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**YORK PARK  
GOLDEN SUN MOTH MONITORING  
2013**

Report prepared for  
Section 22 Barton Pty Ltd

by

**ROBERT JESSOP PTY LTD**

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**ROBERT JESSOP PTY LTD**

ACN 156 136 355 ABN 40 156 136 355

**ENVIRONMENTAL CONSULTANTS**

LEVEL 1, 3 JAMISON CENTRE, MACQUARIE, ACT 2614, AUSTRALIA  
POSTAL ADDRESS: PO BOX 213, JAMISON CENTRE, ACT 2614, AUSTRALIA  
TELEPHONE: (02) 6251 3885 FAX: (02) 6253 1574 MOBILE: 0400 568 564  
E-mail: [ripl@robjessop.com.au](mailto:ripl@robjessop.com.au) WEBSITE: [www.robjessop.com.au](http://www.robjessop.com.au)



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<b>CONTENTS</b>		<b>Page</b>
CONTENTS		iii
1	INTRODUCTION	5
2	METHODS	5
	2.1 Regional GSM Information	5
	2.2 Survey Area and Quadrat Placement	5
	2.3 GSM Flying Surveys	6
	2.4 Pupal Case Monitoring	7
	2.5 Vegetation Monitoring	7
	2.6 Soil Temperature Monitoring	7
	2.7 Meteorological Data	7
3	RESULTS	7
	3.1 Regional GSM Information	7
	3.2 GSM Flying Surveys	8
	3.3 Pupal Case Surveys	8
	3.4 Vegetation Surveys	9
4	ECOLOGICAL INTERPRETATION	9
5	COMPLIANCE WITH MONITORING PLAN	10
	5.1 Survey Requirements	10
	5.2 Reporting Requirements	11
6	CONCLUSION	11
	REFERENCES	13
	APPENDICES	16
	APPENDIX A – Quadrat details	17
	APPENDIX B – Flying moth survey 2013	18
	APPENDIX C – Pupal case survey 2013	19
	APPENDIX D – Vegetation Survey 2013	21
<b>Figures</b>		
	Figure 1. York Park GSM site flying moth survey details 2013.	14
	Figure 2. York Park GSM site pupal case and vegetation survey summary.	15

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**Tables**

Table 1. Survey zone summary and quadrat distribution.	6
Table 2. Site conditions during flying moth surveys.	8
Table 3. Summary of flying GSM numbers - Transect surveys.	8
Table 4. Summary of flying GSM numbers - Point count surveys.	8
Table 5. Summary of the pupal case surveys within control and impact sites.	9
Table 6. Vegetation survey summary for the control and impact sites.	9

## 1 INTRODUCTION

Robert Jessop Pty Ltd (RJPL) prepared this monitoring report on behalf of Section 22 Barton Pty Ltd to meet the 2014 annual reporting requirements of the *Potential shading impacts on York Park golden sun monitoring plan* (RJPL 2014, the monitoring plan). The monitoring plan was developed to meet Commonwealth *Environment Protection Biodiversity Conservation Act (EPBC Act)* approval decision (EPBC 2012/6606) conditions for development of a hotel and carpark at Block 14 Section 22 Barton (14/22 Barton). The report contains detailed descriptions of the site, proposed actions and monitoring procedures (RJPL 2014).

This report presents the Year 1 baseline surveys undertaken in spring and summer 2013 for flying golden sun moth (*Synemon plana*, GSM), GSM pupal cases and vegetation condition at York Park.

Assessment and analysis of the monitoring data is not required until after the 3<sup>rd</sup> year of data collection during the 2015 GSM flying season once post-shading data becomes available. Assessment of the effectiveness of the Natural Temperate Grassland Maintenance Plan (Parsons Brinkerhoff 2008), in the context of potential shading impacts, are also not feasible until several years of data have been collected and analysed.

## 2 METHODS

### 2.1 Regional GSM Information

GSM information, including sightings, general locations and activity levels around the ACT region were shared by researchers and consultants via email on a weekly basis during the GSM flying season. Conservation Planning and Research (CPR) subsequently compiled this data to provide a summary of GSM activity recorded throughout the region between October and December 2013.

### 2.2 Survey Area and Quadrat Placement

The survey area defined in the monitoring plan (RJPL 2013) incorporates the York Park GSM site, and excludes the area proposed for road access to 14/22 Barton and areas of exotic perennial grasses and native *Poa* plantings (Rowell 2012). The site is stratified into the following four zones for the pupal case surveys and vegetation assessments, as specified in the monitoring plan:

- Zone 1a: shaded by the proposed development at 14/22 Barton (impact);
- Zone 1b: shaded by the proposed development at 14/22 Barton and potentially shaded by the proposed development at Part 3/22 Barton;
- Zone 2a: unshaded by the proposed development at 14/22 Barton and unshaded by the proposed development at Part 3/22 Barton (control); and
- Zone 2b: unshaded by the proposed development at 14/22 Barton but potentially shaded by the proposed development at Part 3/22 Barton.

Twenty-four, 1 m<sup>2</sup> quadrats were established across the site at the beginning of the first season, marked using temporary pegs at ground-level and the location recorded with GPS. Appendix A presents GPS point locations and a map of indicative quadrat

placements. Pegs facilitated relocation of the quadrats for repeat sampling during the season and were removed at the end of the season.

Quadrats were distributed across the control and impact zones to obtain representative data for each zone. As the data to be analysed would be the average number of pupal cases detected (i.e. total number of pupal cases per zone divided by the number of quadrats per zone; refer Section 2.5.3), variation in the proportional differences in quadrat number to zone size would not skew analysis results or interpretation. Table 1 presents a summary of survey zones and quadrat distribution.

**Table 1. Survey zone summary and quadrat distribution.**

Zone	Block Shading		Control / Impact	Area (m <sup>2</sup> )	Number of Quadrats
	14/22 Barton	Part 3/22 Barton			
1a	Shaded	Unshaded	Impact	1,715	9
1b	Shaded	Shaded	(Impact)	375	3
2a	Unshaded	Unshaded	Control	1,800	9
2b	Unshaded	Shaded	(Control)	490	3

### 2.3 GSM Flying Surveys

Flying GSM surveys were conducted in a manner consistent with the ACT Government (2010) GSM survey guidelines and with the annual monitoring approach presented in Parsons Brinkerhoff (2008) and refined in Umwelt (*in prep*) to better reflect GSM activity across the York Park GSM site, as follows:

- Flying GSMs were counted along two 100 m transects along the long axis of York Park (Figure 1) and recorded as number of GSM per 100 m transect.
- The transect surveys were undertaken three times approximately half an hour apart.
- Two sets of rotational point counts, involving 10 repeated, 30 second rotational counts, were conducted at one site in the centre of the York Park GSM site between the transect surveys (Figure 1). All GSM seen in a radius of 25 m were recorded. Any individuals that re-crossed the observer's visual path were double counted. Averages were calculated from the ten rotations at each point to provide number of GSM per 30 second rotation.

Despite attempts to ensure that all data was consistent, the flying moth survey undertaken by Umwelt Pty Ltd differs from the monitoring protocol outlined in the monitoring plan (RJPL 2014) in that rotational point counts were conducted at a single central site rather than at two separate sites at the northern and southern ends of the York Park GSM site. Section 5 outlines the implications of this and a proposed response.

The start of the GSM flying season was confirmed using known reference sites in the ACT, including York Park, and consultation with the ACT GSM monitoring group.

Other on-site weather data was recorded during all field surveys of flying GSM. Again these records shall be used to assist with interpreting the GSM survey results

on a year to year basis. Umwelt Pty Ltd recorded the following data during flying moth surveys:

- wind speed and direction; and
- air temperature.

Umwelt Pty Ltd did not record cloud cover during flying moth surveys.

#### **2.4 Pupal Case Monitoring**

Pupal case surveys were conducted based on the quadrat survey approach outlined by Richter *et al.* (2013). While Richter *et al.* (2013) recommended a sample of 12 sampling quadrats for pupal case surveys, 24 quadrats were chosen to better identify the potential impacts of shading at the York Park GSM site.

Pupal cases were counted in each quadrat every two weeks over a six week period (i.e. 3 times) during the GSM flying period from early-to-mid November until late December. All cases detected were removed for identification (e.g. using microscopy) and possible sexing. This would ensure that individual pupal cases were counted in one survey only.

#### **2.5 Vegetation Monitoring**

Data recorded for each quadrat included:

- all species present;
- the dominant species (single or multiple); and
- cover / abundance (%) using the Braun-Blanquet cover / abundance classes outlined in ACT Government (2010b).

Floristic value scores were calculated from abundance data based on Rehwinkel (2007) consistent with ACT Government (2010b).

#### **2.6 Soil Temperature Monitoring**

On-site soil temperature monitoring within shaded and un-shaded areas commenced on 9 May 2014. The first collection of data from temperature loggers is anticipated to be undertaken during vegetation surveys in spring 2014. On-site soil temperature data is therefore not included in this report.

#### **2.7 Meteorological Data**

No analyses or interpretation requiring the use of meteorological data from the Bureau of Meteorology are proposed prior to the 2015 flying season. Meteorological data from Canberra Airport for 2013 and 2014 would be obtained from the Bureau of Meteorology following the GSM flying season in 2015 to contribute to the first analyses of potential shading impacts. This will not have any effect on the content of the data. Data would subsequently be obtained annually to contribute to annual analyses.

### **3 RESULTS**

#### **3.1 Regional GSM Information**

Data compiled by CPR indicated that GSM were confirmed flying at York Park by three different consultants and researchers on 25, 30 and 31 October prior to

surveys commencing. GSM activity was reported from other sites in the ACT region in the first week of November. The flying season was confirmed to have started throughout the region by early November, had peak activity occurring around late November, and had GSM activity continuing until mid-to-late December (CPR, unpublished data).

### 3.2 GSM Flying Surveys

Due to Section 22 Barton Pty Ltd's negotiations with the Commonwealth Departments of Finance (DoF) and Environment (DoE) during the 2013 flying season and preparation of the GSM monitoring plan (RJPL 2014), Umwelt Pty Ltd (Umwelt, *in prep*) conducted flying moth surveys in 2013 on behalf of the DoF. Umwelt Pty Ltd provided all data to Section 22 Barton Pty Ltd with the DoF's permission.

Umwelt Pty Ltd surveyed GSM flying moths on three occasions approximately two weeks apart during the GSM flying period. Table 2 presents the dates and weather conditions of each survey. All surveys were conducted on suitable days. Other consultants and researchers also conducted surveys at various sites in the Canberra region and detected flying GSM (CPR, unpublished data).

**Table 2. Site conditions during flying moth surveys.**

Date	Max Temperature (°C)	Rainfall (mm)	Wind speed and direction	Cloud cover
19/11/2013	28.0	0	Low, SSW	Not recorded
27/11/2013	29.0	0	Low, WNW	Not recorded
12/12/2013	26.4	0	Low, WNW	Not recorded

Appendix B presents Umwelt Pty Ltd's complete dataset (Umwelt, *in prep*) for the flying moth surveys. Table 3 and Table 4 present aggregated survey results for transect surveys and rotational point counts respectively.

**Table 3. Summary of flying GSM numbers - Transect surveys.**

Transect	Transect location	Average (1dp)
Transect 1	East	3.9
Transect 2	West	4.9
Combined		4.4

**Table 4. Summary of flying GSM numbers - Point count surveys.**

Time	Location	Average (1dp)	Range
11:45	Centre	0.4	0 - 3
12:15	Centre	1.4	0 - 6
Combined	Centre	0.9	0 - 6

### 3.3 Pupal Case Surveys

Pupal case surveys were conducted according to the method specified in the monitoring plan (RJPL 2014) on three occasions two weeks apart. Surveys were undertaken on 24 November 2013, 9 December 2013 and 23 December 2013.

Appendix C presents the complete pupal case survey dataset. Table 5 presents a summary of the pupal case survey results for the control and impact zones. Very



low pupal case numbers were recorded, i.e. only one pupal case was recorded in each of Zones 1a and 2a. No pupal cases were recorded in Zones 1b or 2b.

**Table 5. Summary of the pupal case surveys within control and impact sites.**

Zone	Pupal cases	
	Average (1dp)	Maximum number
Zone 1a	0.1	1
Zone 1b	0	0
<b>Zone 1 (impact)</b>	<b>0.1</b>	<b>1</b>
Zone 2a	0.1	1
Zone 2b	0	0
<b>Zone 2 (control)</b>	<b>0.1</b>	<b>1</b>

### 3.4 Vegetation Surveys

Dominant species, percentage cover and complete species lists, including Braun-Blanquet abundance scores, were collected for each quadrat. All data is presented in Appendix D. Species recorded are shown relative to the York Park GSM site cumulative species list of Rowell (2012), with a summary of the floristic value calculations for each quadrat. Table 6 presents a summary of the key vegetation quality indicators for the control and impact zones.

**Table 6. Vegetation survey summary for the control and impact sites.**

Zone	Floristic score		Native species	Exotic species	Cover (%)
	Average	Maximum	Average Number (1dp)		Average
Zone 1a	1.7	5	5.6	5.9	79
Zone 1b	1.3	2	6.0	3.7	78
<b>Zone 1 (impact)</b>	<b>1.6</b>	<b>5</b>	<b>5.7</b>	<b>5.3</b>	<b>79</b>
Zone 2a	1.9	11	4.9	4.5	69
Zone 2b	2.0	6	4.7	4.0	80
<b>Zone 2 (control)</b>	<b>2</b>	<b>11</b>	<b>4.8</b>	<b>4.3</b>	<b>72</b>

## 4 ECOLOGICAL INTERPRETATION

All flying moth surveys were undertaken during the peak period of GSM activity in the Canberra area and are consequently valid representations of GSM activity levels at the York Park GSM site. Flying moth numbers observed were consistently low-to-moderate during the surveys based on the semi-quantitative GSM site assessment method developed by David Hogg Pty Ltd (2010). Low-to-moderate GSM numbers are consistent with GSM populations present throughout large areas of GSM habitat within the ACT. Shared data available for regional GSM observations during the 2013 does not provide sufficient information regarding survey effort to compare GSM activity levels between sites.

Rotational point counts undertaken by Umwelt Pty Ltd in 2013 were performed at a single central point, consistent with methods outlined in the Natural Temperate Grassland Maintenance Plan (Parsons Brinkerhoff 2008), but not with the proposed method outlined in the monitoring plan (RJPL 2014). Consequently, the point count data presented in Table 4 would not be directly comparable to data collected in

future years according to the monitoring plan. The information may be useful as a qualitative assessment of GSM flying activity.

Two GSM pupal cases were recorded during the pupal case surveys, with one case identified in each of the control and impact zones. This represents a very low rate of detection despite applying approximately 6 times the survey effort recommended by Richter (2013). These very low pupal case numbers are indicative of the challenges when conducting pupal surveys, i.e. that distribution of pupal cases is highly variable and unpredictable.

Quadrats varied in floristic value, diversity, vegetation cover and weed presence, but overall were indicative of partially degraded natural temperate grassland. Vegetation in 3 quadrats within each of the control and impact zones had a floristic score of 4 or greater, nominally meeting the criteria of Rehwinkel *et al.* (2007) for inclusion in the natural temperate grassland endangered ecological community. Floristic scores within the control zone were generally marginally greater, as indicated by the slightly higher average floristic score. Sites in the impact zone had marginally higher native and exotic species diversity, and slightly higher vegetation cover. Vegetation data is likely to be highly comparable across seasons and provides valuable data for future BACI analyses.

Overall, the year 1 baseline surveys demonstrate that GSM are present in low to moderate numbers at the York Park GSM site, with pupal cases detected at very low numbers (i.e. 2), within both the control and impact areas. Vegetation surveys confirmed that the York Park GSM site supports partially degraded natural temperate grassland, the majority of which is potential GSM breeding habitat.

## **5 COMPLIANCE WITH THE GSM MONITORING PLAN**

### **5.1 Survey Requirements**

Transect surveys, pupal case surveys and vegetation surveys were conducted according to the methods specified in the monitoring plan (RJPL 2014). Rotational point counts were undertaken at a single central location rather than at two locations at the northern and southern ends of the York Park GSM site, as specified in the monitoring plan.

The inconsistency of rotational point count surveys has arisen due to the need to use flying moth survey data collected by Umwelt Pty Ltd in accordance with DoF and DoE requirements. While RJPL understood that data to be collected by Umwelt Pty Ltd would be consistent with methods outlined in the monitoring plan, rotational point count data was recorded at a single central location following the annual monitoring approach presented in Parsons Brinkerhoff (2008). It is unlikely that observations at the central point would differ greatly from observations at either end due to the small site and the relative mobility of flying male moths. Data would nonetheless not be directly comparable.

RJPL recommends that future rotational point count surveys be undertaken at both the central location, as described in Parsons Brinkerhoff (2008), and at the northern and southern ends of the site as described in the GSMMP (RJPL 2014). This would permit:

- comparison of baseline data for the central point collected over 2 flying seasons (i.e. 2013 and 2014) with post impact data to determine general trends in GSM activity at the York Park GSM site.
- comparison of data from northern and southern points in an attempt to identify potential differential changes in flying moth activity in the northern and southern parts of the site. Results would be interpreted with respect to general trends at the site using data from the central point. The lack of independence of the northern and southern site due to their close proximity and the ability of flying male GSM to freely move between ends of the site would also be considered.

## **5.2 Reporting Requirements**

The GSM monitoring plan (RJPL 2014) requires that annual monitoring reports meet the following specifications:

Annual monitoring and compliance reports would be prepared in a timely manner (e.g. February for the annual monitoring report) each year meeting the *EPBC Act* approval requirements (Conditions 3, 8) by:

- providing and assessing the monitoring data for the previous twelve months against the baseline conditions;
- concluding whether or not there has been a decline in the population of GSM within the area of York Park shaded as a result of the action, taking into account regional population trends and local ecological conditions; and
- reviewing the GSMMP's applicability in achieving its objectives (Condition 8) to determine whether, under *EPBC Act* approval Condition 10, the GSMMP should be revised in consultation with the Commonwealth.

When preparing the report, reference would be made to the current NTGMP and any relevant management and monitoring changes relevant to a review of this GSMMP.

The current report represents the first monitoring report of baseline data. The above requirements for analysis against the baseline conditions and assessment of whether there has been a decline in the population of GSM at York Park do not yet apply.

The preparation of this report was originally scheduled for February 2014, but necessarily delayed due to the organisation of approvals and the establishment of the monitoring program. The preparation of this report consequently fulfils the reporting requirements for year 1 as specified in the monitoring plan (RJPL 2014).

## **6 CONCLUSION**

This report provides baseline results of flying moth surveys, pupal case surveys and vegetation surveys for 2013 in accordance with the *Potential shading impacts on York Park golden sun monitoring plan* (RJPL 2014, the monitoring plan). Data is provided in summarised form suitable for incorporation into future analyses of potential impacts. Appendices A to D present all survey data. Detailed data analysis was not undertaken, as 2013 is the first year of data collection and no winter shading of the York Park GSM sight has occurred.

The surveys confirmed the presence of GSM at low to moderate activity levels within the York Park GSM site, confirmed the low detection rates of pupal cases, and confirmed the vegetation classification within the York Park GSM site as natural temperate grassland. Vegetation condition was generally consistent between the control and impact zones although some minor variation was present between quadrats.

Surveys were conducted in a manner consistent with the survey requirements outlined in the monitoring plan (RJPL 2014), with the exception of the rotational point counts which were conducted at the centre of the site rather than at the northern and southern ends of the site. This report also fulfils requirements for reporting the year 1 baseline monitoring data outlined in the monitoring plan (RJPL 2014).

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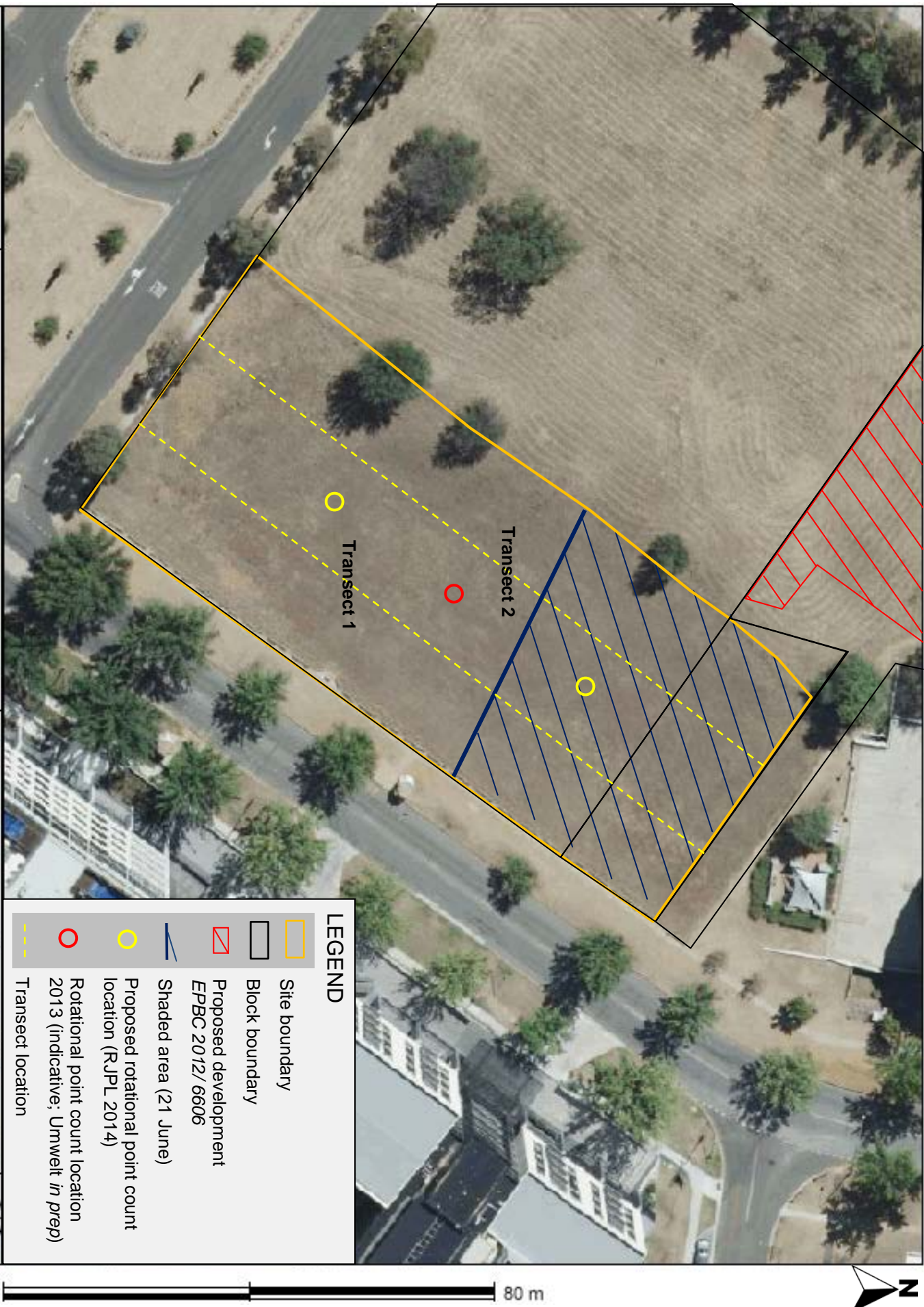


Figure 1. York Park GSM site flying moth survey details 2013.



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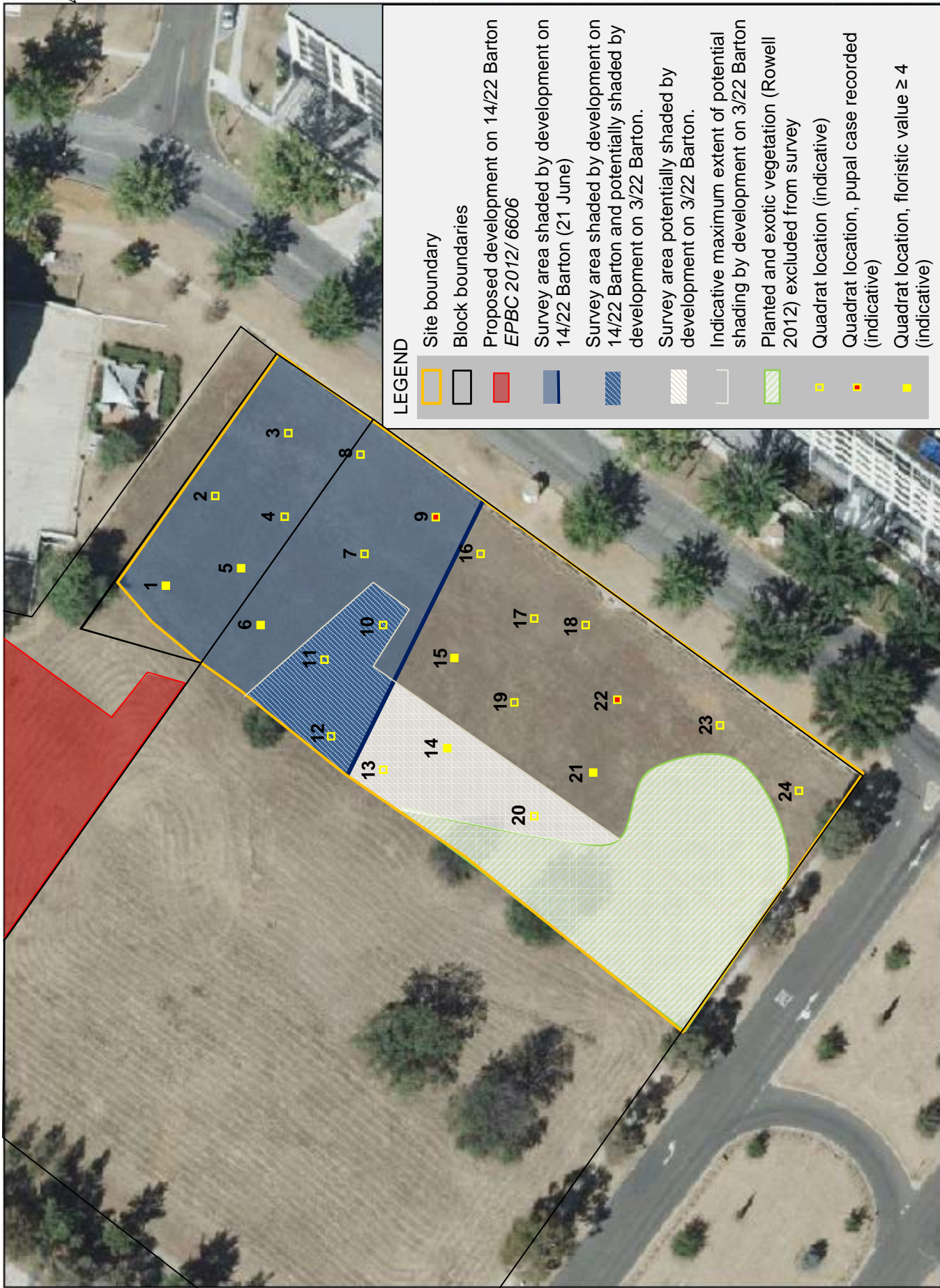


Figure 2. York Park GSM site pupal case and vegetation survey summary.

## APPENDICES



## APPENDIX A – QUADRAT DETAILS

Quadrat	Control or impact site	Zone	X	Y
1	Impact	1a	693852	6090343
2	Impact	1a	693867	6090336
3	Impact	1a	693876	6090322
4	Impact	1a	693866	6090328
5	Impact	1a	693855	6090330
6	Impact	1a	693847	6090327
7	Impact	1a	693849	6090314
8	Impact	1a	693872	6090309
9	Impact	1a	693856	6090304
10	Impact	1b	693842	6090312
11	Impact	1b	693839	6090320
12	Impact	1b	693828	6090321
13	Control	2b	693825	6090311
14	Control	2b	693824	6090302
15	Control	2a	693836	6090301
16	Control	2a	693851	6090295
17	Control	2a	693841	6090284
18	Control	2a	693843	6090278
19	Control	2a	693828	6090294
20	Control	2b	693816	6090284
21	Control	2a	693823	6090279
22	Control	2a	693833	6090274
23	Control	2a	693828	6090255
24	Control	2a	693815	6090244

## APPENDIX B – FLYING MOTH SURVEY 2013

Appendix B - Table 1: Flying moth surveys 2013 – transects.

Date	Transect	Moth numbers			Moth numbers
		1130	1200	1230	Average (1dp)
19/11/2013	Transect 1	4	4	5	4.7
27/11/2013	Transect 1	3	10	5	6.0
12/12/2013	Transect 1	1	0	2	1.0
19/11/2013	Transect 2	1	4	1	2.0
27/11/2013	Transect 2	2	12	9	7.7
12/12/2013	Transect 2	1	5	9	5.0

Appendix B - Table 2: Flying moth surveys 2013 – point observations.

Date	Time	Point	Moth numbers	
			Average (1dp)	Range
19/11/2013	11:45	Centre	0.7	0 - 3
27/11/2013	11:45	Centre	0.3	0 - 1
12/12/2013	11:45	Centre	0.2	0 - 1
19/11/2013	12:15	Centre	0.5	0 - 2
27/11/2013	12:15	Centre	0.0	0
12/12/2013	12:15	Centre	3.6	0 - 6

## APPENDIX C – PUPAL CASE SURVEY 2013

Date	Survey	Quadrat	Control or Impact site	Zone	Pupal case numbers	Notes
24/11/2013	1	1	Impact	1a	0	
24/11/2013	1	2	Impact	1a	0	
24/11/2013	1	3	Impact	1a	0	
24/11/2013	1	4	Impact	1a	0	
24/11/2013	1	5	Impact	1a	0	
24/11/2013	1	6	Impact	1a	0	
24/11/2013	1	7	Impact	1a	0	
24/11/2013	1	8	Impact	1a	0	
24/11/2013	1	9	Impact	1a	1	
24/11/2013	1	10	Impact	1b	0	
24/11/2013	1	11	Impact	1b	0	
24/11/2013	1	12	Impact	1b	0	Robber fly pupal case
24/11/2013	1	13	Control	2b	0	
24/11/2013	1	14	Control	2b	0	
24/11/2013	1	15	Control	2a	0	
24/11/2013	1	16	Control	2a	0	
24/11/2013	1	17	Control	2a	0	
24/11/2013	1	18	Control	2a	0	
24/11/2013	1	19	Control	2a	0	
24/11/2013	1	20	Control	2b	0	
24/11/2013	1	21	Control	2a	0	
24/11/2013	1	22	Control	2a	1	
24/11/2013	1	23	Control	2a	0	
24/11/2013	1	24	Control	2a	0	
9/12/2013	2	1	Impact	1a	0	
9/12/2013	2	2	Impact	1a	0	
9/12/2013	2	3	Impact	1a	0	
9/12/2013	2	4	Impact	1a	0	
9/12/2013	2	5	Impact	1a	0	
9/12/2013	2	6	Impact	1a	0	
9/12/2013	2	7	Impact	1a	0	
9/12/2013	2	8	Impact	1a	0	
9/12/2013	2	9	Impact	1a	0	
9/12/2013	2	10	Impact	1b	0	
9/12/2013	2	11	Impact	1b	0	
9/12/2013	2	12	Impact	1b	0	
9/12/2013	2	13	Control	2b	0	
9/12/2013	2	14	Control	2b	0	
9/12/2013	2	15	Control	2a	0	
9/12/2013	2	16	Control	2a	0	
9/12/2013	2	17	Control	2a	0	

Date	Survey	Quadrat	Control or Impact site	Zone	Pupal case numbers	Notes
9/12/2013	2	18	Control	2a	0	
9/12/2013	2	19	Control	2a	0	
9/12/2013	2	20	Control	2b	0	
9/12/2013	2	21	Control	2a	0	
9/12/2013	2	22	Control	2a	0	
9/12/2013	2	23	Control	2a	0	
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23/12/2013	3	18	Control	2a	0	
23/12/2013	3	19	Control	2a	0	
23/12/2013	3	20	Control	2b	0	
23/12/2013	3	21	Control	2a	0	
23/12/2013	3	22	Control	2a	0	
23/12/2013	3	23	Control	2a	0	
23/12/2013	3	24	Control	2a	0	

## APPENDIX D – VEGETATION SURVEY 2013

Appendix D - Table 1: Vegetation structure 2013.

Date	Quadrat	Control or Impact site	Zone	Species		Cover (%)
				Dominant	Co-Dominant	
9/12/2013	1	Impact	1a	<i>Austrostipa bigeniculata</i>	<i>Cynodon dactylon</i>	80
9/12/2013	2	Impact	1a	<i>Austrostipa bigeniculata</i>		95
9/12/2013	3	Impact	1a	<i>Austrostipa bigeniculata</i>		75
9/12/2013	4	Impact	1a	<i>Paspalum dilatatum</i>		85
9/12/2013	5	Impact	1a	<i>Austrostipa bigeniculata</i>		90
9/12/2013	6	Impact	1a	<i>Austrostipa bigeniculata</i>		75
9/12/2013	7	Impact	1a	<i>Bothriochloa macra</i>		70
9/12/2013	8	Impact	1a	<i>Bothriochloa macra</i>	<i>Rytidosperma sp.</i>	85
9/12/2013	9	Impact	1a	<i>Bothriochloa macra</i>		60
9/12/2013	10	Impact	1b	<i>Bothriochloa macra</i>		85
9/12/2013	11	Impact	1b	<i>Austrostipa bigeniculata</i>	<i>Bothriochloa macra</i>	90
9/12/2013	12	Impact	1b	<i>Plantago lancifolia</i>		60
9/12/2013	13	Control	2b	<i>Austrostipa bigeniculata</i>		80
9/12/2013	14	Control	2b	<i>Austrostipa bigeniculata</i>		70
9/12/2013	15	Control	2a	<i>Austrostipa bigeniculata</i>		80
9/12/2013	16	Control	2a	<i>Bothriochloa macra</i>		80
9/12/2013	17	Control	2a	<i>Bothriochloa macra</i>		90
9/12/2013	18	Control	2a	<i>Bothriochloa macra</i>		90
9/12/2013	19	Control	2a	<i>Austrostipa bigeniculata</i>		80
9/12/2013	20	Control	2b	<i>Austrostipa bigeniculata</i>		90
9/12/2013	21	Control	2a	<i>Austrostipa bigeniculata</i>		80
9/12/2013	22	Control	2a	<i>Paspalum dilatatum</i>		60
9/12/2013	23	Control	2a	<i>Avena sativa</i>	Bare	15
9/12/2013	24	Control	2a	<i>Austrostipa bigeniculata</i>	Bare	50

Appendix D - Table 2: Complete species list for the York Park GSM site (Rowell 2012); abundance scores for each species within quadrats.

Scientific name	Common name	Quadrat number																							
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
<b>Native grasses</b>																									
<i>Aristida ramosa</i>	Wiregrass						+											r							
<i>Austrodanthonia auriculata</i>	Lobed Wallaby Grass																								
<i>Austrodanthonia bipartita</i>	A Wallaby Grass																								
<i>Austrodanthonia caespitosa</i>	Ringed Wallaby Grass																								
<i>Austrodanthonia carphoides</i>	Short Wallaby Grass	r																							
<i>Austrodanthonia fulva</i>	A Wallaby Grass																								
<i>Austrodanthonia laevis</i>	Smooth Wallaby Grass																								
<i>Austrodanthonia</i> spp.	Wallaby Grasses					+	1	+	2	1		+	1	r	+	1	2	1	+	1	+				
<i>Austrostipa bigeniculata</i>	Tall Speargrass	2	3	2	1	1	1				3	2	1	3	2	3		+		3	2	3	r	r	2
<i>Austrostipa densiflora</i>	A Speargrass																								
<i>Austrostipa scabra</i>	Rough Speargrass			+		+	r	+																	
<i>Bothriochloa macra</i>	Redleg Grass	r	2	2	1	1		3	2	2	2	2	+	+	2	2	3	2	4	1	2	2	2	+	1
<i>Chloris truncata</i>	Windmill Grass																								
<i>Elymus scaber</i>	Wheatgrass	r	1				+											r							
<i>Eragrostis brownii</i>	A Lovegrass																								
<i>Eragrostis trachycarpa</i>	A Lovegrass																								
<i>Microlaena stipoides</i>	Weeping Grass																								
<i>Panicum effusum</i>	Hairy Panic Grass					+	+	1					r	+		r		2		1	1				
<i>Poa labillardieri</i>	Tussock Grass																								
<i>Themeda triandra</i>	Kangaroo Grass																								
<b>Native forbs</b>																									
<i>Acaena ovina</i>	Sheeps Burr																								
<i>Asperula conferta</i> <sup>2</sup>	Common Woodruff																								
<i>Bulbine bulbosa</i> <sup>2</sup>	Golden Lily											r													
<i>Calocephalus citreus</i> <sup>2</sup>	Lemon Beauty Heads													1											
<i>Chamaesyce drummondii</i>	Caustic Weed																								
<i>Cheilanthes</i> sp. <sup>2</sup>																									
<i>Cheilanthes sieberi</i> <sup>2</sup>	Rock Fern															+									
<i>Cheilanthes tenuifolia</i> <sup>2</sup>						r									+										

Scientific name	Common name	Quadrat number																							
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
<i>Chenopodium pumilio</i>	Small Crumbweed																								
<i>Chrysocephalum apiculatum</i> <sup>1</sup>	Yellow Buttons	+	2			1	+	2			r	1	1			+									2
<i>Convolvulus angustissimus</i>	Australian Bindweed								r										r						
<i>Crassula sieberiana</i>	Australian Stonecrop																								
<i>Cymbonotus lawsonianus</i>	Bear's Ears																								
<i>Drosera peltata</i>	Sundew																								
<i>Eryngium rostratum</i> <sup>2</sup>	Blue Devil																					r			
<i>Euchiton</i> sp.	A Cudweed																								
<i>Euchiton gymnocephalus</i>	A Cudweed																								
<i>Euchiton sphaericus</i>	A Cudweed																								
<i>Glycine tabacina</i> <sup>2</sup>	Vanilla Glycine																								
<i>Gonocarpus tetragynus</i> <sup>1</sup>	Raspwort																								
<i>Goodenia pinnatifida</i> <sup>2</sup>	Scrambled Eggs	+														1						+			
<i>Hypericum gramineum</i> <sup>2</sup>	Small St John's Wort																								
<i>Juncus</i> sp.	A Rush																								
<i>Lomandra bracteata</i> <sup>1</sup>	A Matrush																								
<i>Lomandra filiformis</i> <sup>1</sup>	A Matrush					1	+									+				+	r	+			
<i>Lomandra multiflora</i> <sup>2</sup>	A Matrush																								
<i>Lomandra</i> sp. <sup>1</sup>	A Matrush																								
<i>Microtis unifolia</i> <sup>2</sup>	Common Onion Orchid															r				r					
<i>Oxalis perennans</i>	Soursob										r					+									
<i>Pimelea curviflora</i> <sup>2</sup>	Curved Rice-flower																								
<i>Plantago varia</i> <sup>2</sup>	Variable Plantain																								
<i>Rumex brownii</i>	Swamp Dock																								
<i>Schoenus apogon</i>	Bog-rush		r	r			+					1													
<i>Sebaea ovata</i> <sup>2</sup>																									
<i>Senecio quadridentatus</i>	Cotton Fireweed																								
<i>Solenogyne dominii</i>	Smooth Solenogyne																								
<i>Stackhousia monogyna</i> <sup>2</sup>	Creamy Candles																								
<i>Tricoryne elatior</i> <sup>2</sup>	Yellow Rush Lily					r	1						r												
<i>Triptilodiscus pygmaeus</i> <sup>2</sup>	Austral Sunray																								

Scientific name	Common name	Quadrat number																							
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
<i>Vittadinia muelleri</i>	Fuzzweed																								
<i>Wahlenbergia</i> sp.	A Bluebell										1	r				+	+			r					
<i>Wahlenbergia communis</i>	Tufted Bluebell																								
<i>Wahlenbergia luteola</i>	A Bluebell		r						+																+
<i>Wahlenbergia stricta</i>	Tall Bluebell								+		1														
<i>Wurmbea dioica</i> <sup>2</sup>	Early Nancy																								
<i>Xerochrysum viscosum</i> <sup>2</sup>	Sticky Everlasting																								
<b>Exotic grasses</b>																									
<i>Aira</i> sp.	A Hairgrass						1	+				+	+	r	+		+	+							
<i>Aira elegantissima</i>	A Hairgrass																								
<i>Avena</i> sp.	Wild Oats	+	r		+			+	r				+	+							+		+	+	+
<i>Avena barbata</i>	Bearded Oats																								
<i>Briza maxima</i>	Blowfly Grass																								
<i>Briza minor</i>	Shivery Grass		+	1	1	1	+		+	+		r			+	r	r	+							
<i>Bromus</i> sp.	A Brome Grass																								
<i>Bromus catharticus</i>	A Brome Grass																								
<i>Bromus diandrus</i>	A Brome Grass																								
<i>Bromus hordeaceus</i>	A Brome Grass																								
<i>Bromus mollis</i>	Soft Brome																								
<i>Cynodon dactylon</i>	Couch																								
<i>Dactylis glomerata</i>	Cocksfoot	2	r		r										r			+			1				
<i>Eleusine tristachya</i>	Goose Grass																								
<i>Eragrostis curvula</i>	African Lovegrass																								
<i>Festuca</i> sp.	A Fine-leaved Fescue																								
<i>Festuca arundinacea</i>	Tall Fescue																								
<i>Lolium perenne</i>	Perennial Ryegrass																								
<i>Lolium rigidum</i>	Ryegrass																								
<i>Lophochloa cristata</i>	Annual Cat's Tail																						1		
<i>Nassella neesiana</i>	Chilean Needlegrass																								
<i>Nassella trichotoma</i>	Serrated Tussock																								
<i>Paspalum dilatatum</i>	Paspalum				2																	1	2		+
<i>Phalaris aquatica</i>	Phalaris																								
<i>Vulpia</i> sp.	Rat's-tail Fescue																								



Scientific name	Common name	Quadrat number																							
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
<b>Exotic forbs</b>																									
<i>Acetosella vulgaris</i>	Sorrel																								
<i>Anagallis arvensis</i>	Scarlet Pimpernel																								
<i>Arctotheca calendula</i>	Capeweed																								
<i>Centaureum erythraea</i>	Pink Stars		r	r	r	r		r	+	+		+				+	+	+	+	+			+		
<i>Cerastium glomeratum</i>	Chickweed																								
<i>Cirsium vulgare</i>	Spear Thistle																								
<i>Conyza bonariensis</i>	Flax-leaf Fleabane																								
<i>Echium plantagineum</i>	Paterson's Curse																								
<i>Erodium cicutarium</i>	Common Crowfoot																								
<i>Galium divaricatum</i>	A Bedstraw																								
<i>Gamochaeta purpurea</i>	A Cudweed																								
<i>Gnaphalium</i> sp.	A Cudweed																								
<i>Hirschfeldia incana</i>	Hoary Mustard																								
<i>Hypericum perforatum</i>	St John's Wort	1		+			+	r		r		1	1	1	r	r							+		
<i>Hypochaeris glabra</i>	Smooth Catsear																								
<i>Hypochaeris radicata</i>	Catsear		1		+	1	+	1	1	+	1	+				1	+	1		1			+	1	+
<i>Lactuca serriola</i>	Prickly Lettuce																								
<i>Lepidium africanum</i>	A Peppergrass																								
<i>Parentucellia latifolia</i>	Common Bartsia																								
<i>Petrorhagia nanteuillii</i>	Proliferous Pink			r	r																				
<i>Plantago lanceolata</i>	Ribwort Plantain	1		1	2	+	+	+	1	2		+	1	1	+		+	2	3	r	2	1	+		
<i>Romulea rosea</i>	Onion Grass																								
<i>Salvia verbenaca</i>	Wild Sage																								
<i>Silene gallica</i>	French Catchfly																								
<i>Sonchus oleraceus</i>	Common Sow-thistle																								
<i>Tragopogon porrifolius</i>	Salsify																								
<i>Trifolium angustifolium</i>	Narrow leaf Clover																								
<i>Trifolium arvense</i>	Haresfoot Clover			1				1	1	r								1	1						
<i>Trifolium campestre</i>	Hop Clover																								
<i>Trifolium dubium</i>																									
<i>Trifolium glomeratum</i>	Clustered Clover																								
<i>Trifolium striatum</i>																									

Scientific name	Common name	Quadrat number																							
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
<i>Trifolium</i> spp.	Clovers			+					+								r	r	r						
<b>Exotic shrubs and trees</b>																									
<i>Cotoneaster</i> sp.	Cotoneaster																								
<i>Crataegus monogyna</i>	Hawthorn																								
<i>Ligustrum sinense</i>	Small-leaved Privet																								
<i>Populus nigra</i> var. <i>italica</i>	Lombardy Poplar																								
<i>Prunus</i> sp.	Plum																								
<i>Sorbus domestica</i>	Service Tree																								

<sup>1</sup>Indicator species level 1, <sup>2</sup>Indicator species level 2

**Appendix D - Table 3: Summary of floristic score metrics 2013.**

Indicator	Quadrat number																							
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Number of common species:	4	5	4	2	5	7	5	4	3	3	5	5	4	3	6	3	6	2	7	4	2	2	2	3
Number of indicator level 1 species:	1	1	0	0	2	2	1	0	0	1	1	1	0	0	2	0	0	0	1	1	1	0	0	1
Number of indicator level 2 species:	1	0	0	0	2	1	0	0	0	0	1	1	0	2	3	0	0	0	0	0	2	0	0	0
Total number of native species:	6	6	4	2	9	10	6	4	3	4	7	7	4	5	11	3	6	2	8	5	5	2	2	4
Number of exotic species:	4	5	7	8	4	5	7	7	6	1	6	4	5	4	4	6	8	4	3	3	2	7	2	3
Number of significant weed species:	1	0	1	0	0	1	1	0	1	0	1	1	1	1	1	0	0	0	0	0	0	1	0	0
Site value score:	4	1	0	0	4	5	1	0	0	0	2	2	0	6	11	0	0	0	1	0	5	0	0	1