recommendation: Eliminate noxious species and undertake detailed management of exotic weeds e.g. broad-leaf weeds.

Plate 6: Monitoring Plot 22 - left autumn 2014, right spring 2014.

4.3.6 Monitoring Plot 24

Jurisdiction	ACT
Native sp. cumulative cover %	**5-25** (5-25)
No. Native sp. with cover score of 1	**7** (8)
No. Native sp. with cover score of 2 or more	**0** (0)
Non-native cover %	**5-25** (5-25-)
Bare Ground %	**50-60** (50-60)
Mulch Cover %	**<1** (5)
KPT	High Conservation Vegetation
KPT met	**No**

Monitoring plot 24 is situated 2650 m east of the LLPS on the west side of the Monaro Hwy in the ACT within former high conservation value Box Gum Grassy Woodland. Native species increased from **12 to 14**. Non-native species also increased from **13 to 25**.

Poor quality top soil and a high proportion of bare ground. Overall this plot (and section of the corridor) has performed poorly.

Noxious species: *Eragrostis curvula* and *Hypericum perforatum* at low density

Recommendation: Eliminated noxious species, re-seed and undertake detailed management of non-noxious weeds e.g. broad-leaf weeds.. Suggested site for sugar (carbohydrate) trial.

Plate 7: Monitoring Plot 24 - left autumn 2014, right spring 2014.

4.3.7 Monitoring Plot 25

Jurisdiction	ACT
Native sp. cumulative cover %	**5-25+** (5-25)
No. Native sp. with cover score of 1	**6** (9)
No. Native sp. with cover score of 2 or more	**1** (0)
Non-native cover %	**25-50** (25-50-)
Bare Ground %	**20** (20)
Mulch Cover %	**<5**
KPT	High Conservation Vegetation
Was KPT met	**No**

Monitoring plot 25 is situated 2800 m east of the LLPS on the east side of the Monaro Hwy in the ACT within former high conservation value Box Gum Grassy Woodland. Native species decreased from **18** to **15**. Non-native species increased **26 to 27**.

Increase in *Avena* sp. and *Trifolium* spp.

Noxious species: *Hypericum perforatum* and *Eragrostis curvula* at moderate densities

Recommendation: Eliminate noxious species. Re-seed, biomass control and undertake detailed management of exotic weeds e.g. broad-leaf weeds.. Suggested site for sugar (carbohydrate) trial.

Plate 8: Monitoring Plot 25 - left autumn 2014, right spring 2014.

4.3.8 Monitoring Plot 01

Jurisdiction	NSW
Native sp. cumulative cover %	**5-25** (5-25+)
No. Native sp. with cover score of 1	**8** (9)
No. Native sp. with cover score of 2 or more	**0** (0)
Non-native cover %	**5-25+** (<5)
Bare Ground %	**<10** (10)
Mulch Cover %	Straw **5**; Woodchip **10**
KPT	High Conservation Vegetation
Was KPT met	**No**

Monitoring plot 01 is situated 3030 m east of the LLPS in NSW (Smith) within former moderate to high conservation value Box Gum Grassy Woodland. Native species increased from **20 to 23**. Non-native species also increased from **14 to 21**.

Plot has performed poorly.

Noxious species: *Carthamus lanatus*, *Eragrostis curvula, Rosa rubiginosa* and *Hypericum perforatum* at low densities.

Recommendation: Eliminate noxious species, re-seed and undertake detailed management of exotic weeds e.g. broad-leaf weeds.. Possible site for sugar (carbohydrate) trial.

Plate 9: Monitoring Plot 01 - left autumn 2014, right spring 2014.

4.3.9 Monitoring Plot 09

Jurisdiction	NSW
Native sp. cumulative cover %	**25-50** (25-50)
No. Native sp. with cover score of 1	**11** (9)
No. Native sp. with cover score of 2 or more	**2** (2)
Non-native cover %	**50-75 (5-25**)
Bare Ground %	**<5** (5-10)
Mulch Cover %	0
KPT	High Conservation Vegetation
Was KPT met	**No, but in mid-range**

Monitoring plot 09 is situated 3600 m east of the LLPS in NSW (McDonald) within former moderate to high conservation value Box Gum Grassy Woodland. Native species increased from **23 to 29**. Non-native species also increased **15 to 17**.

Significant increase in *Bromus spp.* and *Trifolium* spp.

Noxious species: None recorded.

Note: This section was pulse grazed in early April 2014

Recommendation: Continue pulse grazing and undertake detailed management of exotic weeds e.g. broad-leaf weeds.

Plate 10: Monitoring Plot 09 - left autumn 2014, right spring 2014.

4.3.10 Monitoring Plot 04

Jurisdiction	NSW
Native sp. cumulative cover %	**25-50** (5-25)
No. Native sp. with cover score of 1	**10** (12)
No. Native sp. with cover score of 2 or more	**2** (0)
Non-native cover %	**25-50** (5-25)
Bare Ground %	**<5** (5-10)
Mulch Cover %	0
KPT	High Conservation Vegetation
Was KPT met	**No**

Monitoring plot 04 is situated 4025 m east of the LLPS in NSW (McDonald) within former moderate to high conservation value Box Gum Grassy Woodland. Native species increased from **18 to 20**. Non-native species increased from **11 to 21.**

Significant increase in *Bromus spp.* and *Trifolium* spp.

Note: This section was pulse grazed in early April 2014.

Noxious species: *Nassella trichotoma* at low density.

Recommendation: Eliminate noxious species and continue pulse grazing.

Plate 11: Monitoring Plot 04 - left autumn 2014, right spring 2014.

4.3.11 Monitoring Plot 17

Jurisdiction	NSW
Native sp. cumulative cover	**50-75-** (50-75-)
No. Native sp. with cover score of 1	**16** (18)
No. Native sp. with cover score of 2 or more	**2** (2)
Non-native cover	**5-25** (5-25-)
Bare Ground	**<1** (<5)
Mulch Cover	0
KPT	High Conservation Vegetation
Was KPT met	**Near**

Monitoring plot 17 is situated 7600 m east of the LLPS in NSW (Devitt) within former moderate to high conservation value Box Gum Grassy Woodland. Native species increased from **33 to 35**. Non-native species remained on **21**.

Noxious species: *Hypericum perforatum* and *Eragrostis curvula* at low densities.

Recommendation: Eliminate noxious species. Also requires biomass reduction and undertake detailed management of exotic weeds e.g. broad-leaf weeds.

Plate 12: Monitoring Plot 17 - left autumn 2014, right spring 2014.

4.4 Plots in low-diversity native vegetation (KPT category 2)

Eight plots (02, 03, 05, 06, 10, 18, 19 and 20) were established in areas of former low-diversity native vegetation - KPT category 2 (see **Table 1**). Revegetation performance targets for category 2 are similar to those imposed for category 3. Summaries of category 2 results are provided in **Table 6,** below, with additional descriptions of each plot presented in the succeeding sub-sections.

No plot in category 2 met the required KPT (**Table 6**). The best performing plots (05, 10, 18 and 20) had native cover scores of 3 (25-50% cover) are in the mid-range of the KPT.

Species diversity

Native species diversity ranged from 15 to 36 species, at an average of 23 sp./plot – a decline of 0.6 sp./plot from the previous autumn sampling period. Non-native species diversity ranged from 18 to 27 at an average of 21.9 sp./plot - a increase of 2.3 sp. / plot over the same period.

Individual species cover abundance scores

The highest cover abundance score for individual native species was 2 (5-25% cover range) obtained by three species: *Rytidosperma* sp. (Plot 10 and 19), *Microlaena stipoides* (Plot 02 and 06) and *Themeda australis* (Plot 10 and 20). Species with cover scores of 1 (<5% cover & >15 individuals) ranged from 7 to 14 sp./plot.

The highest individual non-native species cover score was 4 (50-75%) obtained by *Bromus* sp. (Plots 05 and 18). Next highest cover scores were 3 (50-75%) by *Bromus* sp. (Plot 03, 06 and 20), *Hypochaeris radicata* (Plot 03); followed by scores of 2 (5-25% cover range) for *Avena* sp. (06), *Bromus* sp. (10 and 19), *Hypochaeris radicata* (06 and 10), *Phalaris aquatica* (06, 10 and 20), *Plantago lanceolata* (Plot 10 and 20), *Trifolium* sp. (Plots 05, 18 and 20), *Erodium cicutarium* (Plot 20), *Lolium perenne* (Plot 06) and *Vulpia* sp. (Plots 03, 18 and 20). Species with cover scores of 1 ranged from 6 to 11 sp./plot at average of 7.0 sp/plot.

Cumulative cover abundance scores

Cumulative native cover increased in one plot, remained constant in two plots and declined in four plots (**Table 6**). There was a slight decrease in total native species cover within this vegetation category compared to the previous autumn 2014 period (falling to the lower end of the 25-50% cover range).

Cumulative non-native cover increased in two plots, remained constant in two plots and declined in three plots (**Table 6**). Overall, there was an increase in total non-native species cover compared to the previous sampling period.

Table 6: Summary of category 2 plot results for spring 2014. Table gives species richness per plot and changes from the previous autumn 2014 survey; native species cover scores (1 = <5% and 2 = 5-25%); and cumulative cover abundance estimates for native and exotic species. Parentheses ( ) enclose results from autumn 2014. Red text identifies an increase and blue a decrease.

Plot No.	Chainage	Location	Native sp.	Exotic sp.	Total sp.	Change native sp.*	Change exotic sp. *	Native sp. with cover score of 1	Native sp. with cover score of 2 or >	% native sp. cover	% exotic sp. cover
19	1020	ACT	**16**	**27**	**43**	-2 (8)	5 (-7)	**8** (8)	1 (0)	5-25+	5-25+
20	1200	ACT	**36**	**22**	**56**	**2** (2)	-4 (-1)	13 (14)	1 (2)	25-50	50-75
18	1450	ACT	**25**	**23**	**48**	3 (-2)	-3 (0)	12 (14)	**0** (0)	25-50-	50-75
02	3220	NSW-Smith	**30**	**22**	**52**	9 (-8)	12 (-11)	8 (9)	**1** (1)	5-25+	5-25
03[P]	3320	NSW-McDonald	**16**	**21**	**37**	**0** (-9)	6 (-9)	10 (9)	1 (0)	5-25+	25-50+
05 [P]	4300	NSW-McDonald	**27**	**24**	**51**	-3 (-2)	8 (-5)	**14** (14)	0 (1)	25-50-	50-75
06	4900	NSW-Lonergan	**15**	**18**	**33**	-5 (2)	-2 (-8)	7 (9)	1 (2)	5-25+	25-50+
10	6030	NSW-Codd / Howarth	**19**	**18**	**44**	-3 (0)	-4 (-2)	7 (10)	**2** (2)	25-50-	25-50
Av. Spring 2014			**23.0**	**21.9**	**39.9**						
Av. autumn 2014			**23.6**	**19.6**	**38.4**						
Av. spring 2013			25.7	25.2	50.9						
Av. autumn 2013			20.9	23.9	44.8						
Av. spring 2012			19.8	26.6	46.3						

* Change in species diversity in the period between autumn 2014 and spring 2014.

[P] Pulse grazed prior to autumn 2014 sampling. (Note: Plot 03 is divided by fencing and only half the plot was grazed).

4.4.1 Monitoring Plot 19

Jurisdiction	NSW
Native sp. cumulative cover %	**5-25+** (5-25)
No. Native sp. with cover score of 1	**8** (8)
No. Native sp. with cover score of 2 or more	**1** (0)
Non-native cover %	**5-25+** (5-25)
Bare Ground %	**30-40** (40)
Mulch Cover &	<5%
KPT	Low diversity native vegetation
Was KPT met	**No**

Monitoring plot 19 is situated 1020 m east of the LLPS in the ACT within former low diversity Box Gum Grassy Woodland. Native species declined from **18 to 16**. Non-native species increased from **22 to 27.**

Prior to autumn 2014 herbicide was applied to control broad-leaf weeds, however, non-target sp. (i.e. *Chrysocephalum apiculatum*) adjacent to the plot have not survived.

Noxious species: *Carthamus lanatus* and *Hypericum perforatum* occur at low densities.

Recommendation: Eliminate noxious species, re-seed and undertake detailed management of exotic weeds e.g. broad-leaf weeds.

Plate 13: Monitoring Plot 19 - left autumn 2014, right spring 2014.

4.4.2 Monitoring Plot 20

Jurisdiction	ACT
Native sp. cumulative cover %	**25-50-** (25-50+)
No. Native sp. with cover score of 1	**12** (14)
No. Native sp. with cover score of 2 or more	**1** (2)
Non-native cover %	**50-75** (50-75-)
Bare Ground %	**<1** (<5)
Mulch Cover %	None applied
KPT	Low diversity native vegetation
Was KPT met	**No, but in mid range**

Monitoring plot 20 is situated 1200 m east of the LLPS in the ACT within former low diversity Box Gum Grassy Woodland. The plot retains a small component of the original vegetation along the N boundary. Native species increased from **34 to 36**. Non-native species declined from **26 to 22.**

Increase in *Bromus* spp., and *Trifolium* spp.

Noxious species: *Echium vulgare* at moderate density and *Hypericum perforatum* and *Carthamus lanatus* at low densities.

Recommendation: Eliminate noxious species and undertake detailed management of exotic weeds e.g. broad-leaf weeds.

Plate 14: Monitoring Plot 20 - left autumn 2014, right spring 2014.

4.4.3 Monitoring Plot 18

Jurisdiction	ACT
Native sp. cumulative cover %	**25-50-** (25-50-)
No. Native sp. with cover score of 1	**12** (15)
No. Native sp. with cover score of 2 or more	**0** (0)
Non-native cover %	**50-75** (25-50+)
Bare Ground %	**<5** (<10)
Mulch Cover %	<1
KPT	Low diversity native vegetation
Was KPT met	**No**

Monitoring plot 18 is situated 1450 m east of the LLPS in the ACT within former low diversity Box Gum Grassy Woodland. Trees/shrubs have been planted within the plot. Native species declined from **30** to **28**. Non-native species remained unchanged on **26**

Significant increase in *Bromus* spp., and *Trifolium* spp.

Noxious species: *Hypericum perforatum* occurred at low densities. *Eragrostis curvula* was previously recorded and may have been obscured by dense cover of *Bromus* spp.

Recommendation: Eliminate noxious species and undertake detailed management of exotic weeds e.g. broad-leaf weeds.

Spring 2014 image unavailable

Plate 15: Monitoring Plot 18 - left autumn 2014

4.4.4 Monitoring Plot 02

Jurisdiction	NSW
Native sp. cumulative cover %	**5-25+** (5-25+)
No. Native sp. with cover score of 1	**8** (9)
No. Native sp. with cover score of 2 or more	**1** (1)
Non-native cover %	**5-25** (5-25)
Bare Ground %	**20-30** (20-30)
Mulch Cover %	**<1** (<5)
KPT	Low diversity native vegetation
Was KPT met	**No**

Monitoring plot 02 is situated 3220 m east of the LLPS in NSW (Smith) within former Brittle Gum / Broadleaf Peppermint Dry Woodland. Native species increased from **21 to 30**. Non-native species increased from **10 to 22**.

Noxious species: *Hypericum perforatum* and *Rosa rubiginosa* at low densities.

Recommendation: Eliminated noxious species and undertake detailed management of exotic weeds e.g. broad-leaf weeds.

Plate 16: Monitoring Plot 02 – left autumn 2014, right spring 2014.

4.4.5 Monitoring Plot 03

Jurisdiction	NSW
Native sp. cumulative cover %	**5-25+** (5-25+)
No. Native sp. with cover score of 1	**10** (9)
No. Native sp. with cover score of 2 or more	**0** (1)
Non-native cover %	**25-50+** (25-50)
Bare Ground %	**<1** (<1)
Mulch Cover %	0
KPT	Low diversity native vegetation
Was KPT met	**No**

Monitoring plot 03 is situated 3320 m east of the LLPS in NSW (McDonald) within low diversity pasture at the interface between Brittle Gum / Broadleaf Peppermint Woodland and Box Gum Grassy Woodland. Native species remained on **16**. Non-native species increased from **15 to 21.**

Increased cover of *Hypochaeris radicata* and *Trifolium spp.*

Noxious species: *Carthamus lanatus* was recorded at low density.

Note: the northern half of this plot was pulse grazed in April 2014 (Autumn).

Recommendation: Eliminated noxious species, maintain pulse grazing and undertake detailed management of exotic weeds e.g. broad-leaf weeds.

Plate 17: Monitoring Plot 03 - left autumn 2014, right spring 2014.

4.4.6 Monitoring Plot 05

Jurisdiction	NSW
Native sp. cumulative cover %	**25-50-** (25-50)
No. Native sp. with cover score of 1	**14** (14)
No. Native sp. with cover score of 2 or more	**0** (0)
Non-native cover %	**50-75** (25-50)
Bare Ground %	**<1** (<5)
Mulch Cover %	Persists
KPT	Low diversity native vegetation
Was KPT met	**No, but in mid range**

Monitoring plot 05 is situated 4300 m east of the LLPS in NSW (McDonald) within former low diversity Box Gum Grassy Woodland. Native species declined **30 to 27.**. Non-native species increased from **16 to 24**.

Significant increase in *Bromus* spp., and to a lesser extent *Trifolium* spp.

Noxious species: R*osa rubiginosa* at low density.

Note: partially grazed in early April 2014 (Autumn).

Recommendation: Eliminate noxious species, continue and expand pulse grazing.

Plate 18: Monitoring Plot 05 - left autumn 2014, right spring 2014.

4.4.7 Monitoring Plot 06

Jurisdiction	NSW
Native sp. cumulative cover %	**5-25+** (25-50)
No. Native sp. with cover score of 1	**7** (9)
No. Native sp. with cover score of 2 or more	**1** (2)
Non-native cover %	**25-50**+ (25-50)
Bare Ground %	**<5** (<5)
Mulch Cover %	<5
KPT	Low diversity native vegetation
Was KPT met	**No, but in mid range**

Monitoring plot 06 is situated 4900 m east of the LLPS in NSW (Lonergan) within former low diversity Box Gum Grassy Woodland. Native species decreased from **20 to 15**. Non-native species declined **20 to 18.**

Increase in *Bromus* spp. and *Hypochaeris radicata*.

Noxious species: *Carthamus lanatus* at moderate densities.

Recommendation: Eliminate noxious species, undertake detailed management of exotic weeds e.g. broad-leaf weeds and reduce biomass preferably through grazing.

Plate 19: Monitoring Plot 06 - left autumn 2014, right spring 2014.

4.4.8 Monitoring Plot 10

Jurisdiction	NSW
Native sp. cumulative cover %	**25-50-** (25-50)
No. Native sp. with cover score of 1	**7** (10)
No. Native sp. with cover score of 2 or more	**2** (2)
Non-native cumulative cover %	**25-50+** (5-25)
Bare Ground %	**<5** (<5)
Mulch Cover %	<1 (<5)
KPT	Low diversity native vegetation (mixed pasture)
Was KPT met	**No, but in mid range**

Monitoring plot 10 is situated 6030 m east of the LLPS in NSW (Codd/Howarth) within former low diversity mixed pasture. Native species declined from **22 to 19.** Non-native species declined from **22 to 18.**

Increase in *Bromus spp.*, *Hypochaeris radicata*, *Phalaris aquatica* and *Plantago lanceolata*.

Noxious species: *Echium plantagineum* and *Hypericum perforatum* at low densities.

Recommendation: Eliminate noxious species and undertake detailed management of exotic weeds e.g. broad-leaf weeds.

Plate 20: Monitoring Plot 10 - left autumn 2014, right spring 2014.

4.5 Plots in non-native vegetation (KPT category 1)

Six plots (07[4], 08, 11, 12, 13 and 14) were established in areas of former non-native or low diversity mixed pasture – KPT category 1 (see **Table 1**). All plots associated with this category occurred in NSW sections of the construction corridor (**Figures 2** and **3 in Appendix 1**). Summaries of category 1 results are provided in **Table 7**, below, with additional descriptions of each plot presented in the succeeding sub-sections.

Plots 13 (Borgia), 14 (Johnston) and Plot 08 (Lonergan) met the required KPT and have been returned to property owners. Plot 07 (Lonergan) has also met the KPT and associated paddocks will be returned to the property owner.

Species diversity

Native species diversity ranged from 11 to 16 species at an average of 13.3 sp./plot – a decrease of 0.7 species from the previous autumn sampling period. Non-native species diversity ranged from 25 to 29 at an average of 26.7 sp./plot – an increase of 5.0 sp./plot over the same period.

Individual species cover abundance scores

The highest cover abundance score for an individual native herbaceous species was 1 (<5% & >15 individuals) obtained by eleven species.

The highest cover abundance score for non-native herbaceous species was 4 (50-75% cover) obtained by *Bromus* sp. in Plot 07 followed by two species with cover scores of 3 (25-50%): *Dactylis glomerata* (Plot 12) and *Plantago lanceolata* (Plot 11), and eight species with cover scores of 2 (5-25%). Non-native species with cover scores of 1 (<5%) ranged from 8 to 12 sp./plot.

Cumulative cover abundance scores

All cumulative native species cover scores were at or below the 5-25% cover range (**Table 7**).

Consistent with previous results plots in category 1 had the highest non-native species combined cover score. Plot 07 and 11 had combined native/non-native cover that exceed >75% and met the required KPT. Plot 12 had a non-native species cover score 50-75% and native species cover of <5%, which places it near the required KPT (**Table 7**).

[4] Formerly in vegetation category 2. The addition of plot 07 into this category has resulted in an increased species count and average per plot.

Table 7: Summary of category 1 plot results for spring 2014. Table gives species richness per plot and changes from the previous autumn 2014 survey; native species cover scores (1 = <5%, 2 = 5-25%), 3 = 25-50%) and 4 = 50-75%); and cumulative cover abundance estimates for native and exotic species. Parenthesis ( ) enclose results from autumn 2014. Red text identifies an increase and blue a decrease.

Plot No.	Chainage	Location	Native sp.	Exotic sp	Total sp.	Change native sp.*	Change exotic sp.*	Exotic sp. cover score of 1	Exotic sp. cover score of 2	Exotic sp. with cover score of 3 or >	% native sp. cover	% exotic sp. cover
07 [A]	5200	NSW-Lonergan	**16**	**26**	**42**	**0** (0)	**-2** (-3)	**12** (8)	**1** (1)	**1**[B] (1)	**5-25**	**50-75+**
08	5680	NSW-Lonergan	-	-	-	-	-	-	-	-	**-**	**-**
11	6450	NSW-Johanson	**13**	**25**	**38**	**-3** (-1)	**10** (0)	**8** (4)	**6** (2)	**1** (1)	**5-25-**	**50-75+**
12	8300	NSW-Bos	**11**	**29**	**40**	**-1** (3)	**-3** (1)	**8** (8)	**2** (2)	**1** (1)	**<5**	**50-75**
14	9850	NSW-Johnston	-	-	-	-	-	-	-		-	-
13	10950	NSW-Borgia	-	-	-	-	-	-	-		-	-
Av. spring 2014			**13.3**	**26.7**	**40.0**							
Av. autumn 2014			**14.7**	**21.7**	**36.3**							
Av. spring 2013			**8.7**	**16**	**24.7**							
Av. autumn 2013			**7.3**	**14**	**21.3**							
Av. spring 2012			**6.8**	**21.4**	**28.2**							

* Represents change in native and non-native species diversity between the autumn 2014 and spring 2014 monitoring period.

[A] Paddock sown with native / non-native seed mix.

[B] Includes one species with a cover score of 4 (50-75%)

4.5.1 Monitoring Plot 07

Jurisdiction	NSW
Exotic cumulative cover %	**50-75+** (50-75)
No. Exotic sp. with cover score of 1	**12** (8)
No. Exotic sp. with cover score of 2 or more	**2** (2)
Native sp. cumulative cover %	**5-25** (5-25)
Bare Ground %	**<5** (<5)
Mulch Cover %	0
KPT	Low diversity mixed vegetation
Was KPT met	**Yes**

Monitoring plot 07 is situated 5200 m east of the LLPS in NSW (Lonergan) within former low diversity native pasture. Native species remained at **16**. Non-native species increased from **24 to 26**.

Significant increase in Bromus spp.

Noxious species: *Carthamus lanatus* at moderate density.

Plot 07 met the required KPT during the autumn 2014 and spring 2014 sample periods and is no longer be monitored.

Plate 21: Monitoring Plot 07 - left autumn 2014, right spring 2014.

4.5.2 Monitoring Plot 08

Jurisdiction	NSW
Exotic sp. cumulative cover %	**>75** (>75)
No. Exotic sp. with cover score of 1	**4** (3)
No. Exotic sp. with cover score of 2 or more	**3** (4)
Native cumulative cover %	**<5** (0)
Bare Ground	**<1** (<1)
Mulch Cover	-
KPT	Non-native vegetation
Was KPT met	**Yes**

Monitoring plot 08 is situated 5680 m east of the LLPS in NSW (Lonergan) within former low diversity native pasture, though has been relegated to category 1 vegetation (non-native pasture).

No noxious species were recorded

Plot 8 met the required KPT during the spring 2013 sample period and is no longer monitored.

Plate 22: Monitoring Plot 08 - left spring 2013

4.5.3 Monitoring Plot 11

Jurisdiction	NSW
Exotic sp. cumulative cover %	**50-75+** (50-75)
No. Exotic sp. with cover score of 1	**6** (6)
No. Exotic sp. with cover score of 2 or more	**7*** (3)
Native sp. cumulative cover	**5-25-** (5-25)
Bare Ground	**<5** (<5)
Mulch Cover	**0** (<1)
KPT	Non-native vegetation
Was KPT met	**Yes**

Monitoring plot 11 is situated 6450 m east of the LLPS in NSW (Johanson) within former low diversity mixed pasture.

Native species declined from **16 to 13**. Non-native species increased from **15 to 25.**

***Non-native species with cover scores in the 5-25% range increased from 2 sp. to 6 sp., with one additional species in the 25-50% cover range.**

Noxious species: *Echium plantagineum* at low density.

Plot 11 met the required KPT during the current spring 2014 sample period and will no longer be monitored.

Plate 23: Monitoring Plot 11 - left autumn 2014, right spring 2014.

4.5.4 Monitoring Plot 12

Jurisdiction	NSW
Exotic sp. cumulative cover %	**50-75** (50-75+)
No. Exotic sp. with cover score of 1	**8** (8)
No. Exotic sp. with cover score of 2 or more	**2*** (2)
Native cover %	**<5** (5-25)
Bare Ground %	**~5** (5-10)
Mulch Cover %	0
KPT	Non-native vegetation
Was KPT met	**Near**

Monitoring plot 12 is situated 8300 m east of the LLPS in NSW (Bos) within former low diversity mixed pasture.

Native species declined from **12 to 11.** Non-native species increased from **26 to 29.**

Noxious species: *Echium plantagineum*, *Echium vulgare* and *Hypericum perforatum* at low densities and *Eragrostis curvula* at low to moderate density.

Recommendation: Eliminate noxious species.

Plate 24: Monitoring Plot 12 - left autumn 2014, right spring 2014

4.5.5 Monitoring Plot 14

Jurisdiction	NSW
Native sp. cumulative cover	<1%
No. Exotic sp. with cover score of 1	0
No. Exotic sp. with cover score of 2 or more	0
Non-native cover	>75%
Bare Ground	<1%
Mulch Cover	Persists
KPT	Non-native vegetation
Was KPT met	**Yes**

Monitoring plot 14 is located 9850 m east of the LLPS in NSW (Borgia).

The plot is situated within former non-native pasture.

Plot 14 met the required KPT during the spring 2012 sample period and is no longer monitored.

Plate 25: Monitoring Plot 14 - spring 2012.

4.5.6 Monitoring Plot 13

Jurisdiction	NSW
Native sp. cumulative cover	<5%
No. Exotic sp. with cover score of 1	0
No. Exotic sp. with cover score of 2 or more	0
Non-native cover	>75%
Bare Ground	<5%
Mulch Cover	Persists
KPT	Non-native vegetation
Was KPT met	**Yes**

Monitoring plot 13 is located 10950 m east of the LLPS in NSW (Johnston).

The plot is situated within former non-native pasture.

Plot 13 met the required KPT during the spring 2012 sample period and is no longer monitored.

Plate 26: Monitoring Plot 13 – spring 2012.

4.6 Rare and threatened plants

No new observations were recorded during the spring 2014 survey period.

4.7 Rare and threatened animals

Both *Lalage sueurii* (White-winged Triller) and *Stagonopleura guttata* (Diamond Firetail) were recorded during the surveys in the eastern section of the McDonald property on 29 October 2014, which are listed as Vulnerable in the ACT and NSW, respectively.

A single *Keyacris scurra* (Keys Matchstick Grasshopper) was observed at Control Site 2 (Plate 27) on 29 October 2014. Six individuals were observed at the same location on 16 April 2014. Key's Matchstick Grasshopper is considered to be an uncommon species in the ACT and is usually confined to good quality grassland and grassy woodland communities dominated by *Themeda australis* and include Asteraceae species such as *Chrysocephalum apiculatum* (Common Everlasting) and *Calocephalus citreus* (Lemon Beauty-heads).

Plate 27: Keys Matchstick Grasshopper *Keyacris scurra* recorded near Control Site 2.

4.8 Other observations

Two plant species not previously recorded in the construction corridor were identified during the current monitoring period: *Caladenia fuscata* (Plot 07) and *Linum marginale* (Plot 10).

There was a significant increase in annual pasture grasses (mainly *Brome* spp.) and clover *Trifolium* spp.

4.9 Noxious weeds

Nine species of noxious plant have been recorded within or adjacent to sample plots (**Table 8**), of these seven were re-recorded during the current survey: they are: *Carthamus lanatus* (Saffron Thistle), *Echium plantagineum* (Paterson's Curse), *Echium vulgare* (Viper's Bugloss), *Eragrostis*

curvula (African Love Grass), *Hypericum perforatum* (St. John's Wort), *Nassella trichotoma* (Serrated Tussock) and *Rosa rubiginosa* (Briar Rose). Species not re-recorded within sample plots were *Marrubium vulgare* (Horehound) and *Rubus* sp (Blackberry), although they may occur elsewhere within the construction corridor.

Table 8: Noxious weeds recorded within the construction corridor.

Noxious Species	Declared in NSW	Declared in ACT	WONS	Plot / Location	Estimated density.
Carthamus lanatus (Saffron Thistle)	Yes	Yes		01	<4 individuals ^
				03	4-15 individuals ^
				06	+15 individuals ^
				07	+15 individuals^
				18	Not re-recorded
				19	4-15 individuals ^
				20	<4 individuals
Echium plantagineum (Paterson's Curse)	Yes	Yes		10	<4 individuals ˅
				11	4-15 individuals
				12	4-15 individuals
Echium vulgare (Viper's Bugloss)	Yes	Yes		12	<4 individuals
				15	+15 individuals
				16	<4 individuals
				19	Not re-recorded
				20	Not re-recorded
				21	+15 individuals
				23	Not re-recorded
				24	Not re-recorded
				25	Not re-recorded
Eragrostis curvula (African Love Grass)	Yes	Yes		01*	4-15 individuals
				02*	Not re-recorded
				06*	Not re-recorded
				12	+15 individuals
				17	4-15 individuals
				18	Not re-recorded
				19	<4 individuals^
				22	Not re-recorded
				24	<4 individuals^
				25*	4-15 individuals and 5-25% cover ^
				Either side of Angle Crossing Rd. near cattle grid	50+ individuals
				Nth of construction corridor b/w Monaro Hwy and Railway corridor	+1000 of individuals
				S. of Plot 24	+400 individual plants
Hypericum perforatum (St. John's Wort)	Yes	Yes		01	4-15 individuals
				02	<4 individuals
				10	<4 individuals

Noxious Species	Declared in NSW	Declared in ACT	WONS	Plot / Location	Estimated density.
				12	<4 individuals ^
				15	4-15 individuals V
				16	4-15 individuals V
				17	<4 individuals
				18	4-15 individuals
				19	4-15 individuals V
				20	4-15 individuals
				21	+15 individuals V
				22	4-15 individuals
				23	4-15 individuals V
				24	4-15 individuals ^
				25*	>15 individuals
Marrubium vulgare (Horehound)	Yes	No		06	Not re-recorded
				E. of Plot 07	Not re-recorded
Nassella trichotoma (Serrated Tussock)	Yes	Yes	Yes	04	4 -15 individuals
Rosa rubiginosa (Briar Rose)	Yes	Yes		01	4 -15 individuals
				02	<4 individuals
				05	4-15 individuals
				18	Not re-recorded
				22	<4 individuals
				23	Not re-recorded
Rubus sp. (Blackberry)	Yes	Yes	Yes	18	Not re-recorded

^ = increasing; V = decreasing
* = recorded in low numbers within adjacent parts of the construction corridor.
WONS = Weed of National Significance, see
<http://www.environment.gov.au/biodiversity/invasive/weeds/weeds/lists/wons.html>

5 Management issues

5.1 Weeds

It is assumed that weed control measures have been implemented (in accordance with the Weed Management Sub-plan) in problem areas previously identified. While some infestations appear to have been contained or even eradicated others persist (**Table 8**).

A variety of relatively small exotic herbs recorded within the construction corridor have minor limiting effects on the germination and survival of native herbaceous species and therefore do not require any specific management action. Species in this group include annual grasses such as *Vulpia* sp., *Aira* sp., *Briza* spp. and *Bromus* spp., and small annual herbs such as *Linaria* spp., *Centaurium* sp., *Erodium botrys*, *Juncus bufonius*, *Spergularia rubra*, *Trifolium arvense*, *T. anguistifolium* and *Galium divaricatum*.

In contrast, exotic perennial pasture grasses, perennial clovers and broad-leaf weeds are imposing significant limitations on the recruitment and vigour of native herbaceous groundcovers in some sections of the construction corridor. Species of greatest concern are perennial grasses such as *Dactylis glomerata*, *Phalaris aquatica*, *Lolium perenne and Bromus catharticus* (initial perennial forms are replaced by annual or short-lived perennial forms), perennial clovers such as *Trifolium repens* and broad-leaf weeds including *Conyza* sp., *Echium* spp., *Hypochaeris radicata*, *Verbena bonariensis, Hirschfeldia incana, Plantago lanceolata, Cirsium vulgare* and *Acetosella vulgaris*.

The following measures are recommended in addition to works required under the weed management sub-plan:

- Continue chemical weed control though care should be taken to minimise the impact on non-target species. In situations where infestations of broad-leaf weeds is confined to a small area or where they occur in low densities plants should be extracted by hand (grubbing or hoeing may also be acceptable) bagged and disposed of appropriately.
- Engage with ACT Government Territory and Municipal Services to reduce significant *Eragrostis curvula* infestations within the Monaro Hwy and Goulburn-Cooma railway corridors.

5.2 Biomass and weed control

Pulse grazing (sheep) was undertaken in sections of construction corridor associated with the McDonald property in early autumn 2014 and has reduced total foliage cover of broad-leaf weeds (mainly *Conyza* sp.). Pulse grazing should be repeated within the central section of the construction corridor in late summer/autumn 2015 and again in late winter 2015. Site inspections should be conducted prior to these periods to determine if broad-leaf weeds or other undesirable species have emerged in order to make better use of short-term grazing.

The following extract is from the spring 2013 plot monitoring report and relates to the application of carbohydrate (sugar) to inhibit weed development.

> *"The availability and use of stock in the ACT sections of the corridor is unknown. A possible alternative approach is the application of carbohydrate (i.e. granulated sugar) to suppress soil nutrients, such as nitrate, to inhibit broad-leaf weed and exotic annual grass development (Prober & Lunt 2009: Prober et al 2005). While this method does not directly promote the growth of native grasses and forbs it has been observed to discourage annual weeds thereby*

reducing competitive pressures on native herbaceous species. It is suggested that this method could be implemented as a trial at relatively low cost. Previous trials (Prober & Lunt 2009: Prober et al 2005) using combinations of grazing/burning and application of sugar have yielded encouraging results."

While there are no guarantees of success such a trial could be undertaken at minimal cost and be conducted within two or three of sample plots situated in the ACT that are under performing due to the competitive pressure of exotic grasses and annual weeds. If successful it could be applied more widely in other ACT sections of the construction corridor. Alternative options include the removal of existing poor quality top-soils and their replacement with an appropriate top-soil mix, site preparation, re-seeding and re-planting.

5.3 Poor quality top-soil

Refer to comments in the spring 2013 plot monitoring report.

5.4 Bare ground

Refer to comments in the spring 2013 plot monitoring report.

5.5 KPTs and category 2 plots

Key Performance Targets (KPT) for category 2 and 3 vegetation require *"70% cover of the native species sown……and < 20% cover of exotic species not sown"*. Recent monitoring results suggest that in some situations this target will be difficult, if not impossible, to reach. For example, the section of corridor associated with Plot 06 (category 2) was seeded with perennial native grasses (i.e. *Rytidosperma carphoides*, *Austrostipa scabra*, *Microlaena stipoides*) however exotic pasture species including *Phalaris aquatica, Avena sp., Bromus sp., Lolium sp., Trifolium spp.* and broad-leaf weeds such as *Hypochaeris radicata* are now dominant. Similar effects were also observed in Plots 05, 18 and 20. The competitive pressure from this faster growing non-native cohort has inhibited the development of native herbaceous species such that the current KPT of 70% will be difficult to meet..

It is suggested that the KPTs be reviewed.

6 Recommendations

The following recommendations are proposed.

1. Continue chemical weed control though care should be taken to minimise the impact on non-target species (see Section 5.1).
2. Pulse' grazing should be repeated in the central section of the construction corridor during late summer/autumn and again in late winter with consideration given to adopting a similar approach in other sections of the corridor which would benefit from biomass reduction and broad-leaf weed control (see Section 5.2).
3. Re-seed areas associated with native vegetation that have consistently achieved low native cover abundance scores (i.e. less than 25% cover).
4. Revision of the Key Performance Targets (KPTs) to reflect expectations and current industry standards.

5. Consider undertaking a trial application of carbohydrate (sugar) in the ACT sections of the construction corridor where native germination and propagation has been particularly poor and non-native pasture grasses and broad-leaf weeds are well established and dominant.

7 Conclusion

Key performance target (KPT) was met in Plot 07 (Lonergan) and Plot 11 (Johanson) and paddocks associated with these plots should be returned to their respective owners. This brings the total number of plots that have met the required KPT to five, however, all are associated with non-native vegetation (category 1).

Plot 12 (also category 1) and Plot 17 (category 3) achieved relevant target species cover scores in the 50-75% range and are near the required KPT.

Although no plot associated with native vegetation (categories 2 and 3) has yet met the required KPT, seven plots (04, 05, 09, 10, 16, 18 and 20) achieved total native species cover scores in the 25-50% range and Plot 17, as mentioned above, is near target. While the results show a slight increase in total native cover in areas of former native vegetation this was offset by a rise in exotic cover, primarily annual pasture grasses, broad-leaf weeds and clovers, which are inhibiting the recruitment of native groundcover species.

A number of recommendations were presented in previous reports (i.e. spring 2013) regarding the control broad-leaf weeds and exotic pasture grasses, particularly in the central and western sections of the construction corridor. As a result pulse grazing was undertaken successfully in the central sections in late March/early April 2014 and it is recommended that a similar approach be repeated during late summer/autumn 2015 and again in late winter 2015 to control biomass and reduce the competitive pressure from a variety of exotic annual and perennial species.

References

Biosis Research (June 2009). *Murrumbidgee River to Googong Dam Water Transfer Pipeline: Terrestrial Flora & Fauna Impact Assessment*. Biosis Research Pty Ltd, Queanbeyan NSW.

Eco Logical Australia (November 2010). *Murrumbidgee to Googong Pipeline: Pre-clearance Surveys.* Prepared for Bulk Water Alliance Joint Venture.

Eco Logical Australia (March 2011). *M2G Rapid Vegetation Assessment of the Hard Rock Re-alignment Route*. Prepared for Bulk Water Alliance Joint Venture.

Eco Logical Australia & Blue Gum Ecological Consulting (August 2013). *M2G Seeding (Plot) Monitoring Report. Construction Corridor (Autumn 2013)*. Prepared for ACTEW Water.

Landscape Rehabilitation and Terrestrial Ecology Management Plan (2014). ACTEW Corporation, Canberra.

M2G Work as Executed (WAE) Landscape Drawings.

Appendix 1: Maps

Figures 1 – 4 below display the locations of the plot monitoring sites within the M2G construction corridor:

- **Figure 1**: Western section
- **Figure 2**: Central-western section
- **Figure 3**: Central-eastern section
- **Figure 4**: Eastern section

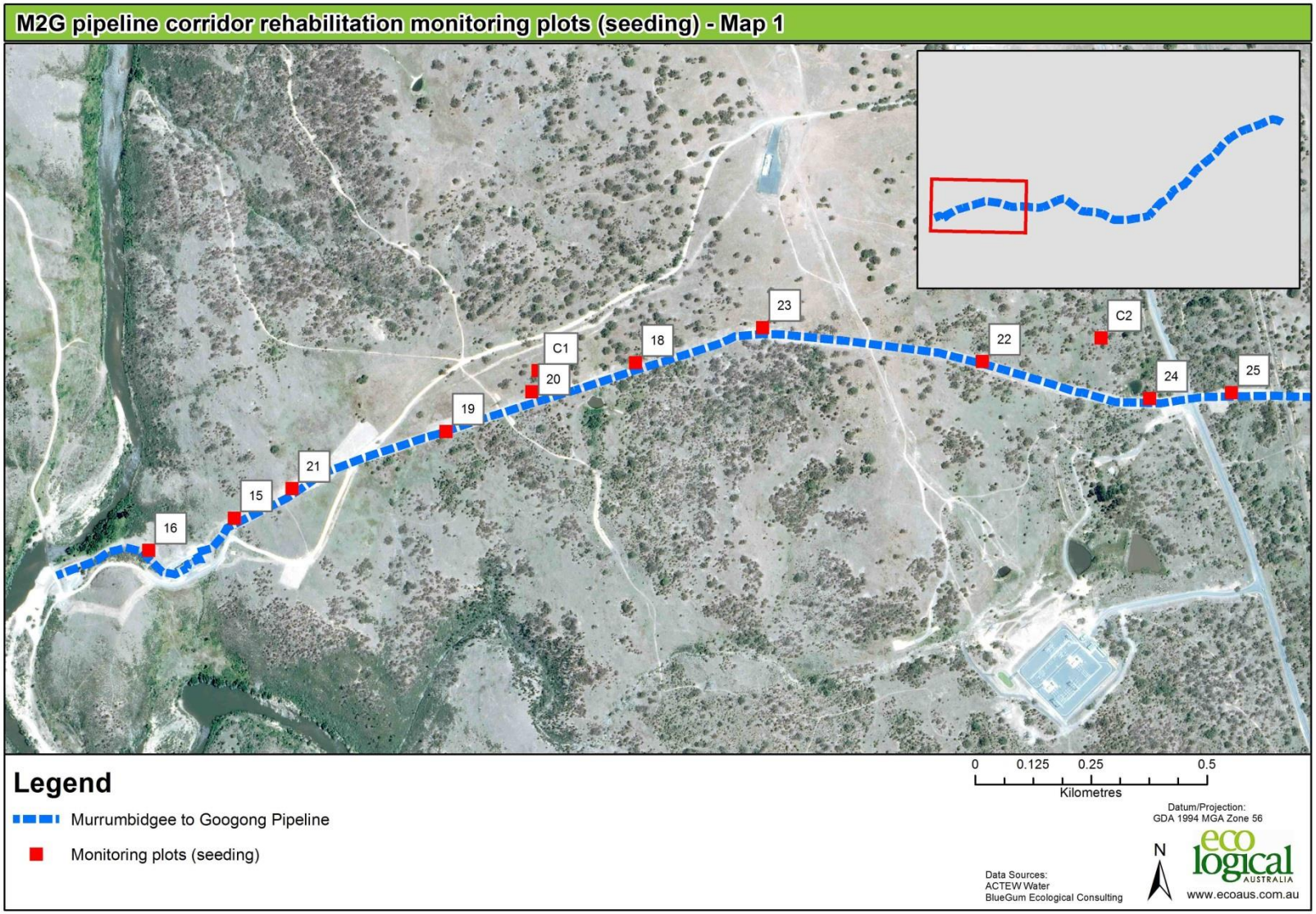


Figure 1: Monitoring sites within the western section of the M2G construction corridor

Figure 2: Monitoring sites within the central-western section of the M2G construction corridor

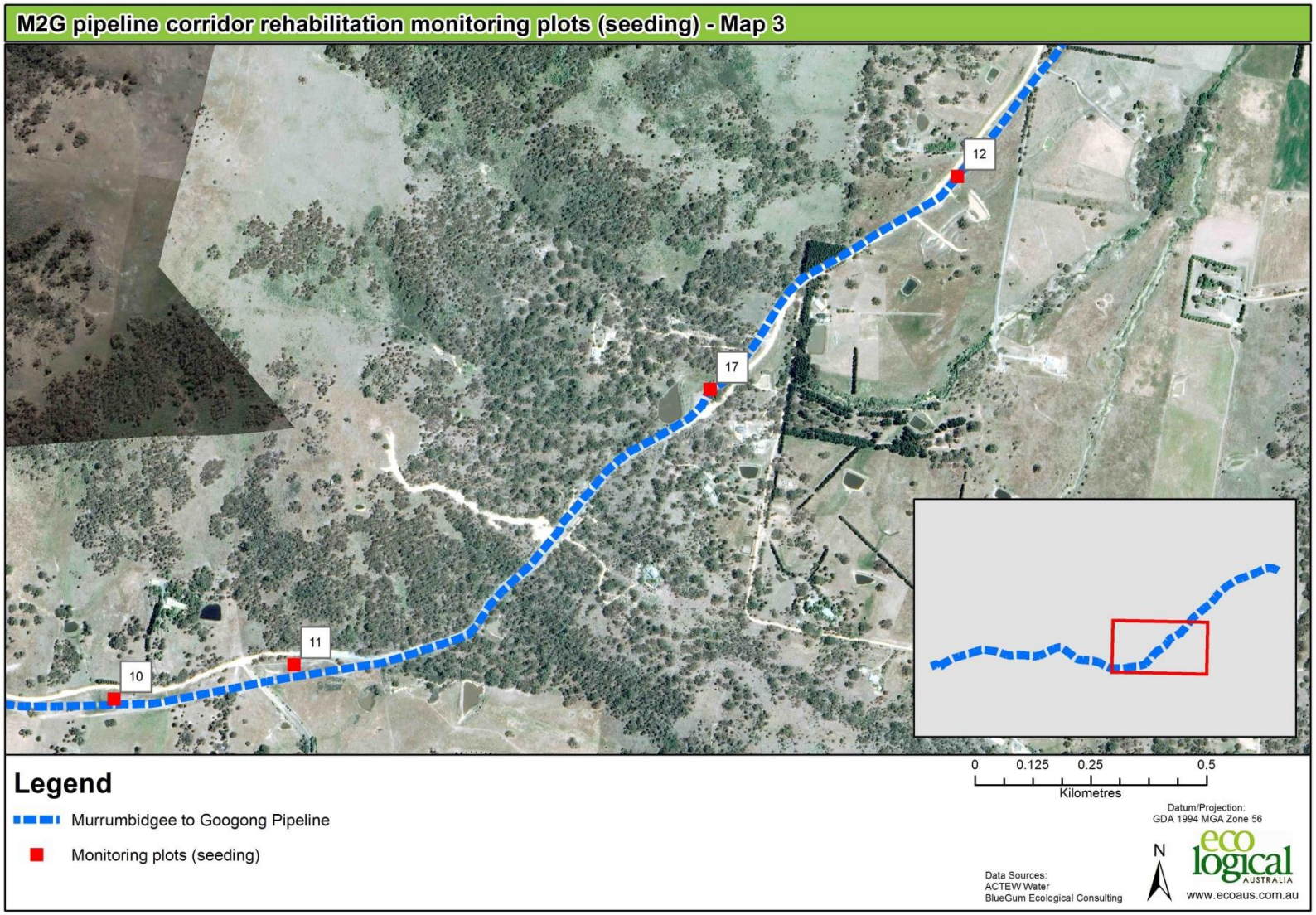


Figure 3: Monitoring sites within the central-eastern section of the M2G construction corridor

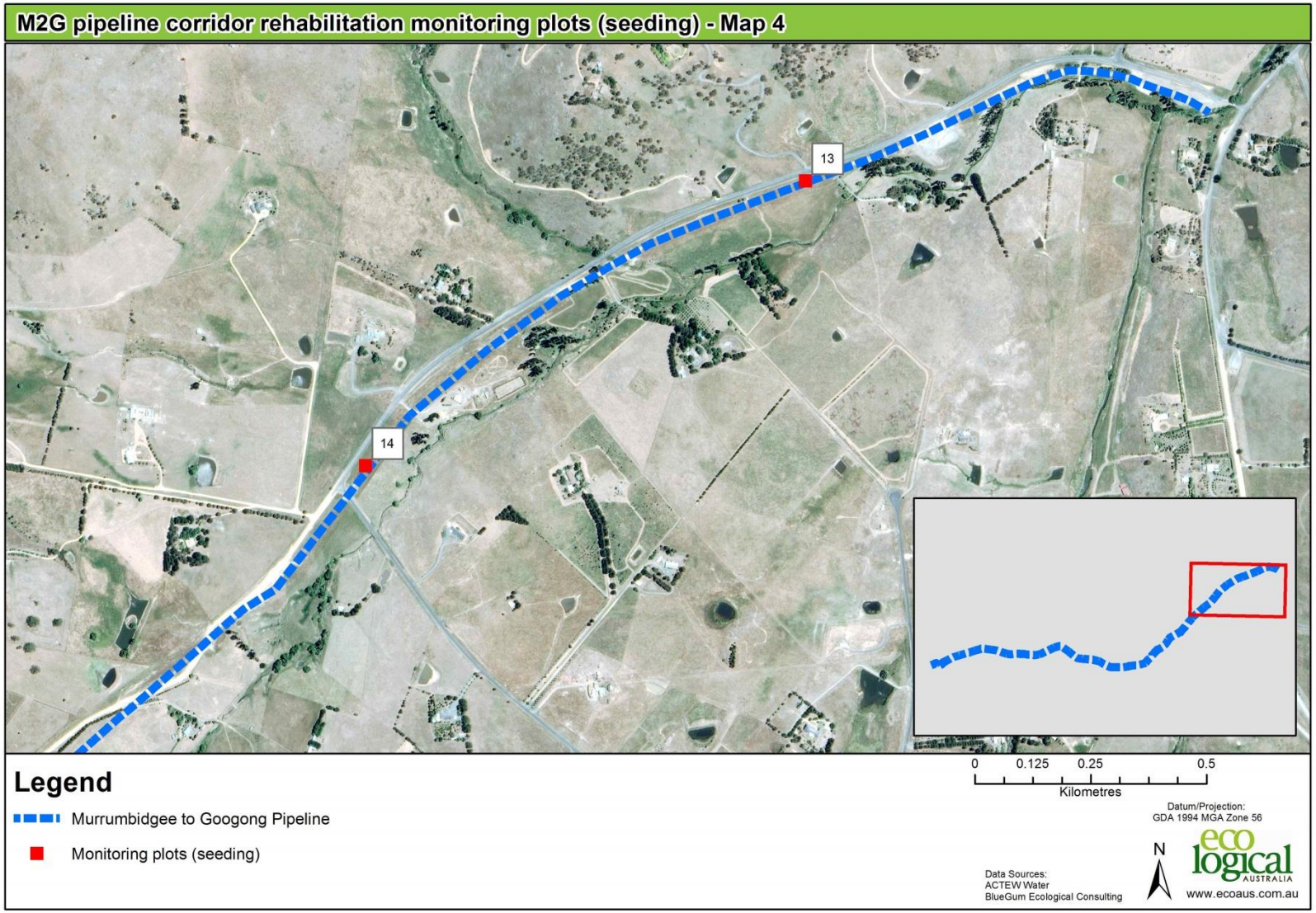


Figure 4: Monitoring sites within the eastern section of the M2G construction corridor

Appendix 2: Plot floristic data

Plot data for the M2G plot (seeding) monitoring study for spring 2014. Data sets for control plots and monitoring plots are provide in Table 7 and Table 8, respectively.

The tables give estimated species cover abundance according to the modified Braun-Blanquet scale below. Species are listed alphabetically and have been separated into native and non-native groups.

Recruiting eucalypt and other woody shrubs are included in the species lists below, but were not considered in the analysis of cover abundance or species tallies.

Modified Braun-Blanquet cover abundance scores

- r = < 5% cover and solitary (< 4 individuals)
- + = < 5% cover and few (4-15 individuals)
- 1 = < 5% cover and numerous/scattered (>15 individuals)
- 2 = 5% – 25% cover
- 3 = 25% – 50% cover
- 4 = 50% – 75% cover
- 5 = > 75% cover

Table 9: Control plot results.

Floristic data collected were collected from two control plots during October 2014. Control plots were placed within moderate to high diversity BGGW situated outside the M2G construction corridor.

According to Rehwinkel (2007) indicator species are referred to as 'grazing intolerant' or 'declining' species. An indicator species score of '1' identifies a site as having conservation value and indicator species score of '2' are highly significant and are given the highest value. The more of these species present at a site the greater its conservation value. *Themeda australis* is treated as a level 2 indicator species when dominant, as is the case at Control Site 2.

Species	Sp. cover score	Sp. with cover score of 1	Sp. with cover score of 2	Sp. with cover score of 3	Sp. with cover score of 4	Indicator score
CONTROL PLOT 1						
Exotic						
*Acetosella vulgaris**	r					
*Aira sp.**	1	1				
*Eragrostis curvula**	+					
*Gamochaeta sp.**	+					
*Hordeum sp.**	+					
*Hypericum perforatum**	+					
*Hypochaeris radicata**	1	1				
*Linaria arvensis**	1	1				
*Lolium perenne**	r					
*Paronychia brasiliana**	1	1				
*Petrorhagia nanteuilii**	+					
*Rosa rubiginosa**	r					
*Rubus fruticosus**	r					
*Vulpia sp.**	1	1	1			
*Trifolium sub**	2					
*Trifolium sp.**	1	1				
*Trifolium arvense**	2		1			
Total exotic species	**17**	**6**	**2**			
Cumulative cover	**2 (5-25%)**					

Species	Sp. cover score	Sp. with cover score of 1	Sp. with cover score of 2	Sp. with cover score of 3	Sp. with cover score of 4	Indicator score
Native						
Aristida ramosa	+					
Asperula conferta	1	1				2
Rytidosperma sp.	3			1		
Austrostipa bigeniculata	1	1				
Austrostipa scabra	1	1				
Bossiaea prostrata	r					2
Bothriochloa macra	1		1			
Chrysocephalum apiculatum	2			1		1
Convolvulus anguistissmus	+					
Crassula sieberana	1	1				
Daucus glochidiatus	+					
Desmodium varians	r					2
Einadia nutans	+					
Elymus scaber	1	1				
Eryngium ovinum	+					2
Eucalyptus bridgesiana	3			1		
Geranium solanderi	+					
Glycine clandestine	r					2
Gonocarpus tetragynus	+					1
Hydrocotyle laxiflora	1	1				2
Isoetopsis graminifolia	1	1				2
Lomandra filliformis	+					1
Luzula densiflora	r					2
Microlaena stipoides	r					
Oreomyrrhis eriopoda	+					2
Oxalis perennans	+					
Panicum effusum	+					

Species	Sp. cover score	Sp. with cover score of 1	Sp. with cover score of 2	Sp. with cover score of 3	Sp. with cover score of 4	Indicator score
Plantago varia	1	1				2
Poa sieberiana	1	1				
Poa meionectes	+					
Rumex brownii	+					
Scleranthus diander	1	1				2
Swainsona sericea	1	1				2
Themeda triandra	1	1				
Triptilodiscus pygmeaus	1	1				2
Vittadinia mulleri	+					
Wahlenbergia sp.	+					
Wurmbea dioica	1	1				2
Total native species	**37**	**14**	**2**	**2**	**0**	**17**
Cumulative cover	**5 (>75%)**					
CONTROL PLOT 2						
Exotic						
*Aira sp.**	1	1				
*Briza minor**	1	1				
*Centaurium sp.**	r					
*Gamochaeta purpurea**	r					
*Hypericum perforatum**	r					
*Hypochaeris radicata**	1	1				
*Linaria pelisserana**	1	1				
*Petrorhagia nanteuilii**	1	1				
*Rosa rubiginosa**	r					
*Tolpis umbellata**	r					
*Trifolium anguistifolia**	1	1				
*Trifolium arvense**	1	1				
*Trifolium campestre**	1	1				

Species	Sp. cover score	Sp. with cover score of 1	Sp. with cover score of 2	Sp. with cover score of 3	Sp. with cover score of 4	Indicator score
*Trifolium sp.**	1	1				
*Vulpia sp.**	1	1				
Total exotic species	**15**	**10**				
Cumulative cover	**2 (5-25%)-**					
Native						
Acaena ovina	+					
Arthropodium milleflorum	1	1				2
Asperula conferta	r					2
Rytidosperma sp.	1	1	1			
Austrostipa scabra	+					
Bulbine bulbosa	1	1				2
Cheilanthes sieberi	+					2
Chrysocephalum apiculatum	1	1				1
Crassula sieberana	+					
Cymbonotus lawsonianus	r					
Daucus glochidiatus	1	1				
Desmodium varians	+					2
Dianella sp.?	r					2
Eryngium ovinum	+					2
Eucalyptus blakelyi	+					
Eucalyptus melliodora	2		1			
Eucalyptus bridgesiana	r					
Euchiton sp.	+					
Galium gaudichaudii	+					2
Geranium solanderi	+					
Gonocarpus tetragynus	1	1				1
Haloragis heterophylla	+					1
Hydrocotyle laxiflora	1	1				2

Species	Sp. cover score	Sp. with cover score of 1	Sp. with cover score of 2	Sp. with cover score of 3	Sp. with cover score of 4	Indicator score
Hypericum gramineum	r					2
Kunzea ericoides	+					
Leptorhynchos squamatus	1	1				2
Lomandra filliformis	+					1
Luzula densiflora	1	1				2
Microseris lanceolata	1	1				2
Poa ? meionectes	1	1				
Sobaea ovata	1	1				2
Stackhousia monogyna	1	1				2
Themeda australis	4				1	2
Triptilodiscus pygmeaus	1	1				2
Wahl'bergia sp.	1	1				
Wurmbea dioica	1	1				2
Total native species	**33**	**13**	**1**	**0**	**1**	**22**
Cumulative cover	**5 (>75%)**					

Note: *Eucalypt* species not included in tallies.

Table 10: Floristic data – monitoring plots Spring 2014.

Species	Plot 1	Plot 2	Plot 3	Plot 4	Plot 5	Plot 6	Plot 7	Plot 8	Plot 9	Plot 10	Plot 11	Plot 12	Plot 13	Plot 14	Plot 15	Plot 16	Plot 17	Plot 18	Plot 19	Plot 20	Plot 21	Plot 22	Plot 23	Plot 24	Plot 25	No. of plots in which sp. occurs
NATIVE SPECIES																										
Acacia decurrens		r																								**1**
Acaena ovina																r	+	+		+		r			r	**6**
Alternanthera sp.																						r				**1**
Aristida ? ramosa											r									+						**2**
Asperula conferta					1											r	1						+			**4**
Austrodanthonia sp.	1	1	1	1	1	1	+		1	2	1	+			1	2-	1	1	2-	1	1	1	2+	1	2	**22**
Austrostipa bigeniculata	+	+	1	1		1	1		1		1	+			r		+	1		+	+	+	+	+		**17**
Austrostipa scabra	1	1	1	1	1	1	1		1	1	+	r			1	1	1	1	1	1	1	1	1	1	1	**22**
Bothriochloa macra	1	1	1	2-	1	1	1		2+	1		r			1	2-	2-		1	1	1	1	r	1	1	**20**
Brachyloma daphnoides																r				r						**2**
Bulbine bulbosa									1												r					**2**
Caladenia sp.		r																								**1**
Carex appressa	+				r																					**2**
Carex breviculmis		+																								**1**
Carex inversa		+	r		r					r							+					r	r			**7**
Cheilanthes sieberi		r													r					+						**3**
Chloris truncata	+	1	1	1	1	1	1		1	1	+	r			1	1	1	1	1		1	1	1	1	1	**21**
Chrysocephalum apiculatum					r												+	+		1		+				**5**
Convolvulus erubescens					r				r							r		r		+	+					**6**
Crassula sieberana				r								1				1				1						**4**
Cymbonotus lawsonianus	r	r													1	1	+	1		1	1	+	+			**10**
Daucus glochidiatus															r	+	+	r		+	+					**6**
Desmodium varians		r			r				r																	**3**
Elymus scaber	1	1	1	1		1			1	1	1				1	1	1	1	+	1	+	1	1	1	1	**19**

Species	Plot 1	Plot 2	Plot 3	Plot 4	Plot 5	Plot 6	Plot 7	Plot 8	Plot 9	Plot 10	Plot 11	Plot 12	Plot 13	Plot 14	Plot 15	Plot 16	Plot 17	Plot 18	Plot 19	Plot 20	Plot 21	Plot 22	Plot 23	Plot 24	Plot 25	No. of plots in which sp. occurs
Enneapogon nigricans															+					+						**2**
Epilobium billardierianum																	+									**1**
Eragrostis ? brownii																	r							r		**2**
Eragrostis sp.																		+								**1**
Eragrostis trachycapa	+	+	1						1		1	+					1		1	+		r	+		+	**12**
Erodium crinitum						+									r								r			**3**
Eryngium ovinum																		+					r			**2**
Eucalyptus bridgesiana		r															r									**2**
Eucalyptus mannifera		r																								**1**
Eucalyptus melliodora		r	+		1												r					r		r	r	**7**
Euchition sp.				+			r		+			+				r	r			r		+				**8**
Galium gaudichaudii										+										1						**2**
Geranium retrorsum			r		r															r	+		+			**5**
Geranium solanderi		+	r		r		+			r					+		1	1	+	+	1	+	1	+	+	**15**
Glycine clandestina		r																								**1**
Gonocarpus teragynus	r	+														+		r		+		+				**6**
Haloragis heterophylla		+			+		+		1	1	1					+	1									**8**
Hibbertia obtusifolia		+																								**1**
Hydrocotyle laxiflora		1	r		1												1	+		+		+	1			**8**
Hypericum gramineum		+			1												+		r							**4**
Isoetopsis graminifolia									r							1										**2**
Juncus australis	r				r	r	r			+							1									**6**
Juncus filicaulis	+	r			1	+				1							+		r				+			**8**
Lachnagrostis filformis		+															r							r		**3**
Leptorhynchos squamatus																				1						**1**
Linum marginale																		r								**1**

Species	Plot 1	Plot 2	Plot 3	Plot 4	Plot 5	Plot 6	Plot 7	Plot 8	Plot 9	Plot 10	Plot 11	Plot 12	Plot 13	Plot 14	Plot 15	Plot 16	Plot 17	Plot 18	Plot 19	Plot 20	Plot 21	Plot 22	Plot 23	Plot 24	Plot 25	No. of plots in which sp. occurs
Lomandra ? filiformis	r		r	r	r				r		+							r		r		+				**9**
Luzula densiflora																				r						**1**
Microlaena stipodies	1	2	+	1	1	2	1		r	+					1	2-	1	1	1	+	1	1	1	1	+	**20**
Oxalis perennans	1	+		+	+		1		+		r				1	1	1	1	1	1	1	+	+	r	+	**18**
Panicum effusum			1	1		+	r		1	r	+	+				r	+	1	1	+	r	1	1	1	r	**18**
Persicaria prostrata															1											**1**
Plantago varia					+				+									1		+		1				**5**
Poa labillardierei	+			+	1	+	r		+								1			+						**8**
Pseudognaphalium luteoalbum		r		+	+		+		+	r		+					r								+	**9**
Rumex brownii	r			+	1	+	+			+					1	r	+	+	+	+	+	+	r				**14**
Schoenus apogon									r												r	r	+			**4**
Sebaea ovata	+	+		1					+													r	r			**6**
Senecio quadridentatus	r			r					r	+					+	+	1			r	r		r	r		**11**
Solenogyne domini									r									r				+	r			**4**
Stackhousia monogyna																r										**1**
Stuartina muelleri																							r			**1**
Swainsona sericea																+										**1**
Themeda australis	1	1	1	2-	1	1	1		2+	2-	1				1	+	2	+		2-	1	1	+	+	1	**20**
Triptilodiscus pygmaeus	1	1		1	1				1	1					1	1	1		1	1	1	1			1	**14**
Vittadinia cuneata																	+									**1**
Vittadinia muelleri									+								1		+		r		r			**5**
Wahlenbergia sp.	+	+	1	1	1	+			1	+	r	r			r	+	+	1	+	1		+	+		+	**19**
Wurmbea dioica	+								+											+	+		+			**5**
Sp. with score of 1	**8**	**8**	**10**	**10**	**14**	**7**	**7**	**-**	**11**	**7**	**6**	**1**	**-**	**-**	**12**	**8**	**16**	**12**	**8**	**12**	**10**	**10**	**7**	**7**	**6**	
Sp. with score of 2	**-**	**1**	**-**	**2**	**-**	**1**	**-**	**-**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**3**	**2**		**1**	**1**	**-**	**-**	**1**	**-**	**1**	
Sp. with score of 3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	

Species	Plot 1	Plot 2	Plot 3	Plot 4	Plot 5	Plot 6	Plot 7	Plot 8	Plot 9	Plot 10	Plot 11	Plot 12	Plot 13	Plot 14	Plot 15	Plot 16	Plot 17	Plot 18	Plot 19	Plot 20	Plot 21	Plot 22	Plot 23	Plot 24	Plot 25	No. of plots in which sp. occurs
Sp. with score of 4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Sp. with score of 5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
TOTAL NATIVE																										
Total cover spring 2014	**2**	**2+**	**2+**	**3**	**3-**	**2+**	**2**	**-**	**3**	**3-**	**2-**	**1**	**-**	**-**	**2**	**3-**	**4-**	**3-**	**2+**	**3-**	**2+**	**2+**	**2+**	**2**	**2+**	
Total cover autumn 2014	*2+*	*2+*	*2+*	*2**	*3+^*	*3*	*2*	*-*	*3**	*3*	*2*	*2*	*-*		*2*	*2+*	*4-*	*3-*	*2*	*3+*	*2*	*2*	*3-*	*2*	*2*	

EXOTIC SPECIES

Species	Plot 1	Plot 2	Plot 3	Plot 4	Plot 5	Plot 6	Plot 7	Plot 8	Plot 9	Plot 10	Plot 11	Plot 12	Plot 13	Plot 14	Plot 15	Plot 16	Plot 17	Plot 18	Plot 19	Plot 20	Plot 21	Plot 22	Plot 23	Plot 24	Plot 25	No. of plots in which sp. occurs
*Acetosella vulgaris**	+	1	1	1	1	1	1			+	+	+			+	r		1	+	+		+	+			**17**
*Aira sp.**	1	1		1					1		1				1	1	1	1		1	1		1		1	**13**
*Anagalis arvensis**	+	+			+						1	+			+						1	r		r		**9**
*Arctotheca calendula**						+				+								r	+							**4**
*Avena sp.**						2	1			1		1			1				+		+				2	**8**
*Briza minor**	1	+	1			+			+	1	1								+			1		+	1	**11**
*Briza sp.**																	1									**1**
*Bromus sp.**	2	1	3+	3	4	3+	4		3+	2	2	1				+	2	4-	2	3	2	3	3-	2	1	**21**
*Carthamus lanatus**	r		+			1	1												+	r						**6**
*Centaurium sp.**		1		1	+	1	+				r					+	+		+		+	r	r			**12**
*Chicorum intybus**											2															**1**
*Chondrilla juncea**												r														**1**
*Cirsium vulgare**	r	+	+	+	+	+	r		+						+	+	+		+	r		r	r	+		**16**
*Conyza sp.**	r	+		r					+			+			1	+	+	1	1		+	1	1	1	+	**15**
Cynodon dactylon*		+										+												+		**4**
*Dactylis glomerata**					+		r		r		2	3			1		+				+					**8**
*Daucus sp.**																1										**1**
*Echium plantagineum**										r	+	+														**3**
*Echium vulgare**												r			1	r					1					**4**
*Eleusine tristachya**							+																	r		**2**
*Eragrostis curvula**	+											1					+		r					r	1	**6**
*Erodium botrys**																+										**1**
Erodium cicutarium*			1	r	+	+	r		+		+	+			+			1	+	1	1		+			**14**
*Festuca elatior**					+						+	2														**3**
*Galium divaricatum**				1															+			1	+	+		**5**

EXOTIC SPECIES

Species	Plot 1	Plot 2	Plot 3	Plot 4	Plot 5	Plot 6	Plot 7	Plot 8	Plot 9	Plot 10	Plot 11	Plot 12	Plot 13	Plot 14	Plot 15	Plot 16	Plot 17	Plot 18	Plot 19	Plot 20	Plot 21	Plot 22	Plot 23	Plot 24	Plot 25	No. of plots in which sp. occurs
Galium sp.*																								r		**1**
Gamochaeta sp.	1			1			1					1				1	+	+	+	+		+	+		+	**12**
*Hirschfeldia incana**															+	+			+	r	1					**5**
*Holcus lanatus**	+	r			+	r	r																			**5**
Hordeum sp.*			1				r												+	+			+	r		**6**
*Hypericum perforatum**	+	r								r		r			+	+	r	+	+	+	1	+	+	+	1	**15**
*Hypochaeris glabra**	+										1				+					+						**4**
*Hypochaeris radicata**	1	1	3	1	1	2	1		1	2+	1	1			+	+	1	1		1	1	+		r	1	**20**
*Juncus bufonius**	r																									**1**
Lactuca serriola*																								r		**1**
*Linaria arvensis**															+	1				+						**3**
*Linaria pelisserana**	r								+			+			+	+										**5**
Lolium perenne*			1	1	1	1	1			1	+							+	1	+		1	1	+	1	**14**
*Lolium sp.**															r											**1**
*Medicago sativa**												+														**1**
*Melilotus sp.**		r	1	1	r												r									**5**
*Modiola caroliniana**											r	1			1				+					r	+	**6**
*Nassella trichotoma**				+																						**1**
Oenothera sp.																+										**1**
Parapholis incurva*																								+		**1**
*Parentucellia latifolia**											1															**1**
*Paronychia brasiliana**		r	r	+	+												r	+	1	+	r	1	+			**11**
*Paspalum dilatatum**					r		r			+		+					+							1	+	**7**
*Petrorhagia nanteuilii**															+			+		+						**3**
Phalaris aquatica*			r			2+	2			2-		2					+								1	**7**

EXOTIC SPECIES

Species	Plot 1	Plot 2	Plot 3	Plot 4	Plot 5	Plot 6	Plot 7	Plot 8	Plot 9	Plot 10	Plot 11	Plot 12	Plot 13	Plot 14	Plot 15	Plot 16	Plot 17	Plot 18	Plot 19	Plot 20	Plot 21	Plot 22	Plot 23	Plot 24	Plot 25	No. of plots in which sp. occurs
*Plantago lanceolata**	+	+			r		+		+	2	3+	1			+	r	1	1	1	2	+	+	r	1	2	**19**
*Rosa rubiginosa**	+	r			+																	r				**4**
Salvia verbenaca*																		+							+	**2**
*Sanguisorba minor**															r											**1**
*Secale cereale**			+		r		+				r													r		**5**
*Silybum marianum**			r																							**1**
*Sisyrinchium iridifoliuim**																									r	**1**
*Solanum nigram**															+	+										**2**
Sonchus spp.	+		1	+	1	1	1		+	+	+					r	1	+	+		r		+	+	r	**17**
*Spergularia rubra**												+						1							+	**3**
*Taraxacum officinale**		+				+	+		+		r	+					+	+								**8**
*Tolpis umbellata**	1	r	+	+			r		1	+					r			+		r	r		+		r	**13**
*Trifolium anguistifolia**																						+		1	+	**3**
*Trifolium arvense**		1	1	1	+				1		1				1	1		2	1	2	1	1	1	1	2	**16**
*Trifolium campestre**			1	2	2				3+	1	2					+		2	1		1	1	1			**12**
Trifolium cernuum					+																					**1**
*Trifolium dubium **		1		1			1								1	1	1				1				1	**8**
*Trifolium repens**							1					+													+	**3**
Trifolium sp.	1	1	1	2	1	1	1		1	1	2	1			1		1	2	1	1	1			1	1	**19**
*Trifolium subterraneum**					1	+	1			1	2	1						2	+	2	+	+	1			**12**
Unknown sp.																									r	**1**
*Verbascum thapsis**												+			+	r					1				r	**5**
*Verbascum virgatum**																r					r					**2**
*Verbena bonariensis**															3				+		1		r			**4**
*Vulpia sp.**	1	1	1	1	1	1	1		1	1	1	1			1	1	1	1	1	1	1	1	1	1	1	**22**

EXOTIC SPECIES

Species	Plot 1	Plot 2	Plot 3	Plot 4	Plot 5	Plot 6	Plot 7	Plot 8	Plot 9	Plot 10	Plot 11	Plot 12	Plot 13	Plot 14	Plot 15	Plot 16	Plot 17	Plot 18	Plot 19	Plot 20	Plot 21	Plot 22	Plot 23	Plot 24	Plot 25	No. of plots in which sp. occurs
Sp. with score of 1	7	9	11	11	6	7	12		6	7	8	8			10	7	8	8	8	5	13	8	7	6	11	
Sp. with score of 2	1	-	-	2	1	3	1	-	-	4	6	2	-	-	-	-	1	4	1	3	1	-	-	1	3	
Sp. with score of 3	-	-	2	1	-	1	-	-	2	-	1	1	-	-	1	-	-	-	-	1	-	1	1	-	-	
Sp. with score of 4	-	-	-	-	1	-	1	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	
Sp. with score of 5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
TOTAL EXOTIC																										
Total cover spring 2014	2+	2	3+	3	4	3+	4+		4-	3	4+	4			3	2	2	4	2	4	3	3	3	2	3	
Total cover autumn 2014	1	2	3	2*	3	3	4-	-	2	2	4-	4+			3+	2-	2-	3+	2	4-	4-	2-	2	2-	3-	

* = heavily (pulse) grazed in late March early April 2014

^ = lightly grazed in March 2014.

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