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Melbourne Water Corporation

Report for Sugarloaf Pipeline - Flora Monitoring

Sheoak Grassland Restoration Experiment Report - Final

March 2012

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Purpose

The purpose of this document is to:

- Describe the general approach used by the Alliance to undertake flora monitoring on the Sheoak Grassland Restoration experiment;
- Summarise the results of the flora monitoring of the Sheoak Grassland Restoration experiment; and
- Provide recommendations for further monitoring and management actions.

The purpose of flora monitoring as a part of the Grassland Restoration experiment is to:

- Document the change in species cover and composition of both native and introduced flora species over time;
- Document the variation in inter-tussock distances between the experimental plots over time; and
- Document the success of the different methods of reinstatement utilised during the Grassland Restoration experiment.

Abbreviations

Term	Description
Alliance	Sugarloaf Pipeline Alliance
DEWHA	Commonwealth Department of the Environment, Water, Heritage and the Arts (now DSEWPaC)
DSE	Victorian Department of Sustainability and Environment
DSEWPaC	Commonwealth Department of Sustainability, Environment, Water, Population and Communities
EMP	Environmental Management Plan
EMS	Environmental Management Strategy
EPBC	Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*
FFG	Victorian *Flora and Fauna Guarantee Act 1988*
GSM	Golden Sun Moth
HLPS	High-lift Pump Station
ROW	Construction Right of Way
SLPA	Sugarloaf Pipeline Alliance (the 'Alliance')

1. Introduction

The Golden Sun Moth (*Synemon plana*) (GSM) occurs in grasslands and open grassy woodlands in south-eastern mainland Australia. The native grassland and grassy woodland habitats used by the GSM are amongst the most threatened of all vegetation types in Australia, with more than 99.5% estimated to have been grossly altered or destroyed (DEWHA 2009, Kirkpatrick et al. 1995, Lunt 1991). The GSM is generally found in grassy habitats that are dominated by native grass species, but they have also been occasionally found within areas dominated by non-native grasses. The species is listed as 'critically endangered' on the Commonwealth *Environment Protection and Biodiversity Conservation* (EPBC) *Act 1999,* 'threatened' on the Victorian *Flora and Fauna Guarantee* (FFG) *Act 1988* and 'critically endangered' on the Department of Sustainability and Environment (DSE) *Advisory List of Threatened Invertebrate Fauna in Victoria* (DSE 2009).

In late 2008, targeted surveys undertaken by the Sugarloaf Alliance (the 'Alliance') identified the presence of flying adult GSM at a number of locations along the proposed Construction Area alignment for the Sugarloaf Pipeline Project ('the Project'). Most observations were within the 3-5 km stretch of the alignment south of Yea, including the property proposed to contain the Sheoak High Lift Pump Station (HLPS)[1].

The Sheoak Grassland Restoration experiment (SLPA 2009ab) is one of the post construction monitoring experiments designed to both help mitigate the impacts of the project on GSM, and to further assist scientific understanding of the species.

[1] The Sheoak property is owned by Melbourne Water; a member of the Sugarloaf Pipeline Alliance.

2. Establishment

The Sheoak Grassland Restoration experiment was established at the Sheoak property in the re-instated area following construction of the pipe in October 2009, in accordance with the requirements outlined in Section 7.1.2 of the Fauna Management Program - Sheoak High Lift Pump Station (SLPA 2009a). The experimental design comprised a total of 60 plots (3 x 3 m plots), with 10 replicates of the following 6 'treatments':

- Control – plots located in unaffected grassland adjacent to the 30 m wide Right Of Way (Construction area for the Sugarloaf Pipeline);
- Subsoil – plots reinstated to subsoil only with topsoil removed;
- Natural Regeneration – plots re-instated with top-soil but no other action;
- Direct Seeding – plots re-instated with topsoil and seed collected from the Sheoak property;
- Tubestock planting – plots re-instated with topsoil and tubestock (36 plants per plot) comprising species in pre-clearance grasslands at the site as follows:
  - *Rytidosperma setacea* 12 – 13 plants per plot;
  - *Austrostipa rudis* var. *rudis* 7 – 8 plants per plot;
  - *Aceana echinata* 3 plants per plot;
  - *Microlaena stipoides* var. *stipoides* 4 – 5 plants per plot;
  - *Lomandra longifolia* 3 – 4 plants per plot;
  - *Juncus amabilis* 3 – 4 plants per plot;
  - *Elymus scaber* var. *scaber* 1 – 2 plants per plot; and
- Tussock replacement – plots reinstated with topsoil and tussocks (*Austrostipa sp., Rytidosperma sp., Juncus sp.*) that were salvaged from the site prior to the site being cleared. Tussocks were randomised across plots. Approximately 40 tussocks were reinstated into each plot.

The 50 treatment plots (all except the 10 controls) were randomly allocated to one of the five treatments. The location and layout of the plots are shown in Appendix A. Flora monitoring on a 3-monthly cycle was undertaken nine times during the experimental period and interim reports have been provided.

Tussocks were collected for the tussock replacement experiment in March 2009 and stored in wooden boxes on the Sheoak property until October 2009. During this time, many of the collected tussocks entered a dormant phase and weeds germinated and became dominant within the boxes. Despite this, all tussocks were placed back into the plots, however, it was not possible to determine the exact number of tussocks and species returned to each plot but it is estimated to be between 35 and 45 tussocks per plot.

Due to the late spring establishment of the experiment, an irrigation system was set up on all plots with the exception of the controls. All plots were watered twice weekly, or at greater frequency if deemed necessary until April 2010.

A decision was made to delay the direct seeding experiment until autumn 2010, as the prospect of a hot summer would compromise the effectiveness of this treatment. Unfortunately, seed collected by contracted seed collectors in 2009 was not viable and appropriate seed complying with the requirements of the approved management program (SPLA 2009ab) could not be sourced elsewhere. This treatment was therefore discontinued and incorporated into the natural regeneration treatment which now constitutes 20 plots. Ten plots from these 20 will be randomly selected for the final analyses.

3. Methods

Monitoring was undertaken in accordance with the methodology outlined in the Golden Sun Moth Overarching Document (SLPA 2009b).

Monitoring included an assessment of the following factors:

- Full species list including native and introduced species present within each plot;
- Percentage cover class of each species within each experimental plot;
- Percentage cover class of each life form within each experimental plot (e.g. graminoids, forbs);
- Percentage cover class of bare ground within each experimental plot;
- Vertical structure of each life form within each experimental plot; and
- Inter-tussock distance as measured at five random points (four quadrants per point) within each experimental plot (i.e. 20 points per plot).

Cover classes recorded followed the categories in Table 1.

Table 1 Cover classes recorded for the Grassland Restoration Experiment

Cover Class	Percentage Cover
+	<1% cover
1	1 – 5% cover
2	5 – 15% cover
3	15 – 25% cover
4	25 – 50% cover
5	50 – 75% cover
6	75 – 100% cover

The dates of each round of flora monitoring for the grassland restoration experiment are documented in Table 2.

Table 2 Flora monitoring undertaken to date for the Grassland Restoration Experiment

Assessment timing	Date
Assessment 3 months after establishment	January 2010
Assessment 6 months after establishment	April 2010
Assessment 9 months after establishment	July 2010
Assessment 12 months after establishment	October 2010
Assessment 15 months after establishment	January 2011
Assessment 18 months after establishment	April 2011
Assessment 21 months after establishment	July 2011
Assessment 24 months after establishment	November 2011
Assessment 27 months after establishment	January 2012

4. Compliance

This report outlines the vegetation monitoring undertaken in accordance with the measures outlined in Section 7.1.2.5 of the Fauna Management Program - Sheoak High Lift Pump Station (SPLA 2009a) and Section 5.2 of the GSM overarching document (SPLA 2009b) SPA-REP-GL-ENV-0014-REV B-VERSION 01). The monitoring fulfils the environmental obligations as set out in:

- Condition 3 and 5 of DEWHA environmental approval for the project under the EPBC Act;
- GSM – Offset package proposal (SPA-REP-GL-ENV-0019); and
- Appendix A: Table 1 of Minister for Planning's written advice.

Adaptive management was required for some aspects of the monitoring when considering the practicalities of collecting the data in the field, with the following changes being adopted:

- No recording of tussock density or tussock condition and survivorship. These measures proved impractical to measure reliably in the field due to difficulty in identifying individual tussocks in the majority of instances. Although tussocks could easily be identified in the surrounding grasslands, this proved extremely difficult to determine in regenerating plots due to the mass of regenerating seedlings and did not provide useful or comparable data; and
- Structure was measured in four classes which are indicative of plant form and maturity rather than 10 cm intervals which proved impractical to measure reliably in the field. The height intervals used were 0–10 cm, 10-30 cm, 30-100 cm and over 100 cm.

The required photographs and monitoring data has been collected at three monthly intervals with this report describing changes noted in the latest round of monitoring (January 2012). Examples of photographs taken are included in this report and an example of the monitoring sheet illustrating the collected data is included in Appendix B.

5. Results

This report examines the changes over time of the various treatments aimed at restoring the native grasslands to disturbed areas. Analysis of the data collected indicated two measures were of prime importance in determining the relative success of the treatments, namely:

- Native tussock cover (cover of native grasses); and
- Introduced species cover (cover of all introduced species).

These two measures best represent the inter-action of native and weed species on the site. These data are plotted over time for each of the treatments as the average with the minimum and maximum also plotted to demonstrate the variability in the measurements over time. Other data are discussed where contextually relevant.

5.1 Control

Even though the area in which the experiment was conducted had previously been mapped as native grassland, Figure 1 demonstrates that introduced species were dominant across the site over the experimental period. There was variation in both native and introduced cover over time, which also varied differently over the seasons, with some plots regularly dominated by native species whilst others were covered almost exclusively by introduced species, commonly pasture grasses.

During the experiment, it was observed that there appeared to be additional growth of introduced species, most likely due to the higher than average rainfall in the area (average 952 mm per year in 2010 to 2011 versus long term average of 638 mm per year[2]) during the experimental period, especially given 10 years below average rainfall in the previous decade. This observation is demonstrated by the photos of Plot 51 at the start and end of the experiment shown below.

January 2010 January 2012

Control (no clearing) (Plot 51)

[2] Data for station 88067 (Yea) from Bureau of Meteorology website.

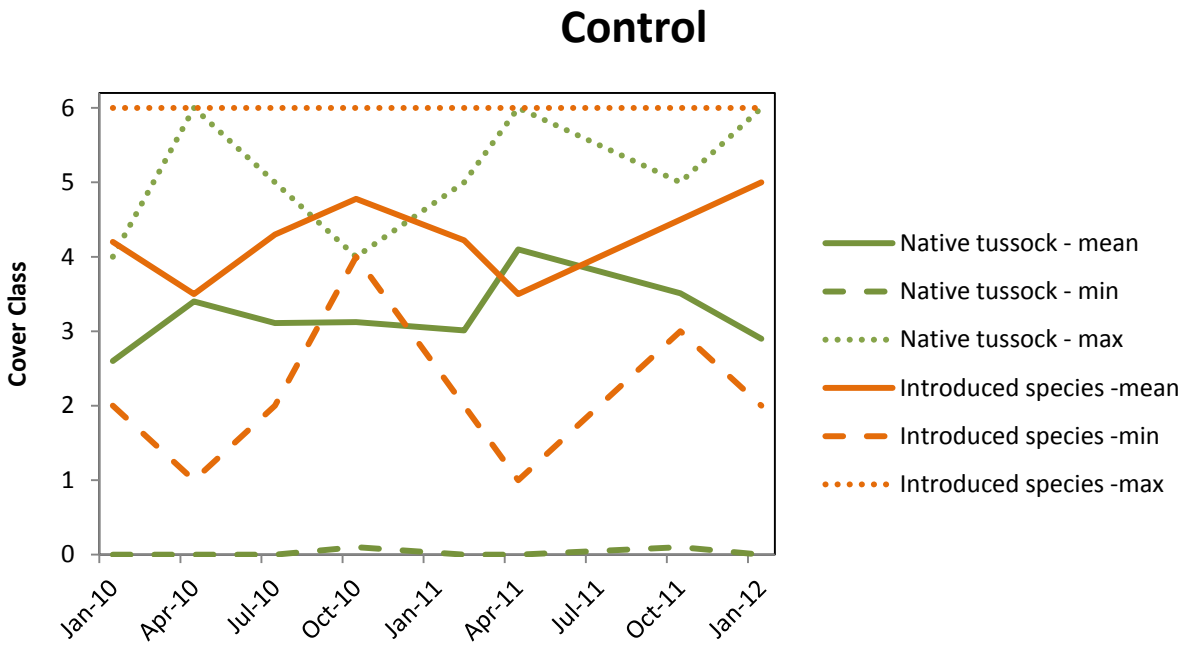

Figure 1 Native tussock cover and Introduced species cover over time for control plots

The data show that there has been a slight increase in the cover of both introduced species and native tussocks in control plots, but this has been relatively slight. What was noted is that there has been a relative drop in the cover of litter and bare ground over time (data not shown), which indicates that the space between tussocks evident in the photos has been filled in with the growth of new grasses as favourable conditions have been maintained.

5.2 Sub-soil Reinstatement

The theory behind the Sub-soil Reinstatement treatment is that the removal of the topsoil removes the weedy seed-bank and high nutrient conditions (due to fertiliser addition over years) of areas that have been used for pastures. Theoretically this provides a competitive advantage for native grasses in the colonisation of the areas.

Contrary to theory though, the data show these plots have been colonised to a greater degree by introduced species than by natives (see Figure 2), but further analysis shows that this is only part of the story. The plots are still predominantly bare (see photos below), whilst the majority of the cover of introduced species has come from transient species such as *Arctotheca calendula* (Cape Weed) which has high cover in spring but dies off over summer, accounting for the “boom and bust” cycle evident in Figure 2. Pasture grasses, which are dominant in the surrounding areas, are largely absent from the plots, whilst the native tussock cover has been steadily increasing over the same time period and many of the tussocks are now well established. A diverse range of native grasses have now established on all of the plots.

Conclusions on the success of this treatment cannot be made at this time, as there is still a great deal of bare ground on these plots (>50% across all plots). It is unlikely that these plots will ever by entirely weed free given the high weed cover of the surrounding areas (as shown in control plots), but the steady increase in native tussock cover indicates that this treatment has the potential to succeed in the long term.

There are other concerns that should also be taken into account for this treatment. The slow rate at which these plots are colonised is likely to be an issue if applied on a larger scale, as any site will appear as bare dirt for years following re-instatement, particularly if there is no adjacent seed source as was the case for this experiment. Whilst this experiment suggests that in time the area will become revegetated, there are likely to be amenity and social concerns that would need to be considered in the meantime.

January 2010 January 2012

Sub soil Reinstatement (Plot 1)

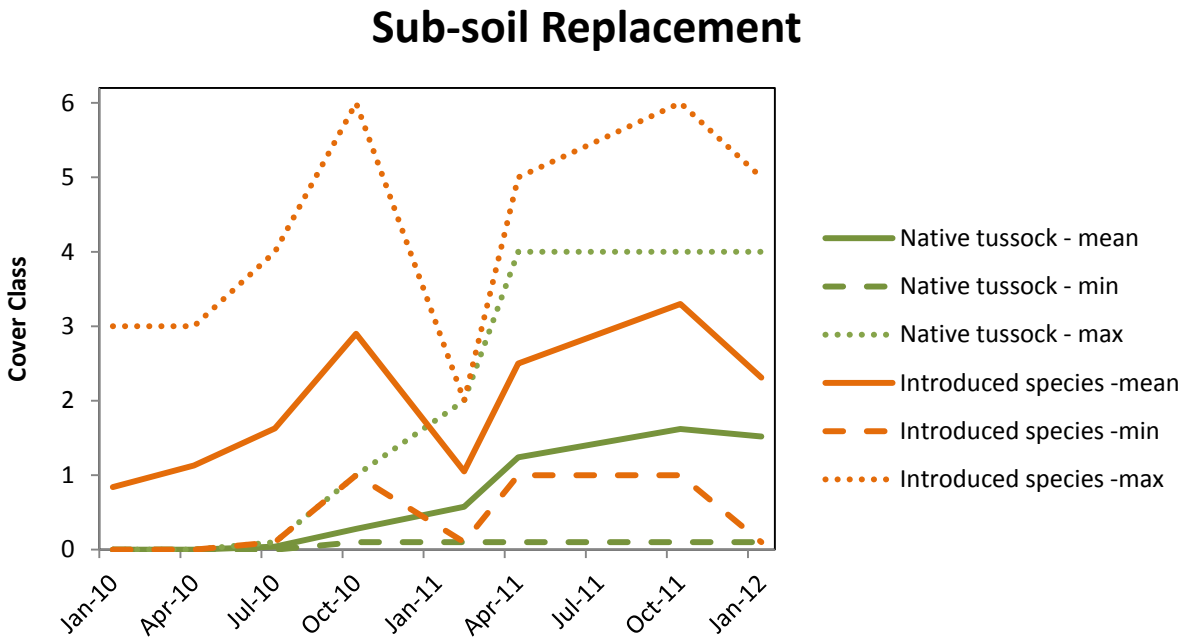

Figure 2 **Native tussock cover and Introduced species cover over time for plots in which no top soil was replaced**

5.3 Natural Regeneration

The natural regeneration treatment aims at allowing the seed-bank present in the soil to germinate and recolonise the construction areas. The major advantage of this treatment is that the soil seed-bank is likely to contain the same suite of species as was removed during clearing. This approach requires careful topsoil management (see Sheoak Reinstatement Management Plan, SLPA 2009 for details) to maintain the soil seed bank for a period of months following clearing, but has relatively low inputs.

The plots for this treatment have been dominated by introduced species throughout the experimental period, though cover of native tussocks has steadily increased over time, especially in the latter stages of the experiment (Figure 3) and are now only slightly lower than control plots. Overall, this treatment has resulted in the restoration of intact grasslands (see photo below), with more than 50% cover recorded at all sites at the conclusion but there is wide variation in the relative success of native grasses, which range from sparse to dominant across the plots (Figure 3). This variation though, is reflected in the data collected on the control plots, and indicates that the aim of restoring grasslands similar to the extant grasslands has been achieved.

The native species recorded within the natural regeneration plots sites includes all those that have been recorded in the control plots, including the poorly known species *Desmodium varians* (Slender Tick-trefoil). This result is important as it indicates that at least the majority, if not all species, have the capability to return to the construction area following reinstatement.

January 2010 January 2012

Natural Regeneration (Plot 20)

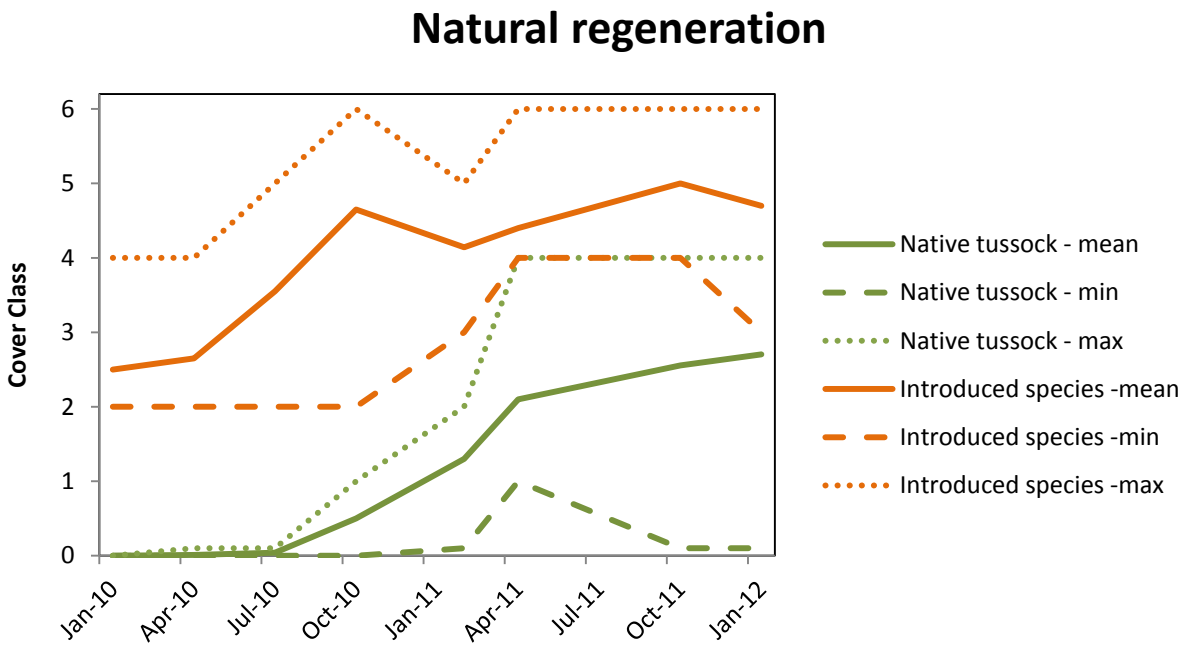

Figure 3 Native tussock cover and Introduced species cover over time for plots in which top soil was replaced

The original protocol had an additional treatment whereby natural regeneration would be supplemented with seed collected from the Sheoak property in 2009 with the aim of reinstating the grasslands in areas outside the experimental area. The aim of broadcasting additional seed within the plot is to boost the relative numbers of targeted species, which in this case would have been native grasses. However, the seed collected was of poor quality and could not be used for the experiment. The majority of collected material had been harvested too late and the seed had already dropped from the plant. The failure of this treatment highlights the need for appropriate seed collection to be factored into the timelines for projects and for knowledgeable and experienced people to undertake the seed collection and seed collection should involve multiple visits to target the range of desired species.

5.4 Tubestock Planting

Reinstating vegetation through planting of tubestock is generally used to reduce some of the risk of failure that is inherent in natural regeneration and direct seeding (poor seed-bank viability, seed predation and germination failure). It is however a comparatively labour intensive and costly method as follow-up watering is essential during summer months to ensure the survival of stock.

As with all treatments, the cover of introduced species has been consistently higher that the native cover, but for the revegetated plots, native cover has increased over time and at the conclusion of the experiment is equal to the introduced cover. When compared to the natural regeneration treatment, which was effectively the default treatment on non-planted areas of the plot, the cover of native grasses has been consistently higher. In addition, whilst variable, all plots have a fair proportion of native grasses at the conclusion of the experiment (Figure 4), which is a result not seen in control plots (Figure 1).

Overall, the treatment has resulted in the restoration of grasslands (see photos below) with an even mix of native grasses and introduced species present at the conclusion. The survival rate of the tubestock used in this experiment was high with most plants surviving the experimental period, with the exception of short lived grasses such as *Elymus scaber* (Common Wheat-grass).

April 2011 July 2011

Tubestock planting (Plot 31)

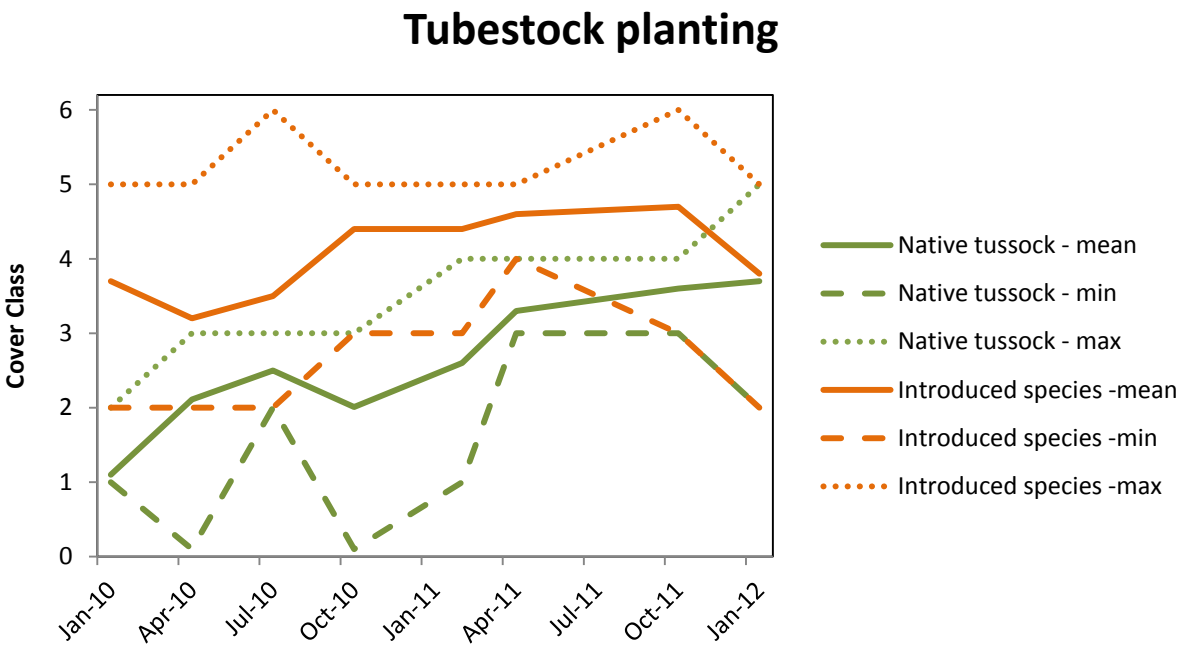

Figure 4 **Native tussock cover and Introduced species cover over time for plots in which top soil was replaced and tube-stock were planted**

5.5 Tussock Replacement

The tussock replacement experiment was a novel treatment, which aimed to use the principal of tube-stock planting (i.e. planting of live tussocks), combined with the advantages of natural regeneration (i.e. species returning are from the disturbed area. An additional theoretical advantage was the potential to re-introduce Golden Sun Moth larvae, which live in the root balls of the native grasses that were harvested prior to disturbance.

In practice, there were numerous issues inherent in the application of this treatment, particularly in the storage of the tussocks. The boxes in which the tussocks were stored became overgrown with weeds, predominantly *Lolium sp.* (Rye Grass), in the latter stages of the storage period, which apparently choked the native grasses. The majority of the weeds were removed prior to replacement of the tussocks but many were in poor health when replaced.

The weediness of the storage boxes is reflected in the data collected for the tussock replacement plots over the experimental period. The cover of introduced species started at very high levels and this has been maintained throughout the experiment (Figure 5). Native tussocks have been present at all plots throughout the experimental period, unsurprising given these were actively planted in the plots, but the cover of native tussocks has remained low (Figure 5) when compared to other treatments such as the tube-stock planting, which have seen steady increases in the proportion of native tussock cover over time (Figure 4).

It has been noted during the assessment period that these plots have typically had higher diversity including native species, than other treatment plots, although the degree to which this has been evident has decreased over time. It also the only treatment to record *Eucalyptus camaldulensis* (River Red-gum, see Photos below), trees which dot the Sheoak property, however this is almost certainly a result of the tussocks being stored near a stand of River Red-gums.

January 2010 January 2012

Tussock replacement (Plot 29)

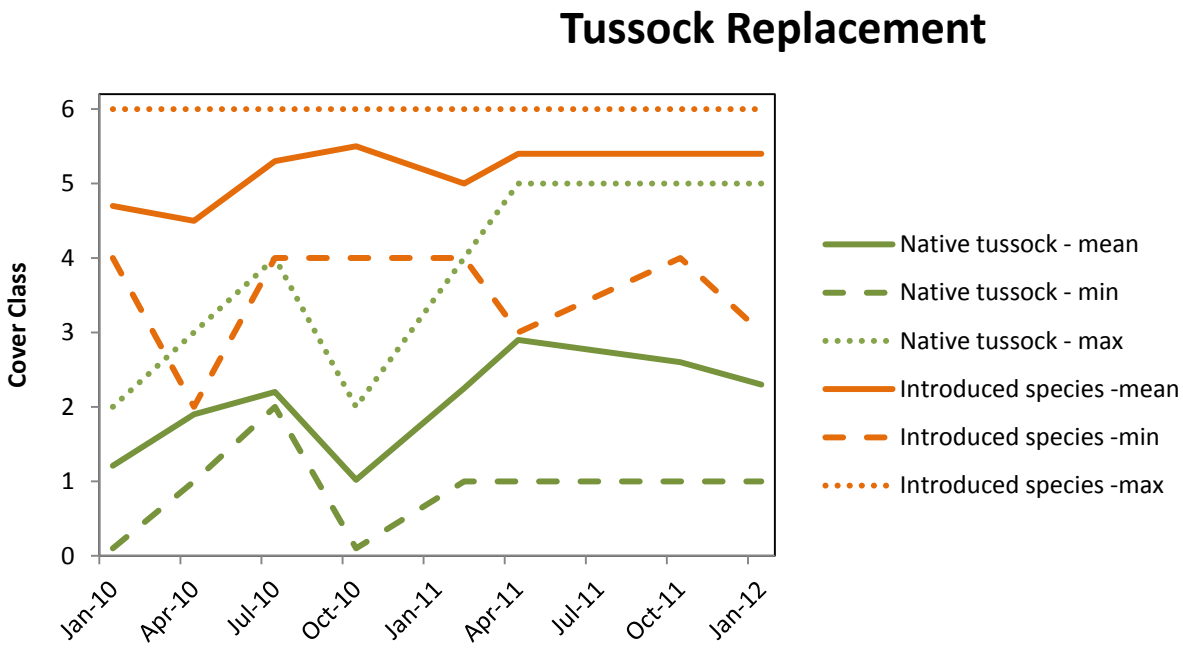

Figure 5 Native tussock cover and Introduced species cover over time for plots in which top soil was and salvaged tussocks replaced

6. Conclusions

At the end of the monitoring period for this experiment, all treatments except for the sub-soil replacement treatment can be shown to have returned the construction area to a grassland similar to that found in the adjacent grasslands at the Sheoak property, when considering the cover of native grasses and weeds compared to the control plots. Statistical analysis failed to detected a significant difference between and treatments and the control site for native tussock or and only detected a difference for sub-soil replacement plots for introduced species cover. The lack of statistically significant results is primarily due to the large variation observed within each treatment and the control site, which is shown in Figure 6.

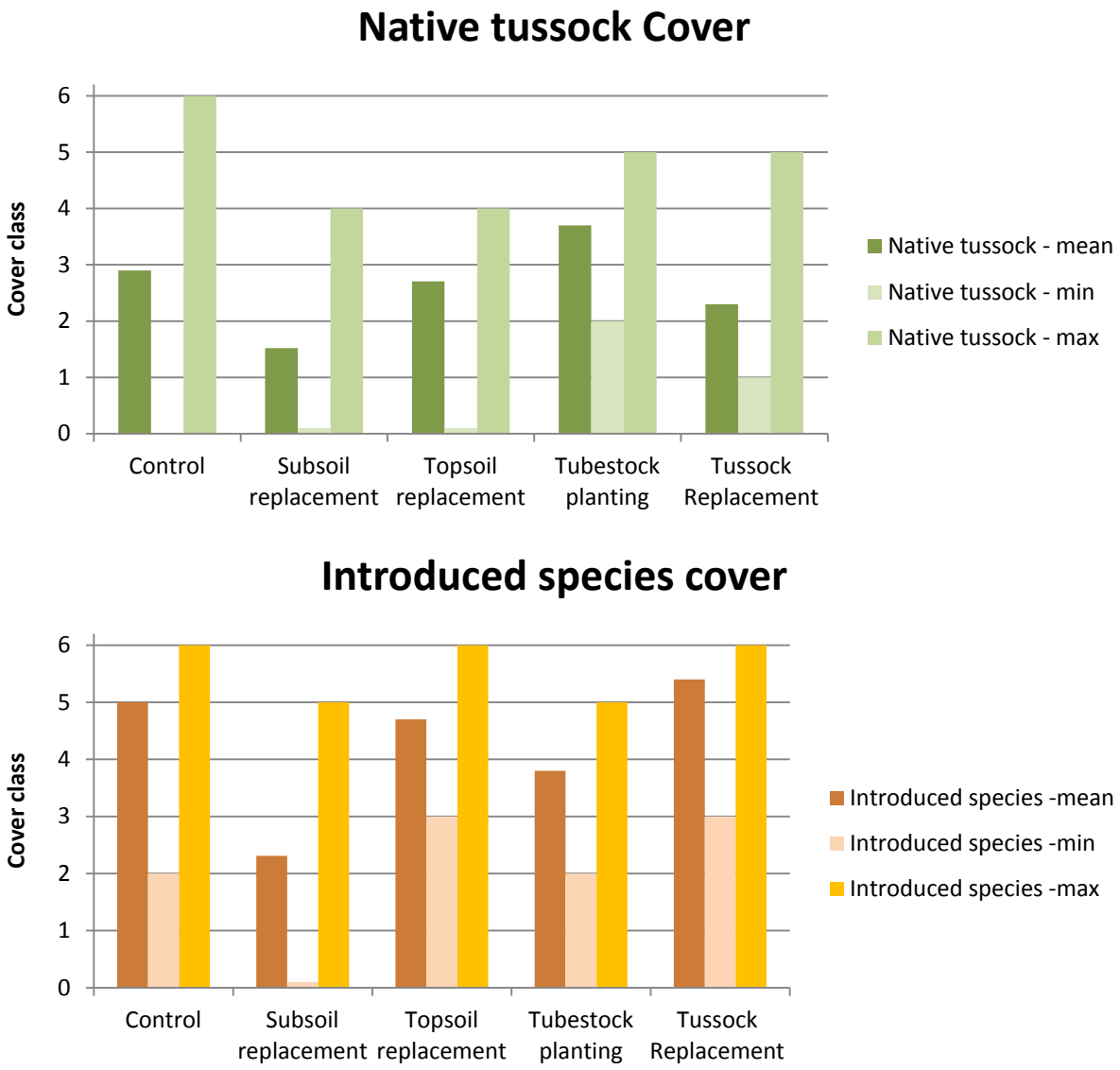

Figure 6 **Native tussock and Introduced cover across all treatments at conclusion of experiment**

Introduced species have higher average cover than native grasses across all treatments but the ratio varies from plot to plot as can be seen in the range between the minimums and maximums shown in Figure 6.

We can conclude that all treatments have on average produced grasslands that have a similar mix of native grasses versus introduced species to the control sites and therefore can return the site to conditions similar to the surrounding area. However, none of the treatments including the control have consistently produced what may be termed native grasslands.

Effectiveness of experiment

Whilst we can conclude that most treatments have been successful in returning grasslands similar to the surrounding area to the site after two years, the aim of this experiment was to return native grasslands that will provide habitat for Golden Sun Moth. Concurrent surveys for the species have been conducted at the same time as this experiment but have been confounded by poor environmental conditions (high rainfall, low temperatures and lack of sunny periods) for Moth over the past two years. Further surveys are planned for coming years and the results of those surveys should be referenced in determining the success of this experiment.

This report is the final report to be produced for the Grassland restoration experiment and no further monitoring of the experimental plots will be undertaken.

7. References

Department of the Environment, Water, Heritage and the Arts (DEWHA) (2009) *Significant Impact Guidelines for the Critically Endangered Golden Sun Moth (*Synemon plana*) January 2009.* http://www.environment.gov.au/epbc/publications/pubs/golden-sun-moth.rtf Accessed 24 June 2009 @15.47:22

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Sugarloaf Pipeline Alliance (SLPA) (2009a) *Fauna Management Program – Sheoak High Lift Pump Station Document No. SPA-EPR-SH-ENV-0005-rev 0–version 00.* Prepared as part of the Sugarloaf Pipeline Project.

Sugarloaf Pipeline Alliance (SLPA) (2009b) *Golden Sun Moth overarching document SPA-REP-GL-ENV-0014-Rev B-version 01*. Prepared as part of the Sugarloaf Pipeline Project.

Appendix A

Location of Sheoak Grassland Restoration experimental plots

362000

28

324

326

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50

362000

Sugarloaf Pipeline Project

Figure - Grassland Resoration Experiment

SUGARLOAF PIPELINE ALLIANCE

GDA94 MGA55

N

0 7.5 15 30 45

Metres

Legend

- Grassland Restoration Plot

EVC within Sheoak

- 175-GC
- 68/R
- NNV

- Sheoak Construction ROW
- Property
- Easement

NNV = Non-Native Vegetation

Appendix B

Example of completed monitoring form

31 21633 13: Sheoak Grassland Restoration Floristic Survey

Date	5/10/10	Observers	TJW / DJK	Time started	12:50pm
Site no. / ID	6	Photo #	7955	Quadrat dimensions 3 x 3 m	
Control site	Y / (N)	**Overall cover abundance of vegetation**		6	

1. Species abundance, Vertical structure and Overall composition

+	1	2	3	4	5	6
<1%	<5%	5<15%	15<25%	25-50%	50-75%	75-100%

Turns replacement
* 33 spp!!

Native species (tick if present)	√?	Cover
Acaena sp.		
Austrodanthonia caespitosa		
Austrodanthonia duttoniana		
Austrodanthonia setacea		
Austrodanthonia sp.		
Austrostipa rudis var. *rudis*		
Austrostipa sp.	✓	+
Bothriochloa macra		
Cassinia sp.		
Chamaesyce drumondii		
Convulvus erubescens		
Convulvus sp.		
Crassula sp.	✓	+
[illegible]modium varians		
[illegible]ondra repens		
Elymus scaber var. *scaber*		
Epilobium hirsutum		
Eucalyptus camaldulensis	✓	+
Eucalyptus sp.		
Glycine tabacina		
Juncus bufonius	✓	+
Juncus flavidus		
Juncus pallidus		
Juncus sp.	✓	+
Lomandra filiformis		
Lomandra longifolia		
Lythrum hyssopifolia	✓	+
Microlaena stipoides var. *stipoides*	✓	+
Oxalis perennans	✓	+
Pseudognaphalium luteoalbum		
Rumex brownii		
Isolepis	✓	+
Hyper gramin	✓	+

Introduced species (tick if present)	√?	Cover
Acetosella vulgaris	✓	1
Agrostis capillaris		
Agrostis stoloniferous		
Arctotheca calendula	✓	3
Aphanes arvensis	✓	+
Avena sp.	✓	1
Bromus catharticus		
Bromus diandrus	✓	+
Bromus hordeaceus	✓	+
Chenopodium album		
Chenopodium pumilio		
Cirsium vulgare		
Cynodon dactylon var. *dactylon*	✓	+
Dactylis glomerata	✓	+
Erodium sp.		
Holcus lanatus	✓	1
Hordeum sp.	✓	+
Hypochoeris radicata	✓	+
Lactuca serriola		
Lolium sp.	✓	3
Lotus sp.	✓	+
Lythrum juncea		
Paspalum dilatatum		
Phalaris aquatica		
Phalaris minor		
Poa annua	✓	+
Polygonum aviculare	✓	+
Romulea rosea	✓	+
Rumex crispis		
Rumex sp.		
Setaria parviflora	✓	+
Solanum nigrum s.s.		
Sonchus sp.		
Trifolium repens		
Trifolium sp.	✓	2
Vulpia sp.	✓	2
Unknown Introduced Poaceae		
Sonchus asper	✓	+
Unknown Asteraceae (latex)	✓	+
Sonchus olar	✓	+
Trifolium ~~[illegible]~~ camp/dubi (yellow flowers <20 flowers)	✓	+

Native graminoids % cover (inc.Juncus, Lomandra,	1	Introduced graminoids % cover	5
Native forbs % cover	+	Introduced forbes % cover	4
Bryophytes/Lichens % cover	1	Bare ground % cover	1
Litter % cover	+	Overall % cover of introduced species	6

2. Vertical Structure

	0-10cm	10-30cm	30-100cm	>100cm
Native grasses (Poaceae)	+	+	+	–
Introduced grasses	5	2	1	+
Native sedge or rush (eg. *Lomandra, Juncus*)	+	–	–	–
Introduced sedge or rush	–	–	–	–
Native forbs	+	+	–	–
Introduced forbs (inc. *R.rosa*)	4	2	1	–

3. Inter tussock distance (irrespective of whether tussock native or introduced, alive or dead) for 10 random points within treatment/control area. Note: SM = Soil Moisture

* Distance (cm) to edge of closest tussock (inc. Juncus) **with diameter of 3 cm** (if Cynodon, distance to closest point where plant is completely attached, not just a rooting point along a rhizome).

17

1	Species	Distance*
1	Hole lana	11
2	Micr stip	9
3	Lolium sp.	10
4	"	16

24

2	Species	Distance*
1	Lolium sp.	11
2	~~Brom~~ "	27
3	Seta parv	6
4	Lolium sp.	19

73

3	Species	Distance*
1	Lolium sp.	24
2	Avena sp.	11
3	Lolium sp	11
4	"	16

72

4	Species	Distance*
1	Micr stip	6
2	Lolium sp.	10
3	"	23
4	UK	16

47

5	Species	Distance*
1	Dact glom	10
2	Lolium sp.	9
3	"	13
4	Avena sp.	16

Random numbers (start from the point using first and second number of site ID e.g. #43 is 4 for first number and 3 for second number. Update from Random number 2.xls for each monitoring period).

Second number	First Number: 0 (and 60)									
1	5	5	5	2	2	4	4	4	3	7
2	6	1	1	3	7	0	8	2	8	3
3	9	8	8	6	2	6	7	3	0	4
4	4	2	3	7	6	0	4	3	5	1
5	4	3	3	1	1	8	6	5	3	7
6	1	8	4	6	2	8	5	4	8	0
7	0	3	5	5	8	5	3	3	7	6
8	6	1	9	1	3	8	2	1	8	1
9	4	4	8	7	8	4	7	1	7	4
0	1	7	7	3	4	7	1	7	2	4

Second number	First Number: 1									
1	9	5	4	7	4	8	7	5	7	3
2	8	7	5	3	6	4	4	4	1	3
3	3	2	5	4	8	4	7	4	5	5
4	2	7	1	5	7	2	8	4	5	6
5	9	6	4	5	6	5	5	5	7	6
6	5	3	6	1	1	6	2	4	6	3
7	5	2	4	4	8	3	0	1	2	8
8	4	0	2	4	5	3	4	6	8	4
9	1	0	8	3	5	8	7	3	6	7
0	7	2	6	0	8	6	8	7	6	3

Second number	First Number: 2									
1	5	1	3	1	3	3	0	6	2	3
2	8	1	3	5	8	4	0	5	8	7
3	1	4	3	4	3	2	7	1	3	0
4	1	4	2	4	7	6	7	4	8	2
5	2	1	9	2	1	7	2	8	2	3
6	2	3	5	7	9	1	7	2	9	3
7	5	1	7	4	8	6	1	3	2	1
8	1	4	7	4	1	5	3	1	7	1
9	2	5	8	5	5	6	9	7	9	5
0	4	3	4	3	7	6	9	8	6	0

Second number	First Number: 3									
1	8	2	5	7	6	4	1	6	9	4
2	3	4	5	3	4	3	3	8	1	1
3	7	6	2	4	1	4	5	3	2	2
4	3	6	3	1	5	2	7	8	5	4
5	2	3	3	6	6	1	3	2	6	7
6	5	7	3	4	3	4	7	2	5	7
7	6	7	9	7	2	7	5	7	2	4
8	4	2	6	7	8	4	7	7	6	3
9	7	1	2	5	5	2	8	2	0	3
0	6	3	6	7	2	8	1	8	7	0

Second number	First Number: 4									
1	8	7	6	1	4	7	4	3	6	0
2	8	1	0	5	4	7	4	2	7	0
3	7	3	5	3	3	0	0	5	1	2
4	7	4	2	6	1	7	3	3	0	0
5	7	1	2	2	9	8	2	5	4	5
6	2	6	2	3	1	6	4	1	1	4
7	0	6	4	6	4	2	1	3	0	2
8	5	8	9	0	7	2	0	2	5	2
9	5	4	1	1	3	3	3	6	3	4
0	2	0	2	6	1	4	3	5	2	6

Second number	First Number: 5									
1	7	4	7	7	4	1	4	6	3	2
2	6	5	3	7	6	1	1	8	6	6
3	7	3	3	3	8	6	3	5	3	1
4	4	4	0	1	5	1	8	6	7	1
5	4	2	7	6	4	4	9	0	1	8
6	3	6	2	5	6	1	4	1	7	3
7	3	4	7	1	1	2	1	7	4	8
8	5	7	1	6	9	7	8	3	7	2
9	9	3	3	6	1	4	8	6	3	4
0	3	3	9	2	2	6	7	5	3	8

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