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M2G Seeding (Plot) Monitoring Report

Construction Corridor (Spring 2015)

Prepared for
Icon Water

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Abbreviations

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LRMP	Landscape Rehabilitation Management Plan (superseded by the LRTEMP)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TEMP	Terrestrial Ecology Management Plan (superseded by the LRTEMP)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 2015 plot monitoring survey for the seeding rehabilitation of the M2G pipeline construction project. Current surveys were conducted in October 2015.

Floristic data were collected from fifteen monitoring plots (four plots located in the central section of the corridor could not be accessed) and two control plots.

A total of 135 herbaceous species (69 native and 66 non-native) were recorded in monitoring plots with native species richness ranging from 12 to 35 sp. (Av. 23.7 sp./plot) and non-native species richness from 11 to 28 sp. (Av. 21.7 sp./plot). As expected, native species richness was significantly higher in control plots (37 sp./plot).

Cover abundances measures also exposed the relative differences between monitoring and control plots, with the former having an estimated total native cover in the mid to upper level of the 25-50% cover range and the latter 90%.

All plots associated with non-native vegetation (category 1) have now met the required Key Performance Target (KPT) and are no longer monitored. Plot 17 (category 3 – high conservation value vegetation) also met the required KPT and should be returned to the landowner.

The highest individual native species cover score was 3 (25-50%) attained by *Panicum effusum* (Hairy Panic) and *Themeda australis* (Kangaroo Grass) across two plots, followed by five native species (including the two just mentioned) with cover scores of 2 (5-25%) across fifteen plots. The remaining 64 native species had individual cover scores below 5%. Both native species richness and total cover abundances were relatively unchanged from the previous monitoring period.

Seven noxious species were recorded during the current survey. While most infestations were minor and manageable outbreaks of *Eragrostis curvula* (African Lovegrass) and *Hypericum perforatum* (St John's Wort) could manifest into more serious infestations and should be attended to. As indicated previously, the wider local occurrence of these species pose continued management problems not just in the construction corridor.

The main recommendations are:

- continue chemical weed control though minimise the impact on non-target species;
- 'pulse' grazing should be adopted in the central section and western section of the construction corridor, preferably in summer/autumn 2016 and again during late winter 2016.
- Re-seeding has been undertaken in the ACT and should be investigated in other areas where native germination has been poor, such as the area between the NSW/ACT border and Plot 22 west of the Monaro Highway;
- KPTs for native vegetation categories 2 and 3 should be reviewed with consideration given to lowering the native vegetation target of the former category to 50% and the later 60%.

2 Introduction

2.1 Background

This report provides the results and analysis of the spring 2015 plot monitoring survey for the seeding rehabilitation of the Murrumbidgee to Googong Water Transfer Project (M2G) construction corridor. This is the eighth in a series of bi-annual reports examining the post-construction vegetation recovery of the M2G construction corridor.

Twenty-five monitoring plots were established within the construction corridor (ten in the ACT and fifteen in the NSW sections of the corridor) following the completion of construction and re-seeding operations in autumn 2012. Two control plots were later set within moderate to good condition Box Gum Grassy Woodland in the ACT and have been monitored since spring 2013.

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 post-construction vegetation recovery within the M2G construction corridor and measure the results against specific Key Performance Targets (KPTs) for each vegetation category (**Table 1**).

Note: Icon is seeking approval to reduce the current KPT for category 3 (high conservation value vegetation) and category 2 (low diversity native vegetation) to 60% and 50%, respectively. This is discussed further in Sections 5 and 6.

Table 1: Key performance targets (KPTs) for each vegetation category within the M2G construction corridor. This table has been 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
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

Twenty-five sample plots were originally established within M2G construction corridor during 2012 and have been monitored on a bi-annual basis (autumn and spring/summer periods) since that time.

The current autumn survey was conducted between 7 and 29 October 2015 with vegetation data collected from fifteeen[1] monitoring plots and two control plots (**Table 2**).

3.2 Monitoring plots

All monitoring plots are 400m^2 in size and were placed at selected locations within the M2G construction corridor (**Figure 1** – **Figure 4** in **Appendix 1**). Plots were located to account for differences in physical condition (i.e. elevation, slope and aspect) and the former vegetation type according to three broad categories: non-native; native-low diversity and native-high conservation value, see **Table 1**, above.

Table 2: Monitoring plots listed in order of chainage from the LLPS. Also shown are pre-construction vegetation types in which plots were placed, post-construction seeding regime and KPT for each plot and whether these were achieved and when.

Plot ID	Chainage (m)	Jurisdiction	Original vegetation	Seeding regime	KPT category	Was KPT met	When KPT was achieved
16	250	ACT-PCS	NTG	N	3	No	-
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-Icon	Degraded BGGW	N	2	No	-
18	1450	ACT-Icon	Degraded BGGW	N	2	No	-
23	1740	ACT-Icon	Degraded BGGW	N	3	No	-
22	2150	ACT-Icon	BGGW	N	3	No	-
24	2650	ACT-Icon	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	-

[1] Five plots (07, 08, 11, 13 and 14) previously met the required KPT and are no longer monitored. Four plots (03, 04, 05 and 09) located in the central section of the corridor were not sampled due to access restrictions.

Plot ID	Chainage (m)	Jurisdiction	Original vegetation	Seeding regime	KPT category	Was KPT met	When KPT was achieved
09	3600	NSW-McDonald	Low to moderate diversity secondary grassland	N	3	No	-
04	4025	NSW-McDonald	Moderate to high diversity secondary grassland	N	3	No	-
05	4300	NSW-McDonald	Low diversity native pasture	N	2	No	-
06	4900	NSW-Lonergan	Low diversity native pasture	N	2	No	-
07	5200	NSW-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]	No	-
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	**Yes**	**Current survey**
12	8300	NSW-Bos	Poor quality mixed pasture	E	1 [B]	**Yes**	**Current survey**
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 situated 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

Access to the central section of the construction corridor (McDonald property) was not approved for the current survey, and there is no data for Plots 03, 04, 05 and 09.

The ability of the observer to detect all species, particularly those that occur at low densities or are easily obscured due to habit can be hampered by high cover abundances of both native (i.e. *Panicum effusum*) and non-native annuals, in particular *Brome* spp., *Trifolium* spp. and some broad-leaf weeds.

4 Results

Results and analysis of the current monitoring survey are provided in the following sub-sections: *Overview: All monitoring plots* (Section 4.1); *Control plots* (Section 4.2); *Monitoring plots – category 3: high conservation value vegetation* (Section 4.3); *Monitoring plots – category 2: low diversity native vegetation* (Section 4.4); and, *Monitoring plots – category 3: non-native vegetation* (Section 4.5).

Plot data sets for the current surveys are presented in **Table 8** and **Table 9** in **Appendix 2**.

4.1 Overview: Monitoring plots

A total of 135 herbaceous plants comprising 69 native species and 66 exotic species (ratio of 1:0.96)[2] were recorded from fifteen monitoring plots during the current sampling period. Comparative species counts for all sampling periods are provided in **Chart 1**.

Initial patterns in native and exotic species occurrence showed relative (as well as proportional) declines in autumn and increases in spring (**Chart 1**, below). This pattern persisted for native species up to autumn 2014, after which species numbers stabilised at about 70. Exotic species, on the other hand, present a more consistent pattern of seasonal fluctuation (spring 2013 being the exception) accompanied with a downward trend in species richness (**Chart 1**).

4.1.1 Species Frequency

Fourteen native species and 11 exotic species were present in ten or more monitoring plots. This compared with 16 and 14 species, respectively, for the previous autumn 2015 survey.

Of the ten most commonly recorded species seven were native and three exotic (nine and one, respectively, in autumn 2015). The most commonly recorded native species (or genus) were: *Austrostipa scabra* (Speargrass*)*, *Bothriochloa macra* (Red Grass), *Chloris truncata* (Windmill Grass), *Rytidosperma* spp. (Wallaby Grass) and *Themeda australis* (Kangaroo Grass) in 15 plots; *Elymus scaber* (Common Wheatgrass) and *Microlaena stipoides* (Weeping Grass) in 14 plots. Exotic *Vulpia* sp. (Rat's Tail Fescue) was present in 15 and *Hypochaeris radicata* (Flatweed) and *Trifolium campestre* (Hop Clover) in 14 plots.

4.1.2 Species Diversity (richness)

Native species richness ranged from 12 to 35 sp. per plot (10 to 34 for the previous survey), and for non-native species the range was 11 to 28 (12 to 25 for the previous survey).

In autumn 2012 the average native species richness per plot was 15.8 and steadily increased to a high of 23.7 sp./plot in spring 2013, after which the average hovered between 20.3 and 22 sp./plot. The current average has risen once again to 23.7 sp./plot (**Chart 2**).

[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); **1:0.99** (autumn 2014), **1:1.07** (spring 2014) and **1:0.84** (autumn 2015).

Non-native species on the other hand continue to fluctuate in line with seasonal influences, but which have shown a steady decline in number over the monitoring period. This is partly explained by the removal of non-native plots (category 1) from the study as they gradually met the required KPT.

Chart 1: Total species counts during all monitoring periods.

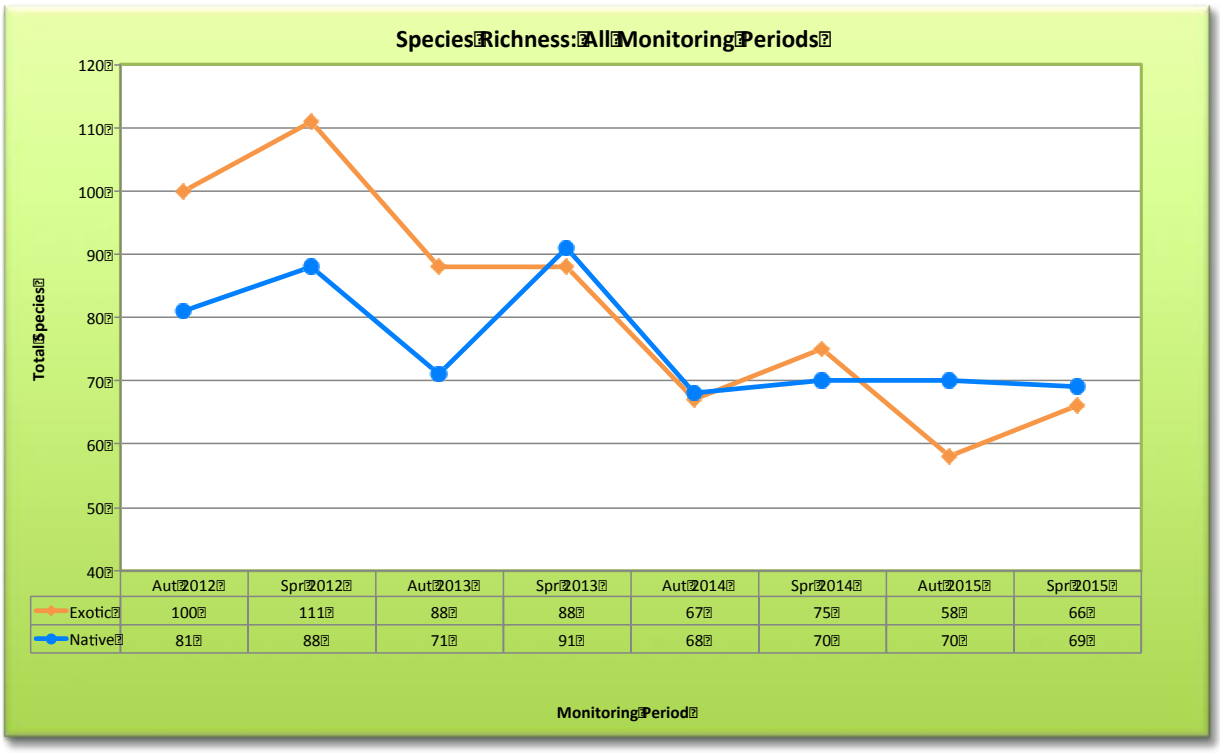
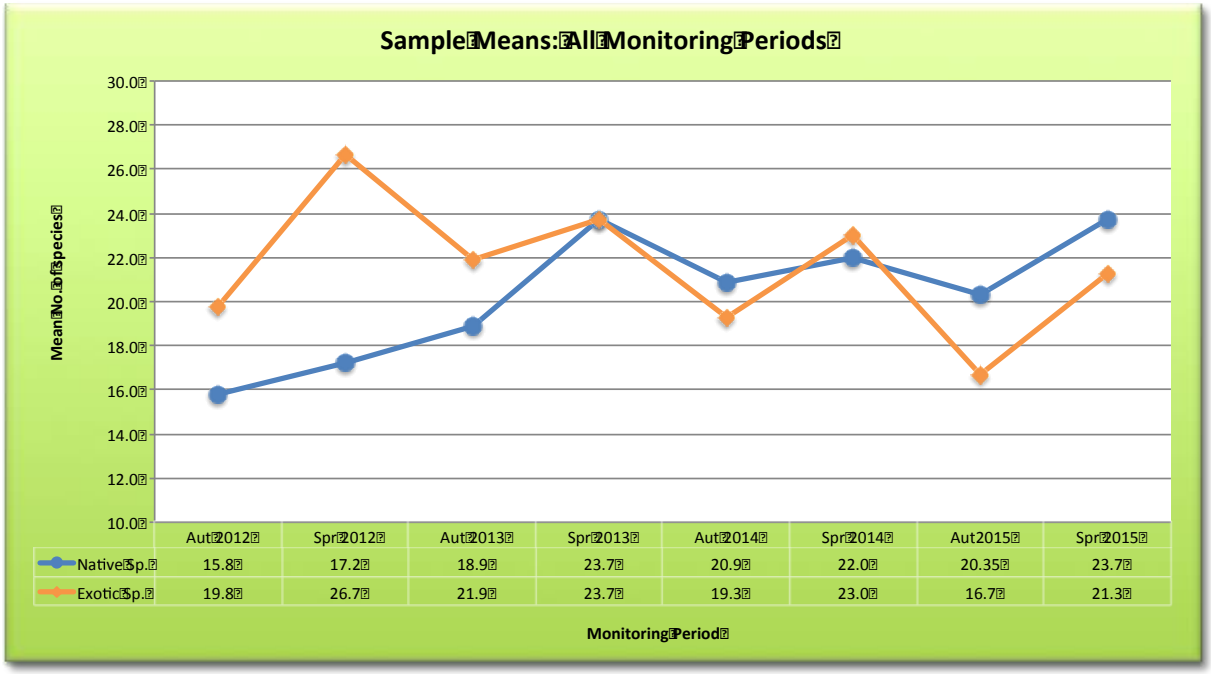


Chart 2: Species means (per plot) during all monitoring periods.



4.1.3 Cover Abundance - native vegetation plots

Four of the nineteen plots associated with native vegetation (KPT categories 2 and 3) exhibited small increases in native vegetation cover, ten plots maintained their native cover and one plot showed a decline relative to the previous monitoring period**. *Access to the central section of the construction corridor was not approved and therefore Plots 03, 04, 05 and 09 were not sampled during the current monitoring period*. *The latter three plots previously had native cover abundance scores at the high end of the 25-50% range during the previous monitoring period.***

Plot 17 had a native cover score at the higher end of the 50-75% range and is considered to have met the required KPT. Eight plots (02, 06, 10, 16, 18, 19, 20 and 23) attained native cover scores in 25-50% range, and the remaining six plots had less than 25% native cover (**Table 4**).

Total native species cover abundance was consistent with the previous monitoring period and remained at the mid to upper level of the 25-50% cover range. It is a reasonable to expect, based on previous results, that the total would have been slightly higher had plots in the central section of the construction corridor been included in the sample.

Exotic cover abundance increased[3] slightly and is now at the middle of the 25-50% range (**Table 4**) and can be attributed to seasonal growth of annual species, such as *Bromus* spp.

4.1.4 Cover Abundance – non-native vegetation plots

All six plots (07, 08, 11, 12, 13 and 14) associated with non-native vegetation have met the required KPT and are no longer monitored**.**

[3] The estimated percentage exotic cover abundance was incorrectly entered as **25-50+** in Table 4 of the autumn 2015 plot monitoring report. It should have read **25-50-**.

Table 4: Estimated cover abundances from all plots for autumn 2015 and spring 2015 monitoring periods. Red text indicates an increase in cover, blue a decrease and black no change compared to the previous monitoring period. The last two columns provide outcomes for revised KPTs for category 3 (60%) and category 2 (50%), should they be accepted.

Plot No.	Chainage	Location	Estimated total vegetation cover				KPT Category	Was 70% KPT achieved?	Adjusted KPT	
			Autumn 2015		Spring 2015				Cat 3 60% KPT achieved?	Cat 2 50% KPT achieved?
			Native	Exotic	Native	Exotic				
16	250	ACT	25-50-	<5	25-50	5-25+	3	No (mid)	No (mid)	-
15	530	ACT	5-25+	25-50	5-25+	25-50-	3	No	No	-
21	700	ACT	5-25	<5	5-25	5-25-	3	No	No	-
19	1020	ACT	25-50-	<5	25-50-	5-25-	2	No (mid)	-	No (mid)
20	1200	ACT	25-50+	5-25+	25-50+	25-50+	2	No (mid)	-	Near
18	1450	ACT	25-50+	5-25+	25-50+	25-50+	2	No (mid)	-	Near
23	1740	ACT	25-50-	5-25+	25-50+	5-25+	3	No (mid)	Near	-
22	2150	ACT	25-50-	<5	2-25+	25-50-	3	No (mid)	No (mid)	-
24	2650	ACT	5-25+	5-25-	5-25+	5-25+	3	No	No	-
25	2800	ACT	5-25+	5-25	5-25+	25-50-	3	No	No	-
1	3030	Smith	5-25+	5-25	5-25	25-50-	3	No	No	-
2	3220	Smith	25-50-	5-25	25-50-	5-25	2	No (mid)	-	No (mid)
3	3320	MacDonald	25-50	25-50+	-	-	2	?	-	?
9	3600	MacDonald	25-50+	5-25-	-	-	3	?	?	-
4	4025	MacDonald	25-50+	5-25	-	-	3	?	?	-
5	4300	MacDonald	25-50+	25-50-	-	-	2	?	-	?
6	4900	Lonergan	25-50-	5-25+	25-50-	50-75-	2	No (mid)	-	No (mid)
7	5200	Lonergan	-	-	-	-	1[B]	Yes	-	-
8	5680	Lonergan	-	-	-	-	1	Yes	-	-
10	6030	Codd-Howath	25-50-	25-50	25-50	25-50	2[A]	No (mid)	-	Near
11	6450	Johanson	-	-	-	-	1[B]	Yes	-	-
17	7600	Devitt	50-75	5-25-	50-75+	5-25+	3	Yes	-	-
12	8300	Bos	<5	50-75+	-	-	1[B]	Yes	-	-
14	9850	Borgia	-	-	-	-	1	Yes	-	-
13	10950	Johnston	-	-	-	-	1	Yes	-	-
Total cover estimate all plots			25-50	25-50-	25-50	25-50				

[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.

+ = cover estimated at the upper end of range

- = cover estimated at the lower end of range

4.2 Control plots

Both Control Plots 1 and 2 (**Plate 1**) had moderate to high native species richness with 39 and 34 herbaceous species, respectively. Cumulative native cover abundances remained high with 75% in Control 1 (slightly lower than previously due to recent stock grazing) and 90% in Control 2. Exotic species richness remained low although cumulative cover increased to about 20% in Control 1 due to seasonal increase in *Trifolium* spp. (see **Table 8** in **Appendix 2**).

Measures of native cover abundance were considerably lower among monitoring plots (Plot 17 excluded) than control plots (see. **Table 4**, **above**).

Plate 1: Control plots in high diversity BGGW. The image on the left shows control plot 1 and the right control plot 2 during the current spring 2015 monitoring period.

Control Plot 1 | **Control Plot 2**

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

Eleven plots were established in areas of former high conservation value vegetation (category 3) and were set the highest KPT, see **Section 2.3 above** (Icon Water proposes that the current KPT for category 3 be lowered from 70% to 60%).

Summaries of survey results are provided in **Table 5**, below, with additional descriptions of each sample plot presented in the succeeding sub-sections.

Note: Plots 04 and 09 located in the central section of the corridor were not sampled during this monitoring period.

Species richness

Native species ranged from 12 to 33 sp./plot at an average of 23.1 sp. (21.2 sp. in autumn 2015), and non-native species ranged from 11 to 28 sp./plot at an average of 20.8 sp. (15.8 in autumn 2015).

Individual species cover abundance scores

The highest individual native species cover score was 3 (25-50%) obtained by Kangaroo Grass *Themeda australis* (Plot 17). This was followed by four species with cover scores of 2 (5-25%) that were recorded on nine separate occasions across six plots. These results were below the previous autumn surveys and are likely to have been influenced by the omission of data from Plots 04 and 09.

The highest individual non-native species (or genus) cover score was 3 (25-50%) obtained by *Bromus spp.* in Plot 22. This was followed by six species (or genus) with cover scores of 2 (5-25%) in six plots (01, 15, 17, 23, 24 and 25).

Cumulative cover abundance scores

As indicated above, Plot 17 has consistently achieved native species cover scores of 4 (50-75% range) and is considered to have met the KPT. Two plots had native cover scores of 3 (25-50%) and are in the mid-range of the target. The remaining six plots had cover scores of 2 (5-25%) (**Table 5**).

The current results suggest a slight decline of native cover in this category (which sits slightly below the mid point of the 25-50% range) compared to the previous autumn survey. While this was slightly lower than the previous autumn survey the decline may be attributed in part to the absence of sample data from Plots 04 and 09.

Cumulative non-native cover increased relative to the previous autumn survey.

Table 5: Summary of category 3 plot results for the current spring 2015 survey. The table provides plot data on: current species richness and changes compared to autumn 2015; native species cover scores and cumulative cover abundance estimates for native and exotic species.

Parentheses ( ) enclose results from autumn 2015 and red text identifies an increase in species, blue a decrease and black no change.

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 >	Total native cover %	Total exotic cover %
16	250	ACT	**32**	**28**	**48**	**6** (0)	**6** (3)	**9** (8)	**3** (3)	**25-50**	**5-25+**
15	530	ACT	**20**	**26**	**46**	**0** (0)	**4** (7)	**10** (10)	**1** (1)	**5-25+**	**25-50-**
21	700	ACT	**12**	**11**	**23**	**0** (10)	**2** (12)	**9** (8)	**0** (0)	**5-25**	**5-25-**
23	1740	ACT	**28**	**25**	**53**	**4** (4)	**6** (2)	**13** (10)	**2** (1)	**25-50+**	**5-25+**
22	2150	ACT	**27**	**21**	**48**	**0** (1)	**6** (5)	**15** (9)	**0** (2)	**5-25+**	**25-50-**
24	2650	ACT	**19**	**24**	**43**	**5** (0)	**11** (12)	**7** (6)	**1** (1)	**5-25+**	**5-25+**
25	2800	ACT	**17**	**18**	**35**	**0** (2)	**2** (11)	**7** (8)	**1** (1)	**5-25+**	**25-50-**
01	3030	NSW-Smith	**20**	**18**	**38**	**3** (6)	**3** (7)	**9** (8)	**0** (1)	**5-25**	**25-50-**
09 N/A	3600	NSW-McDonald	-	-	-	-	-	-	-	-	-
04 N/A	4025	NSW-McDonald	-	-	-	-	-	-	-	-	-
17	7600	NSW-Devitt	**33**	**16**	**49**	**1** (1)	**2** (7)	**16** (18)	**2** A (3)	**50-75+**	**5-25+**
Av spring 2015			**23.1**	**20.8**	**43.9**					**25-50-**	**25-50-**
Av autumn 2015			21.0	15.8	36.8					25-50	5-25-
Av spring 2014			23.6	22.9	46.5					25-50-	25-50
Av autumn 2014			20.7	18.5	39.2					5-25+	5-25+
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						
Av. autumn 2012			17.3	19.4	30.1						

* Change in species richness in the period between autumn 2015 and spring 2015.

+ cover estimated at the upper end of range

- cover estimated at the lower end of range

A =includes species with cover score of 3 (25-50%)

4.3.1 Monitoring Plot 16

Jurisdiction	ACT
Native sp. cumulative cover %	**25-50** (25-50-)
No. Native sp. with cover score of 1	**9** (8)
No. Native sp. with cover score of 2 or more	**3** (3)
Non-native cover %	**5-25+** (<5)
Bare Ground %	**30** (30-40)
Mulch Cover %	<1
KPT	High Conservation Vegetation
Was KPT met	**No**

Monitoring plot 16 is situated 250 m east of the LLPS in the Murrumbidgee River corridor within former high conservation value natural temperate grassland.

Native sp. increased from **26** to **32**. Non-native species increased from **22** to **28**.

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

Recommendation: Eliminate noxious species and undertake detailed management of broad-leaved weeds.

Plate 2: Monitoring Plot 16 - left autumn 2015, right spring 2015.

4.3.2 Monitoring Plot 15

Jurisdiction	ACT
Native sp. cumulative cover %	**5-25+** (5-25+)
No. Native sp. with cover score of 1	**10** (10)
No. Native sp. with cover score of 2 or more	**1** (1)
Non-native cover %	**25-50-** (25-50)
Bare Ground %	**20-30** (20)
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. remained unchanged on **20**. Non-native species increased from **22 to 26**. **Broad-leaf weeds remain dominant but have moderated slightly.**

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

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

Plate 3: Monitoring Plot 15 - left autumn 2015, right spring 2015.

4.3.3 Monitoring Plot 21

Jurisdiction	ACT
Native sp. cumulative cover %	**5-25** (5-25+)
No. Native sp. with cover score of 1	**9** (8)
No. Native sp. with cover score of 2 or more	**0** (0)
Non-native cover %	**5-25-** (<5)
Bare Ground %	**20-30** (20)
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 remained on **12**. Non-native species decreased from **13** to **11**.

While previous herbicide treatment has reduced the number of exotic weeds it has also suppressed native forb diversity.

Noxious species: No viable noxious species were recorded.

Recommendation: Monitor vegetation recovery and consider

Plate 4: Monitoring Plot 21 - left autumn 2015, right spring 2015.

4.3.4 Monitoring Plot 23

Jurisdiction	ACT
Native sp. cumulative cover %	**25-50- (**25-50-)
No. Native sp. with cover score of 1	**13** (10)
No. Native sp. with cover score of 2 or more	**2** (1)
Non-native cover %	**5-25+** (5-25+)
Bare Ground %	**5-10** (15)
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 **24** to **28.** Non-native species also increased from **19** to **25**.

Noxious species: *Hypericum perforatum* persists at low density

Recommendation: Maintain control of noxious species and broad-leaf weeds.

Plate 5: Monitoring Plot 23 - left autumn 2015, right spring 2015.

4.3.5 Monitoring Plot 22

Jurisdiction	ACT
Native sp. cumulative cover %	**5-25+** (25-50-)
No. Native sp. with cover score of 1	**15** (9)
No. Native sp. with cover score of 2 or more	**0** (2)
Non-native cover %	**25-50-** (<5)
Bare Ground %	**10** (10)
Mulch Cover %	<10
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 remained at **27**. Non-native species increased from **15** to **21**.

Note: Poor quality top-soil. Increase in non-native groundcover, site has been heavily browsed by Kangaroos and Rabbits.

Noxious species: *Hypericum perforatum* persists at low density.

Recommendation: Maintain control of noxious species and broad-leaf weeds.

Plate 6: Monitoring Plot 22 - left autumn 2015, right spring 2015.

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** (6)
No. Native sp. with cover score of 2 or more	**1** (1)
Non-native cover %	**5-25+** (5-25-)
Bare Ground %	**40-50** (40-50)
Mulch Cover %	**<1** (1)
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 **14** to **19**. Non-native species increased from **13** to **24**.

Poor quality top-soil. The section of corridor either side of the Monaro Highway, including this plot, has performed poorly.

Noxious species: *Eragrostis curvula*, *Hypericum perforatum* and *Nassella trichotoma* at low density.

Recommendation: Check if recently re-seeded. Eliminate noxious species and undertake detailed management of broad-leaf weeds.

Plate 7: Monitoring Plot 24 - left autumn 2015, right spring 2015.

4.3.7 Monitoring Plot 25

Jurisdiction	NSW
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	**1** (1)
Non-native cover %	**25-50-** (5-25)
Bare Ground %	**20** (20)
Mulch Cover %	**<1**
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 remained at **17**. Non-native species increased from **16** to **18**.

Noxious species: *Hypericum perforatum* and *Eragrostis curvula* at moderate densities and *Nassella trichotoma* at low density.

Recommendation: Check if recently re-seeded. Eliminate noxious species and undertake detailed management of broad-leaf weeds.

Plate 8: Monitoring Plot 25 - left autumn 2015, right spring 2015.

4.3.8 Monitoring Plot 01

Jurisdiction	NSW
Native sp. cumulative cover %	**5-25** (5-25+)
No. Native sp. with cover score of 1	**9** (8)
No. Native sp. with cover score of 2 or more	**0** (1)
Non-native cover %	**25-50-** (5-25)
Bare Ground %	**10** (10)
Mulch Cover %	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 **17** to **20**. Non-native species also increased from **15** to **18**.

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

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

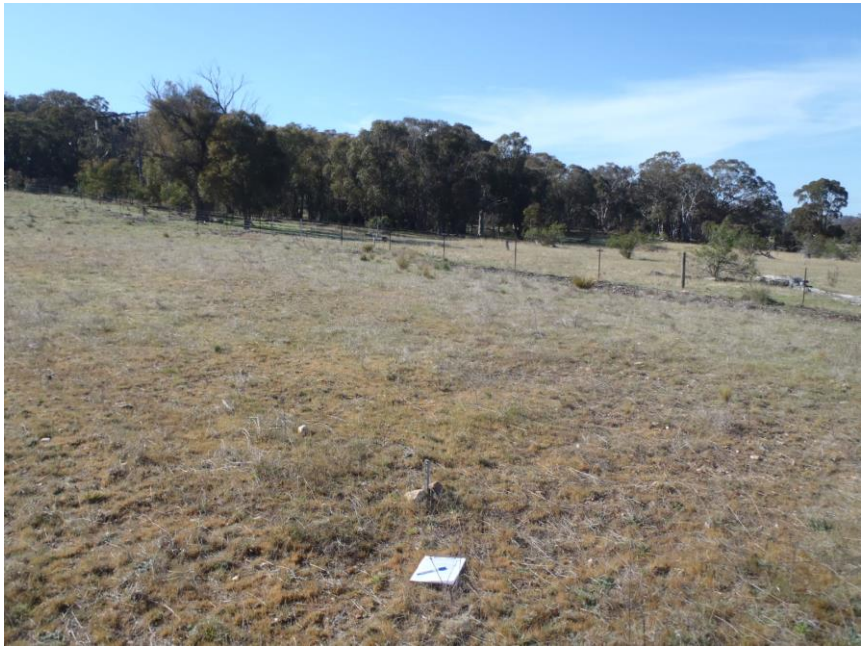


Plate 9: Monitoring Plot 01 - left autumn 2015, right spring 2015.

4.3.9 Monitoring Plot 09

Jurisdiction	NSW
Native sp. cumulative cover %	-
No. Native sp. with cover score of 1	-
No. Native sp. with cover score of 2 or more	-
Non-native cover %	-
Bare Ground %	-
Mulch Cover %	-
KPT	High Conservation Vegetation
Was KPT met	-

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.

No access site not sampled.

Plate 10: Monitoring Plot 09 - left autumn 2015, right spring 2015.

4.3.10 Monitoring Plot 04

Jurisdiction	NSW
Native sp. cumulative cover %	-
No. Native sp. with cover score of 1	-
No. Native sp. with cover score of 2 or more	-
Non-native cover %	-
Bare Ground %	-
Mulch Cover %	-
KPT	High Conservation Vegetation
Was KPT met	-

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.

No access site not sampled.

Plate 11: Monitoring Plot 04 - left autumn 2015, right spring 2015.

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*** (3)
Non-native cover %	**5-25+** (5-25-)
Bare Ground %	**<1**
Mulch Cover %	**<1**
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 declined from **34** to **33**. Non-native species increased from **14** to **16**.

Noxious species: None re-recorded.

Recommendation: Site requires biomass reduction and management of broad-leaf weeds and perennial exotic grasses such as *Plantago lanceolata* and *Phalaris aquatica*.

Plate 12: Monitoring Plot 17 - left autumn 2015, right spring 2015.

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

Eight plots were established in areas of former low-diversity native vegetation - KPT category 2 (see **Table 1**). Performance targets for category 2 are at present similar to those imposed for category 3 and are provided in Section 2.3, above (Icon Water propose that the current KPT for category 2 be lowered from 70% to 50%).

Summaries of category 2 results are provided in **Table 6**, below, with additional descriptions of each plot presented in the succeeding sub-sections.

Note: Plots 03 and 05 located in the central section of the corridor were not sampled during this monitoring period.

Species diversity

Native species ranged from 15 to 35 sp./plot at an average of 24.7 sp. (20.7 sp. in autumn 2015) and non-native species ranged from 15 to 27 at an average of 22.0 sp. (16.9 in autumn 2015).

Individual species cover abundance scores

The highest individual native species cover score was 3 (25-50% cover range) obtained by Hairy Panic *Panicum effusum* (Plot 20). Four species had cover scores of 2 (5-25%) and were recorded on nine separate occasions across six plots (incidentally this was the same outcome for category 1 vegetation). These results were below the previous autumn survey and are likely to have been influenced by the omission of data from Plots 03 and 05.

The highest individual non-native species (or genus) cover score was 3 (25-50%) obtained by *Bromus sp.* in Plots 06, 18 and 20. This was followed by five species (or genus) with cover scores of 2 (5-25%) that were recorded on six separate occasions across three plots.

Cumulative cover abundance scores

While no plot in category 2 met the required KPT, all plots obtained native cover scores of 3 (25-50% cover) and are in the mid range of the target. Only one (Plot 10) exhibited an increase against the previous autumn survey (**Table 6**).

The results indicate no significant change in total native species cover in this category (currently at the mid to upper level of the 25-50% range) compared to the previous sampling period. *The result may have been affected in part by the absence of sample data from Plots 03 and 05.*

Cumulative non-native cover increased relative to the previous autumn survey.

Table 6: Summary of category 2 plot results for the current spring 2015 survey. Table provides plot data on: current species richness and changes compared to autumn 2015; native species cover scores and cumulative cover abundance estimates for native and exotic species.

Parentheses ( ) enclose results from spring 2014 and red text identifies an increase, blue a decrease and black no change.

Plot No.	Chainage	Location	Native sp.	Exotic sp.	Total sp.	Change native sp.*	Change exotic sp. *	Native sp. cover score of 1	Native sp. cover score of 2 or >	Total native cover %	Total exotic cover %
19	1020	ACT	**15**	**22**	**37**	**2** (3)	**7** (12)	**7** (5)	**2** (3)	**25-50-**	**5-25-**
20	1200	ACT	**35**	**22**	**57**	**3** (4)	**8** (8)	**16** (13)	**2**[A] (3[A])	**25-50+**	**25-50+**
18	1450	ACT	**28**	**27**	**55**	**5** (2)	**7** (3)	**14** (11)	**1** (1[A])	**25-50+**	**25-50+**
02	3220	NSW-Smith	**27**	**15**	**42**	**0** (3)	**2** (8)	**10** (8)	**2** (1)	**25-50-**	**5-25**
03[P]	3320	NSW-McDonald	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
05 [P]	4300	NSW-McDonald	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
06	4900	NSW-Lonergan	**21**	**25**	**46**	**5** (1)	**4** (3)	**10** (8)	**1** (2)	**25-50-**	**50-75-**
10	6030	NSW-Codd / Howarth	**22**	**21**	**43**	**8** (3)	**5** (-4)	**10** (7)	**2** (2)	**25-50**	**25-50**
Av spring 2015			**24.7**	**22.0**	**46.7**					**25-50+**	**25-50-**
Av autumn 2015			20.7	16.9	37.6					25-50+	5-25+
Av spring 2014			23.0	21.9	39.9					25-50-	25-50+
Av autumn 2014			23.6	19.6	38.4					25-50	25-50-
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						
Av. autumn 2012			19.7	19.6	39.2						

* Change in species richness in the period between autumn 2015 and spring 2015.

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

\+ Total cover estimated at the upper end of range

\- Total cover estimated at the lower end of range

[A] = includes species with cover score of 3 (25-50%)

4.4.1 Monitoring Plot 19

Jurisdiction	NSW
Native sp. cumulative cover %	**25-50-** (25-50-)
No. Native sp. with cover score of 1	**7** (5)
No. Native sp. with cover score of 2 or more	**2** (3)
Non-native cover %	**5-25-** (<5)
Bare Ground %	**30** (30)
Mulch Cover %	**1%**
KPT	Low diversity native vegetation
Was KPT met	**No (mid range)**

Monitoring plot 19 is situated 1020 m east of the LLPS in the ACT within former low diversity Box Gum Grassy Woodland.

Native species increased from **13** to **15**. Non-native species also increased from **15** to **22.**

Noxious species: *Carthamus lanatus, Eragrostis curvula* and *Hypericum perforatum* occurs at low density.

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

Plate 13: Monitoring Plot 19 - left autumn 2015, right spring 2015.

4.4.2 Monitoring Plot 20

Jurisdiction	ACT
Native sp. cumulative cover %	**25-50+** (25-50+)
No. Native sp. with cover score of 1	**16** (13)
No. Native sp. with cover score of 2 or more	**2*** (3)
Non-native cover %	**25-50+** (5-25+)
Bare Ground %	**<1%**
Mulch Cover %	<5% grass stems
KPT	Low diversity native vegetation
Was KPT met	**No (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 **32** to **35**. Non-native species increased from **14** to **22.**

Seasonal increase of *Bromus* spp. and *Panicum effusum*.

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

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

Plate 14: Monitoring Plot 20 - left autumn 2015, right spring 2015. *includes one species of with a cover score of 3 (25-50%)

4.4.3 Monitoring Plot 18

Jurisdiction	ACT
Native sp. cumulative cover %	**25-50+** (25-50+)
No. Native sp. with cover score of 1	**14** (11)
No. Native sp. with cover score of 2 or more	**1** (1)
Non-native cover %	**25-50+** (2-25+)
Bare Ground %	**<5** (<5)
Mulch Cover %	**<1** (grass stems)
KPT	Low diversity native vegetation
Was KPT met	**No (mid range)**

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 increased from **23** to **28**. Non-native species also increased from **20** to **27.**

Seasonal increase of *Bromus* spp. and *Trifolium* spp.

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

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

Plate 15: Monitoring Plot 18 - left autumn 2015, right spring 2015.

4.4.4 Monitoring Plot 02

Jurisdiction	NSW
Native sp. cumulative cover %	**25-50-** (25-50-)
No. Native sp. with cover score of 1	**10** (10)
No. Native sp. with cover score of 2 or more	**1** (2)
Non-native cover %	**5-25** (5-25)
Bare Ground %	**15** (15-20)
Mulch Cover %	**<1%**
KPT	Low diversity native vegetation
Was KPT met	**No (mid range)**

Monitoring plot 02 is situated 3220 m east of the LLPS in NSW (Smith) within former Brittle Gum / Broadleaf Peppermint Dry Woodland.

Native species remained unchanged on **27**. Non-native species increased from **13** to **15**.

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

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

Plate 16: Monitoring Plot 02 – left autumn 2015, right spring 2015.

4.4.5 Monitoring Plot 03

Jurisdiction	NSW
Native sp. cumulative cover %	-
No. Native sp. with cover score of 1	-
No. Native sp. with cover score of 2 or more	-
Non-native cover %	-
Bare Ground %	-
Mulch Cover %	-
KPT	Low diversity native vegetation
Was KPT met	-

Monitoring plot 03 is situated 3320 m east of the LLPS in NSW (McDonald) within low diversity pasture at the interface of Brittle Gum / Broadleaf Peppermint Woodland and Box Gum Grassy Woodland.

No access site not sampled.

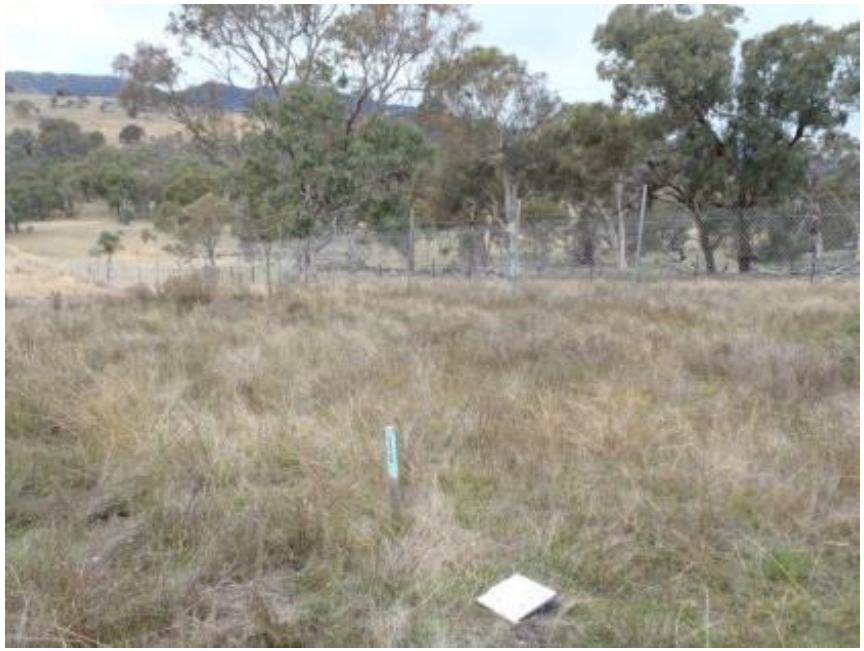


Plate 17: Monitoring Plot 03 - left autumn 2015, right spring 2015.

4.4.6 Monitoring Plot 05

Jurisdiction	NSW
Native sp. cumulative cover %	-
No. Native sp. with cover score of 1	-
No. Native sp. with cover score of 2 or more	-
Non-native cover %	-
Bare Ground %	-
Mulch Cover %	-
KPT	Low diversity native vegetation
Was KPT met	-

Monitoring plot 05 is situated 4300 m east of the LLPS in NSW (McDonald) within former low diversity Box Gum Grassy Woodland.

No access site not sampled.

Plate 18: Monitoring Plot 05 - left autumn 2015, right spring 2015.

4.4.7 Monitoring Plot 06

Jurisdiction	NSW
Native sp. cumulative cover %	**25-50-** (25-50-)
No. Native sp. with cover score of 1	**10** (8)
No. Native sp. with cover score of 2 or more	**1** (2)
Non-native cover %	**50-75-** (5-25+)
Bare Ground %	**<1**
Mulch Cover %	**0**
KPT	Low diversity native vegetation
Was KPT met	**No (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 increased from **16** to **21**. Non-native species also increased from **21** to **25.** Seasonal increase of *Bromus* spp.

Noxious species: *Carthamus lanatus* and *Echium plantagineum* at moderate density. *Eragrostis curvula* near Valve 5007 to east.

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

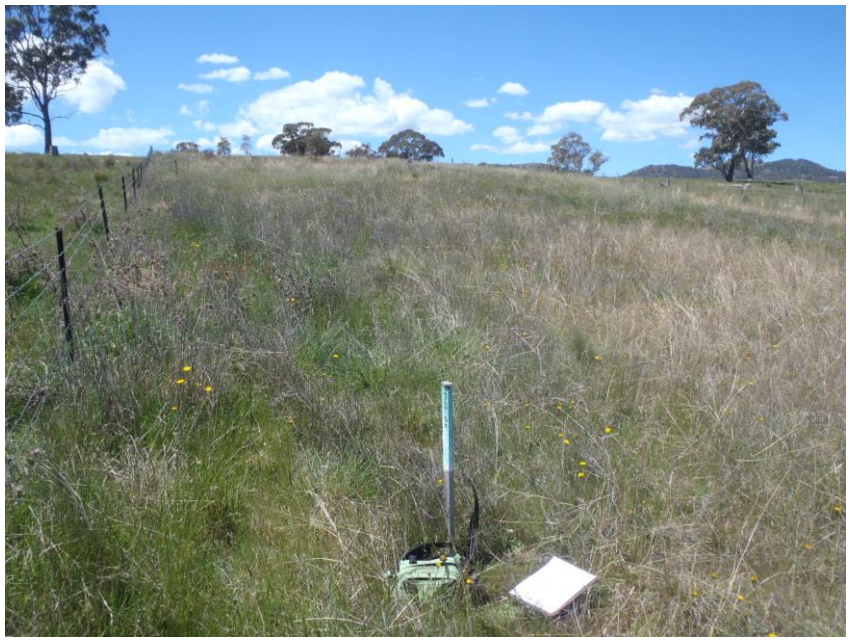


Plate 19: Monitoring Plot 06 - left autumn 2015, right spring 2015.

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	**3** (2)
Non-native cumulative cover %	**25-50** (25-50+)
Bare Ground %	**<1**
Mulch Cover %	0
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 increased from **19** to **22.** Non-native species increased from **13** to **21.**

Noxious species: none observed

Recommendation: Consider biomass control and undertake detailed management of broad-leaf weeds.

Plate 20: Monitoring Plot 10 - left autumn 2015, right spring 2015.

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

Six plots were established in areas of former non-native vegetation or low diversity mixed pasture – KPT category 1 (see **Table 1**). All plots in this category were located in the NSW section of the construction corridor (**Figure 2** and **Figure 3** in **Appendix 1**).

All plots in category 1 (07, 08, 11, 12, 13 and 14) have met the required KPT and no longer require monitoring.

4.6 Rare and threatened plants

No new observations were recorded during the spring 2015 survey period.

4.7 Rare and threatened animals

No new observations were recorded during the spring 2015 survey period.

4.8 Other observations

There was a moderate seasonal increase in the cover abundance of some annual pasture grasses (mainly *Brome* spp. and *Vulpia* sp.) and to a lesser extent clover *Trifolium* spp. While this resulted in a net increase in exotic species cover it was not a pronounced as in previous survey sessions: i.e. spring 2014.

4.9 Noxious weeds

Nine species of noxious plant have been recorded within or adjacent to sample plots (**Table 7**). 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).

The infestation of *Eragrostis curvula* on the western side of the Monaro Highway south of the main access gate has declined in response to recent control measures. However, the species is now widespread throughout the central and western sections of the construction corridor, though the infestations are, at this stage, in low densities.

Table 7: Noxious weeds recorded within the construction corridor.

Noxious Species	Declared in NSW	Declared in ACT	WONS	Plot / Location	Estimated density.
Carthamus lanatus	Yes	Yes		01	Not re-recorded
(Saffron Thistle)				03	*No access*
				06	>15 individuals
				18	Not re-recorded
				19	<4 individuals **^**
				20	<4 individuals
Echium plantagineum	Yes	Yes		06 10	<4 individuals **N** Not re-recorded
(Paterson's Curse)					
Echium vulgare	Yes	Yes		15	>15 individuals
(Viper's Bugloss)				16	4-15 individuals **^**
				19	Not re-recorded
				20	Not re-recorded
				21	Not re-recorded **v**
				23	Not re-recorded
				24	Not re-recorded
				25	Not re-recorded **v**
Eragrostis curvula	Yes	Yes		01*	4-15 individuals **^**
(African Love Grass)				02*	<4 individuals
				06*	Not re-recorded
				17	Not re-recorded
				18	4-15 individuals **^**
				19	4-15 individuals **^**
				20	4-15 individuals **N**
				22	<4 individuals **^**
				24	4-15 individuals **^**
				25*	>15 individuals
				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	<20 individual plants
				Low numbers though widespread east of plot 24 to Valve 3279	unknown
Hypericum perforatum	Yes	Yes		01	4-15 individuals
(St. John's Wort)				02	4-15 individuals
				10	Not re-recorded
				15	>15 individuals
				16	>15 individuals
				17	Not re-recorded

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

N = new record
^ = increase from previous survey period;
v = decrease from previous survey period
* = also recorded in low numbers within adjacent sections of the construction corridor.
WONS = Weed of National Significance, see
<http://www.environment.gov.au/biodiversity/invasive/weeds/weeds/lists/wons.html>

5 Management actions & recommendations

5.1 Weeds

Weed control measures appear to have been implemented (in accordance with the Weed Management Sub-plan) in some problem areas previously identified. While some infestations have declined others persist (**Table 7**, **above**).

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. (although Brome can be seasonally abundant), 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*, *Paspalum dilatatum*, *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 a variety of 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. However, in situations where infestations of broad-leaf weeds are confined to small areas 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 infestations of *Eragrostis curvula* and *Hypericum perforatum* within the Monaro Hwy and Goulburn-Cooma railway corridors. *This has been frequently recommended, but to this point in time little or no action has taken place.*

5.2 Biomass and weed control

Pulse grazing should be repeated in the central section of the construction corridor in late summer / early autumn 2016 and again during late winter 2016. If feasible, similar actions should also be considered for the area between Angle Crossing Road and the main power transmission easement near Plot 23 (other sections of the ACT are either still recovering and have insufficient groundcover).

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 Re-seeding

Re-seeding was undertaken prior to the autumn 2015 survey by Greening Australia within the western parts of the construction corridor, between Angle Crossing Road and Plot 19. Re-seeding should also be considered for the section of corridor either side of the Monaro Highway, specifically between Plot 22 to the west and the Railway corridor to the east.

5.6 KPTs

Difficulties associated with achieving KPTs were raised in Section 5.5 of the spring 2014 plot monitoring report, which recommended a review of the KPTs.

Despite recent improvements in native vegetation cover it remains unlikely that the current KPT of 70% would be achieved in the short to medium term. Furthermore, in order to reach this target it is likely that considerably greater effort in biomass and weed control and re-seeding would be required.

As stated previously, the current 70% KPT for both categories 2 and 3 vegetation should be lowered to 50% and 60%, respectively (with the condition that Icon Water commit to all management obligations until these targets are met).

6 Conclusion

All plots in category 1 (non-native vegetation) have met the required KPT.

Plot 17 (category 3 - high conservation value native vegetation) has consistently achieved native groundcover scores in the 50-75% range and is also considered to have met the KPT.

While no other plot associated with native vegetation (categories 2 and 3) achieved the required target three plots have native cover scores at the high end of the 25-50% range and five plots at the mid to lower end of the same range, which places them near the mid range of the KPT.

A total of four plots exhibited increased native cover compared to the previous autumn monitoring period, however, these gains were offset by either no change or declines among the remaining eleven plots. In addition, the inability to access four of the better performing plots in the central section of the construction corridor is likely to have lowered estimates of native cover.

Recommendations relate to the broad-leaf weed and biomass control in the central and western sections of the construction corridor. Measures include cautious application of herbicide and pulse grazing.

Finally, conjecture regarding the KPT for native vegetation should be resolved. It is our opinion that the current 70% KPT should be lowered 60% and 50% for categories 3 and 2, respectively.

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

Figure 1 – **Figure 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

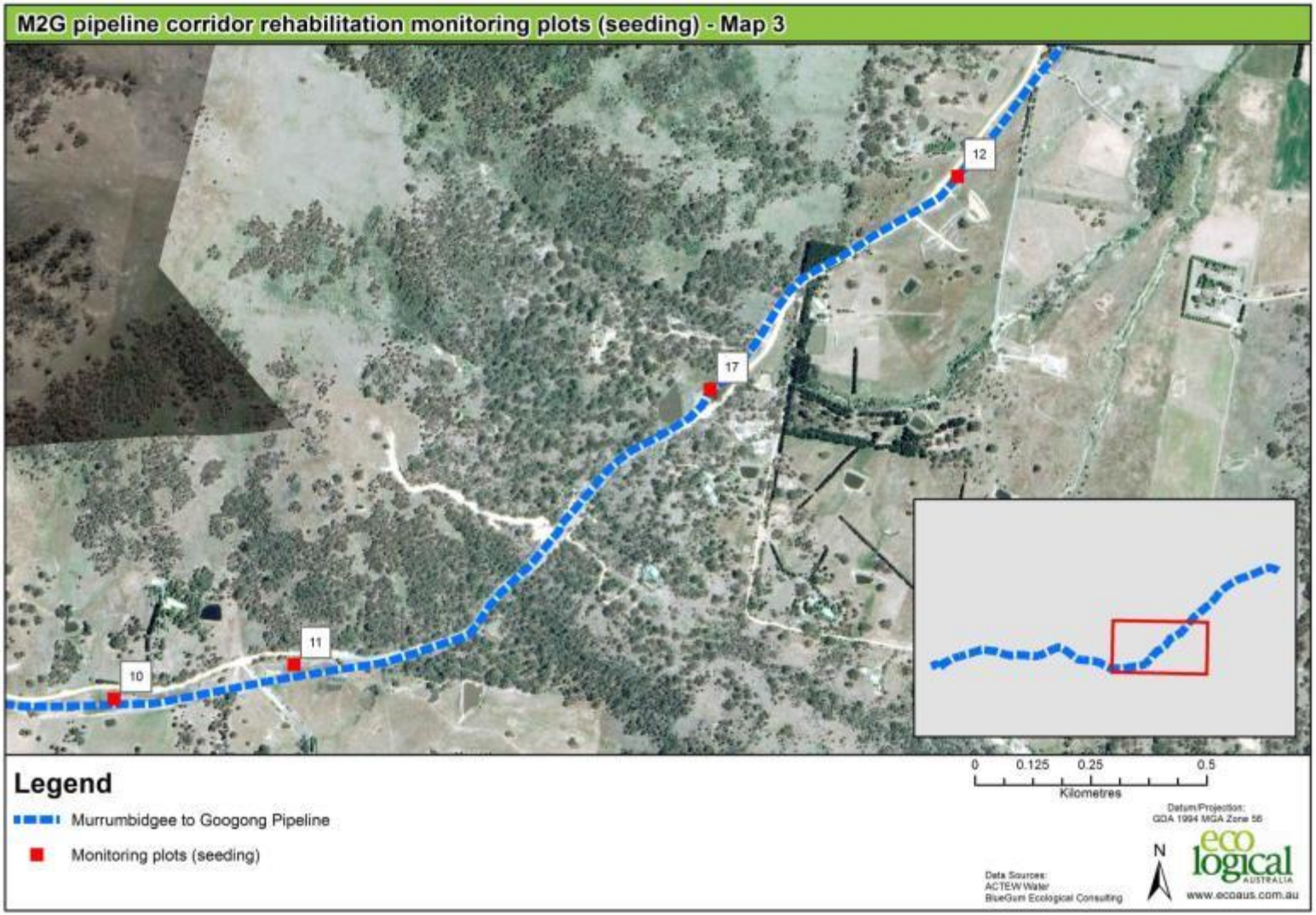


Figure 3: Monitoring sites within the central-eastern section of the M2G construction corridor

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 8: Floristic data: Control plot autumn 2015.

*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						
*Aria sp.**	1	1				
*Cirsium vulgare**	r					
*Eragrostis curvula**	+					
*Hypericum perforatum**	1	1				
*Hypochaeris glabra**	r					
*Hypochaeris radicata**	r					
*Paronychia brasiliana**	1	1				
*Petrorhagia nanteuilii**	1	1				
*Rosa rubiginosa**	r					
*Rubus sp.**	r					
*Taraxacum officinale**	+					
*Trifolium arvense**	1	1				
*Trifolium subterraneum**	2		1			
*Trifolium sp.**	2		1			
Total exotic species	**14**	**4**	**2**	**0**	**0**	
Cumulative cover	**1 (<5%)**					
Native						
Acaena ovina	1	1				
Arthropodium milleflorum	r					2
Austrosanthonia sp.	3			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*
Austrostipa bigeniculata	1	1				
Austrostipa scabra	1	1				
Bossiaea prostrata	+					2
Bothriochloa macra	2		1			
Chrysocephalum apiculatum	2		1			1
Convolvulus angustissmus	1	1				
Crassula sieberana	1	1				
Cymbonotus lawsonianus	+					
Daucus glochidiatus	+					
Desmodium varians	r					2
Einadia nutans	+					
Elymus scaber	1	1				
Eryngium ovinum	+					2
Eucalyptus bridgesiana	3			1		
Galium gaudichaudii	1	1				2
Geranium solanderi	+					
Gonocarpus tetragynus	+					1
Hydrocotyle laxiflora	1	1				2
Isoetopsis graminifolia	+					2
Leptorhynchos squamatus	1	1				2
Lomandra bracteata	r					1
Lomandra filliformis	+					1
Microlaena stipoides	+					
Oreomyrrhis eriopoda	+					2
Oxalis perennans	1	1				
Panicum effusum	1	1				
Plantago varia	1	1				2
Rumex brownii	r					

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*
Scleranthus diander	1	1				2
Senecio quadridentatus	r					
Solenogyne dominii	+					
Swainsona sericea	1	1				2
Themeda australis	1	1				
Triptilodiscus pygmeaus	1	1				2
Vittadinia mulleri	+					
Wahlenbergia sp.	1	1				
Wurmbea dioica	1	1				2
Total native species	**39**	**18**	**2**	**1**	**0**	**18**
Cumulative cover	**5 (>75%)**					
CONTROL PLOT 2						
Exotic						
*Aria sp.**	1	1				
*Centaurium sp.**	1	1				
*Gamochaeta purpurea**	1	1				
*Hypochaeris radicata**	+					
*Petrorhagia nanteuilii**	+					
*Rosa rubiginosa**	r					
*Trifolium campestre**	1	1				
*Vulpia sp.**	1	1				
Total exotic species	**8**	**5**	**0**	**0**	**0**	
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						
Acaena ovina	+					
Arthropodium milleflorum	1	1				2
Asperula conferta	+					2
Austrodanthonia sp.	1	1				
Austrostipa scabra	+					
Bulbine bulbosa	1	1				2
Cheilanthes sieberi	r					2
Chrysocephalum apiculatum	2		1			1
Cymbonotus lawsonianus	+					
Desmodium varians	r					2
Elymus scarber	+					
Eryngium ovinum	+					2
Eucalyptus bridgesiana	r					
Eucalyptus melliodora	2					
Euchiton sp.	+					
Galium gaudichaudii	+					2
Geranium solanderi	+					
Gonocarpus tetragynus	1	1				1
Hydrocotyle laxiflora	1	1				2
Hypericum gramineum	r					2
Kunzea ericoides	+					
Leptorhynchos squamatus	1	1				2
Lomandra bracteata	r					1
Luzula densiflora	1	1				2
Melichrus urceolatus	r					2
Microseris lanceolata	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*
Oxalis perennans	+					
Poa sieberiana	+					
Schoenus apogon	+					
Sebaea ovata	r					2
Stackhousia monogyna	1	1				2
Themeda australis	4				1	2
Triptilodiscus pygmeaus	1	1				2
Vittadinia muelleri	1	1				
Wahlenbergia sp.	1	1				
Wurmbea dioica	1	1				2
Total native species	**34**	**13**	**1**	**0**	**1**	**21**
Cumulative cover	**5 (>75%)**					

Note: *Eucalypt* species not included in cover score tally.

Table 9: Floristic data – monitoring plots autumn 2015.

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 dealbata		r																								**4**
Acaena ovina		r							r							+	r	+		+					r	**13**
Alternanthera sp.					+																					**1**
Aristida ramosa		1																		r						**0**
Arthropodium mille																						r				**3**
Asperula conferta																	1					r				**2**
Austrodanthonia sp.	1	1	1	1	1				1	1					1	2-	2-	1	2-	1	1	1	2	1	2	**0**
Austrostipa bigeniculata	+	1	1	1	+	+			1	+		+					1	1	+	+		+	+	+	1	**14**
Austrostipa scabra	1	1	2-	1	1	1			1	1					1	1	1	1	1	1	1	1	1	1		**0**
Bossiaea buxifolia																r										**1**
Bothriochloa macra	1	1	2-	2+	3-	2+			3	2-		+			2	2	2	1	1	2-	1	2-	1	2-	1	**4**
Brachyloma daphnoides																r				r						**1**
Carex appressa																									r	**0**
Carex breviculmis																				+						**5**
Carex inversa	+	+	+																							**0**
Cassinia sp.																r										**0**
Chamaesyce drummondii			1	1		1			1			r			r	r		+		1			+	r		**1**
Cheilanthes sieberi		+	r	+											r	r				1						**0**
Chloris truncata	1	1	1	2+	1	1			1	1		1			1	1	1	1	2-	1	1	1	1	1	1	**1**
Chrysocephalum apiculatum																	r	+		1		+				**1**
Convolvulus erubescens																r		r								**1**
Cullen microphyllum																	r									**0**
Cymbonotus lawsonianus	+	+													r	1	+	+		1	+	1	+			**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
Daucus ? glochidiatus																							r			**4**
Desmodium varians									r						r	r										**2**
Dichelachne sp.				r																		r				**0**
Dichondra repens					+																	r				**0**
Dillwynia sericea		r																								**3**
Elymus scaber	1	1	1	1	1	+			1	1					1	1	1	1	1	1	1	1	1	1	1	**0**
Enneapogon nigricans																				1						**12**
Epilobium billardierianum																				+						**1**
Eragrostis brownii																						+	+	+		**1**
Eragrostis sp.												+					1								1	**7**
Eragrostis trachycarpa	1	1			1	1			1	1		1					1	1	+			r	1		1	**1**
Erodium crinitum						r																r				**0**
Eryngium ovinum																							r			**1**
Eucalyptus bridgesiana		r																								**0**
Eucalyptus mannifera		r																								**0**
Eucalyptus melliodora		r	+		+					r							+							+	r	**2**
Euchiton sp.	+	+				r						r					r	+	r	+			+			**2**
Geranium retrosum																				r						**1**
Geranium solanderi		r	+	r	+	+				r					1		1	1		+	+	+	+	r	+	**2**
Glycine sp.																		r								**6**
Glycine tabacina																				r						**0**
Gonocarpus tetragynus		1													r	1		+		1		+				**0**
Haloragis heterophylla		+			1				1	1					r	+	1									**1**
Hibbertia obtusifolia		+														r										**0**
Hydrocotyle laxiflora		+			1																		1			**0**
Hypericum gramineum		+			1				+							+	1					r				**0**

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
Juncus australis										r							1						r		r	**0**
Juncus filicaulis	+				1					+							1		r	+			+			**0**
Lachnagrostis filiformis		r															+									**0**
Leptorhynchos squamatus																				1						**0**
Lomandra filiformis									+											+		+	+	+		**0**
Microlaena stipoides	1	2-	2-	1	1	2			1	1					1	2	1	1	1	+	1	1	1	1		**1**
Ophioglossum lusitanicum									r																	**0**
Oxalis perennans	+	r	1	+	1	1			1	1					1	1	1	+	+	1		r	+	+	r	**0**
Panicum effusum	2-	1	1	2-	1	1			1	1		1			1	1	1	3	2-	3	1	2-	1	1	1	**9**
Persicaria prostrata															1		r								+	**12**
Plantago varia																		1				1				**0**
Poa labillardierei																	1			r						**8**
Poa sieberiana	+			+	+	+				r		r														**7**
Pseudognaphalium luteoalbum				r					+			r					r									**1**
Rumex brownii				r	1	1			r	+					+	r	+	+		+	r					**3**
Schoenus apogon																	r								r	**16**
Senecio quadridentatus		r								+					+		+									**0**
Solenogyne dominii									r													r	r			**0**
Stackhousia monogyna																r						r				**0**
Stellaria pungens ?																	r									**0**
Swainsona sericea																+										**1**
Themeda australis	1	2-	1	2-	2-	1			2	2-					1	1	2	1	1	2-	1	1	+	+	1	**12**
Veronica gracilis																	+									**4**
Vittadinia muelleri																	1			r	r					**14**

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
Wahlenbergia sp.	r	r	1	1	1				1	1					+	+	1	+		1		1	1		+	**0**
Sp. with score of 1	**8**	**10**	**9**	**7**	**14**	**8**	**-**	**-**	**12**	**10**	**-**	**3**	**-**	**-**	**10**	**8**	**18**	**11**	**5**	**13**	**8**	**9**	**10**	**6**	**8**	
Sp. with score of 2	**1**	**2**	**3**	**4**	**1**	**2**	**-**	**-**	**1**	**2**	**-**	**-**	**-**	**-**	**1**	**3**	**3**	**-**	**3**	**2**	**-**	**2**	**1**	**1**	**1**	
Sp. with score of 3	**-**	**-**	**-**	**-**	**1**	**-**	**-**	**-**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**-**	**1**	**-**	**-**	**-**	**-**	**-**	
Sp. with score of 4	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	
Sp. with score of 5	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	
TOTAL NATIVE																										
Total cover autumn 2015	**2+**	**3-**	**3**	**3+**	**3+**	**3-**	**-**	**-**	**3+**	**3-**	**-**	**1**	**-**	**-**	**2+**	**3-**	**4**	**3+**	**3-**	**3+**	**2**	**3-**	**3-**	**2+**	**2+**	
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	2+	1	1	+				+		+			+	+		1	+	1	+		+			**4**
*Anagallis arvensis**	+	+	r		+	+			+	r		r			+	+	r									**13**
*Avena sp.**						1				+					r											**1**
*Briza sp.**																	r									**0**
*Bromus sp.**	1		1	1	1	1			1	1		1						2	1	1	+	1	2	1	1	**3**
*Carthamus lanatus**						1														+						**2**
*Centaurium sp.**	r	1	+	1	+	+			1	+		+			1	1	1				+	1	1		1	**0**
*Chenopodium ? album**			r																							**14**
*Chondrilla juncea**												r										r				**0**
*Cirsium vulgare**		r	1	+	1	+			+	r					+	+	r	+	+			+	+	r		**1**
*Conyza sp.**	+	r	r		+	1			+			+			1	1		1	1	r		1	1	1	+	**4**
*Cynodon dactylon**			2+						r			r							+					+		**1**
*Cyperus eragrostis**																			r							**0**
*Dactylis glomerata**						+						4-			+		+									**5**
*Echinochloa esculenta**												r														**0**
*Echium plantagineum**												+														**0**
*Echium vulgare**															1	1					+				r	**1**
*Eleusine tristachya**					1	+												1	1				+	1	1	**0**
*Eragrostis cillianensis**												r														**1**
*Eragrostis curvula**	r	r										1												+	1	**1**
*Eragrostis sp.**																				r						**1**
*Erodium botrys**																+										**0**
*Erodium cicutarium**						r			r						r	+		1		1			+			**1**
*Festuca elatior**					+							1														**4**
*Gamochaeta ? calviceps**	+																									**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
*Gamochaeta purpurea**																+							+			**0**
*Gamochaeta sp.**		+		+					+								1					+				**3**
*Hirschfeldia incana**																+			+		+					**0**
*Holcus lanatus**					+																					**12**
*Hordeum sp.**																		+								**1**
*Hypericum perforatum**	+	+													1	1		+	+		1	r	r	+	1	**1**
*Hypochaeris radicata**	2	2-	3	1	2	2			1	2-		1			+			1		1	r	+	+		+	**7**
*Lolium perenne**				1	1					1		+						+				1	1		1	**1**
*Marrubium vulgare**																r										**0**
*Modiola caroliniana**												1			1			r							r	**1**
*Nassella trichotoma**				+																				r	r	**0**
*Oenothera sp.**															+	r										**0**
*Panicum capillare**					+	1																		+		**2**
*Paronychia brasiliana**			r		+											+						+				**2**
*Paspalum dilatatum**	+		+		+	1				+		+					1		r					1	2-	**1**
*Phalaris aquatica**			+			1				1		1					1								1	**2**
*Plantago lanceolata**	1	r			r	1			+	3-		1			+		1	1	+	2	+	+	r	1	1	**6**
*Rosa rubiginosa**	r	r																								**0**
*Salvia verbenacea**																		r								**0**
*Sanguisorba minor**															r											**1**
*Setaria sp.**				r						+							+							+		**0**
*Silybum marianum**			+																							**0**
*Solanum nigrum**						r									r	+							r			**0**
*Sonchus sp.**	+	+	+	+	+	1									+	r		+	r			+	1		r	**0**
*Taraxacum officinale**			+		+	+			+			r			+	+	r	+	r	+	r	+	r			**0**

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
*Tolpis umbellata**	r																	+		+		r	r			**0**
*Trifolium arvense**					1							+			+	+		1		+					+	**0**
*Trifolium sp.**			1	+	1	r			1			+				+	1	1		1	r		1			**0**
*Trifolium subterraneum**					1							+					1	1					1			**1**
*Verbascum thapsus**			r									r			1	+		r		r	+					**0**
*Verbascum virgatum**																r										**0**
*Verbena bonariensis**															3	+			+		r					**9**
*Vulpia sp**	1	1	1	1	1	1			1	1		1			1		1		1	1	+	1	1	1		**12**
Sp. with score of 1	**3**	**3**	**4**	**6**	**9**	**10**	**-**	**-**	**5**	**4**	**-**	**8**	**-**	**-**	**7**	**4**	**8**	**9**	**4**	**6**	**1**	**5**	**7**	**6**	**8**	
Sp. with score of 2	**1**	**1**	**2**	**-**	**1**	**1**	**-**	**-**	**-**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**-**	**1**	**-**	**-**	**1**	**-**	**1**	
Sp. with score of 3	**-**	**-**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**-**	**-**	**-**	**-**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	
Sp. with score of 4	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	
Sp. with score of 5	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	
TOTAL EXOTIC																										
Total cover Autumn 2015	**2**	**2**	**3+**	**2**	**3-**	**2+**	**-**	**-**	**2-**	**3+**	**-**	**4**	**-**	**-**	**3**	**1**	**2-**	**2+**	**1**	**2+**	**1**	**1**	**2+**	**2-**	**2**	
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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