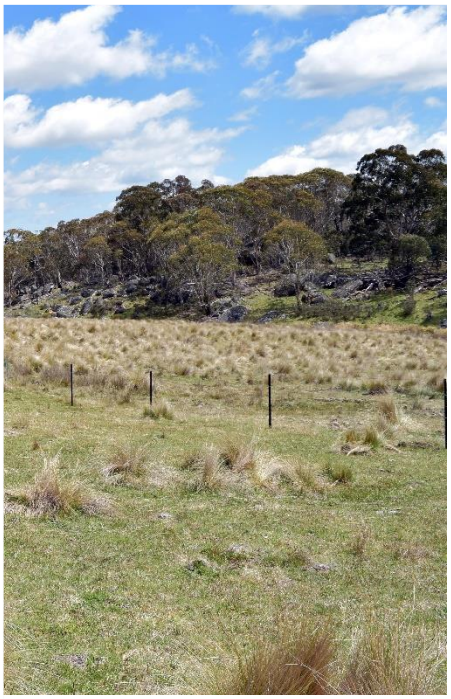
VEGETATION MONITORING REPORT

Lake Wallace offset sites

December 2019

Project Number: 19-813



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CONTENTS

TABLES

FIGURES

1. INTRODUCTION

This report presents the findings of the 2019 vegetation condition monitoring survey conducted in offset sites established for the Lake Wallace dam development. The Lake Wallace block and southern blocks offset sites are located on Pigring Creek, around and upstream of the dam and approximately 6 kilometres south of Nimmitabel. The survey follows biennial vegetation monitoring surveys conducted in 2014, 2015 and 2017, and annual orchid monitoring surveys conducted since 2014.

Snowy Monaro Regional Council is responsible for establishing, managing and monitoring the offset sites in accordance with the Lake Wallace Offset Management Plan (NGH Environmental 2014a) and the Conservation Property Vegetation Plan. State and Commonwealth Government approval conditions require a monitoring program to measure change in vegetation condition and evaluate management. The NSW approval also requires the annual monitoring of the Small Snake Orchid colony at the Lake Wallace offset site. This monitoring report has been prepared for Snowy Monaro Regional Council for submission to the NSW Department of Planning, Industry and Environment (DPIE).

2. MANAGEMENT CONTEXT

2.1. BACKGROUND

Cooma Monaro Shire Council/Snowy Monaro Regional Council completed construction of the 320 megalitre Lake Wallace storage dam on Pigring Creek in mid-2016. The dam provides a town water supply to the nearby village of Nimmitabel.

Construction of the dam required the clearing of native vegetation belonging to two Threatened Ecological Communities (TECs):

- NSW Tablelands Snow Gum, Black Sallee, Candlebark and Ribbon Gum Grassy Woodland in the South Eastern Highlands, Sydney Basin, South East Corner and NSW South Western Slopes Bioregions ('Snow Gum – Candlebark Woodland')
    - now listed as the Monaro Tableland Cool Temperate Grassy Woodland in the South Eastern Highlands Bioregion Critically Endangered Ecological Community (CEEC)
- Commonwealth Natural Temperate Grassland of the Southern Tablelands of NSW and the Australian Capital Territory
    - now listed as the Natural Temperate Grassland of the South Eastern Highlands CEEC.

Two offset sites located adjacent to and upstream of the dam were established to compensate for the loss of TEC vegetation (refer Figure 3-2 and Figure 3-3). The Lake Wallace block and southern blocks offset sites originally formed part of an 860 hectare freehold property used for commercial grazing. The sites are to be managed to maintain and improve biodiversity values, including the condition of the threatened communities at the sites.

The results of ecological surveys conducted at the sites are provided in the flora and fauna assessment (Eco Logical Australia 2011), Preliminary Offset Assessment (Eco Logical Australia 2012), Review of Environmental Factors (NGH Environmental 2013a), Species Impact Statement (NGH Environmental 2013b) and the Offset Site Assessment report (NGH Environmental 2014b) prepared for the dam project.

2.2. SMALL SNAKE ORCHID MONITORING

2.2.1. Monitoring and reporting requirements

The Lake Wallace offset site which surrounds the dam contains a colony of the Small Snake Orchid. The taxon was listed as threatened in NSW (as *Diuris pedunculata*) at the time of the dam proposal. As a condition of State Government approval for the dam, Council is required to protect and monitor the orchid colony during and following construction:

Condition 42

The colony of Small Snake Orchids identified in the SIS [Species Impact Statement] must be protected through all stages of the project, including temporary fencing during construction.

The Site Environmental Officer must make personnel aware of the location and significance of the colony.

The colony must be monitored during the flowering period each year from project approval until the dam has been constructed and operating for 5 years.

Monitoring results must be provided to OEH [now DPIE] within 2 months of the fieldwork. Monitoring must include the number of individuals present, photographs of the colony and an assessment of whether there have been any impacts to the colony.

Any new Small Snake Orchid records at the site must be submitted to OEH [DPIE] and Bionet.

These requirements have been included in the Offset Management Plan. The orchid and vegetation condition monitoring are to be conducted in mid-November each year.

2.2.2. Conservation status and taxonomy

The Small Snake Orchid (*Diuris pedunculata*) was revised in 2008, splitting the species into *Diuris pedunculata*, which is confined to the New England area of NSW, and the new species *D. subalpina*, which is found in southeast NSW, ACT and north-east Victoria (Jones 2008 in DSEWPAC 2012). The revision was accepted by the NSW Herbarium.

At the time of project approval, the southern *D. subalpina* had been excluded from the Commonwealth threatened species listing but the NSW Scientific Committee had not recognised the revision, and the southern taxon remained part of the NSW listing for *D. pedunculata* (A. Treweek OEH pers comm 24 May 2013). The NSW Scientific Committee has since advised that the taxon is now considered to be different to the listed species and is not covered by the NSW *Diuris pedunculata* listing (Dr Mark Eldridge, Chairperson, NSW Scientific Committee pers comm 30 June 2017).

2.3. OFFSET MANAGEMENT PLAN

The Offset Management Plan (OMP) identifies the following management objectives for the offset sites:

- protect and enhance the condition of Snow Gum – Candlebark Woodland (secondary grassland and structural woodland) and Natural Temperate Grassland (Wet Tussock Grassland) at the offset sites
- manage herbaceous groundcover biomass to the optimal level necessary to protect and enhance habitat values, native species richness and resilience
- protect and enhance soil stability, landscape function and water quality

- protect and enhance woodland fauna habitat values
- control and minimise the impacts of threatening processes including soil erosion, invasive weeds and pest animals.

The conservation of biodiversity values is the over-riding management priority for the sites. Limited stock grazing may be used as a management tool to control grass biomass in Snow Gum – Candlebark Woodland secondary grassland areas.

The Offset Management Plan divides the sites into three management zones based on vegetation communities and management focus:

Zone 1 – the Lake Wallace riparian buffer and catchment forest, managed for biodiversity conservation and water quality protection (stock grazing is excluded)

Zone 2 – the Pigring Creek riparian buffer and tributary Wet Tussock Grassland area, managed primarily for biodiversity conservation (stock grazing is excluded)

Zone 3 –middle and upper slope areas managed primarily for biodiversity conservation, where rotational stock grazing may be used to control grass biomass.

The three management zones are shown on Figure 3-2 and Figure 3-3.

The OMP details a condition monitoring program, including timeframe, indicators, targets and methodology. The plan provides for condition monitoring at the establishment of the offset sites (2014), subsequent monitoring after one year (2015), and then every two years until 2025. The Small Snake Orchid monitoring and reporting take place annually. Both orchid and condition monitoring are conducted in mid-November.

The Small Snake Orchid and condition monitoring reports are prepared for Council and sent to the NSW Department of Planning, Industry and Environment (DPIE) - formerly the Office of Environment and Heritage (OEH) - and the Commonwealth Department of the Environment and Energy (DEE). A draft condition monitoring report is initially provided to DPIE to allow an opportunity for input to the interpretation of results. South East Local Land Services are also sent a copy of the final monitoring report, as party to the Conservation Property Vegetation Plan agreement.

Monitoring scope, methods and frequency may be adjusted depending on monitoring results, the observed rate of change or following any alteration to the management regime. Any change to the monitoring program requires written approval from DEE and DPIE.

2.4. VEGETATION CONDITION TARGETS

The scope and methods of monitoring at the offset sites are selected to measure change in the condition of grassy groundcover in the Snow Gum - Candlebark Woodland and Natural Temperate Grassland (Wet Tussock Grassland) communities. Quantitative and comparative condition targets have been identified in the OMP to assess management effectiveness; refer Table 2-1 below. The baseline status of the sites and progress against the targets are discussed in sections 5 and 6.

Table 2-1 Vegetation condition targets for the offset sites in the Offset Management Plan

Condition indicator	Condition target	Achievement target
Live native groundcover	≥80%	December 2017
Bare ground cover	≤10%	December 2017
Average grass height (secondary grassland)	5-10 cm	December 2017
Kangaroo Grass cover (secondary grassland)	≥50%	December 2019
Floristic richness	SR637 Snow Gum - Candle Bark woodland benchmark- 20 SR610 River Tussock - Tall Sedge - Kangaroo Grass moist grasslands benchmark - 16	December 2019
Floristic Value Score	≥ high floristic value category (scores ≥20)	December 2019
Pest animal scat count	No occurrences	December 2017
Noxious weed count	No occurrences	December 2017
Grazing-sensitive flora species	Abundance maintained or increased between years	Continuing
Small Snake Orchid	Abundance and area maintained or increased between years	Continuing

2.5. STOCK GRAZING

2.5.1. Stock Management Plan

The offset sites may be leased for grazing to control grass biomass, subject to a Stock Management Plan contained in the OMP. The plan includes the following grazing rules (summarised):

- stock grazing is permitted between 1 February and 30 September
- stocking rates will not exceed 4 DSE per hectare of pasture
- grazing will not commence, and stock will be removed from the paddocks, when:
  - the live pasture cover falls below 80%, or
  - the average grass height is ≤50mm.

The leaseholder is to monitor live pasture cover and grass height on a fortnightly basis using a methodology and reporting checklist provided by Council. Council monitors compliance with the plan using monthly inspections.

2.5.2. Stock grazing at the offset sites

Stock grazing in 2016

In the 2016 grazing period, the leaseholder grazed 45 heifers, each weighing around 250kg and each representing 6.5 DSE (refer NGH Environmental 2017). The maximum stocking rate prescribed in the Offset Management Plan is 4 DSE/ha. There was a one week delay in the removal of stock in October 2016. Slight overstocking occurred during the 2016 grazing season due to delays calculating paddock areas and

maximum stocking rates. 45 stock were grazed in the southern blocks site rather than the maximum of 43 permissable under the grazing rules (NGH Environmental 2017). The South and West paddocks have been considered as one paddock for the purposes of maximum stocking rate because the gates between them have been left open (there is no water in the West paddock).

Stock grazing in 2017

Stocking during the 2017 season is summarised in Table 2-2. All paddocks were grazed during the season and the maximum stocking rate was exceeded on 7 occasions, in the North and West-South paddocks. Grazing was confined to the approved grazing period specified in the OMP and PVP.

Table 2-2 Stocking records 2017 (OMP breaches shaded, red outline is non-grazing period)

Date	No. stock in paddock (max stocking rate - DSE, 250kg heifers)				Reported by
	North (164, 25)	East (94, 14)	West (99, 15)*	South (159, 24)*	
28/03/2017	18	9	50*	16*	SMRC
9/04/2017	23	12	17	16	Leaseholder
22/04/2017	23	12	17	16	Leaseholder
27/04/2017	20	11	20	0	SMRC
13/05/2017	23	12	17	16	Leaseholder
23/05/2017	11	12	12	0	SMRC
28/05/2017	18	-	17	32	Leaseholder
11/06/2017	17	-	18	32	Leaseholder
14/06/2017	12	0	0	5	SMRC
24/06/2017	17	-	18	32	Leaseholder
13/07/2017	35	0	0	34	SMRC
14/08/2017	0	0	25	18	SMRC
12/09/2017	32	0	0	20	SMRC
19/10/2017	0	0	0	0	SMRC

* West and South paddock numbers are combined because the gate between the paddocks remains open. Total heifers allowed in both paddocks combined is 39.

Stock grazing in 2018

The ecological monitoring conducted in November 2017 revealed below-target grass heights, attributed to a combination of total grazing pressure and prolonged drought conditions (NGH Environmental 2018a). The monitoring report recommended that stock grazing be suspended for 2018 and not recommence until the average grass height at all sites is at least 10 centimetres. Council advised the leaseholder by letter that the monitoring results indicated that grazing should be suspended for 2018.

No stock were recorded by Council at the offset sites during inspections in January 2018, and between May and September 2018 (February to April checklists were not available). However, stock were found to be present at the sites in October, November and December 2018, in contravention of the approved grazing period. Recorded grazing at the offset sites during 2018 are presented in Table 2-3.

Table 2-3 Stocking records 2018 (OMP breaches shaded, red outline is non-grazing period)

Date	Paddock (max stocking rate - DSE, 300-350 kg cows/heifers)				Reported by
	North (164, 19)	East (94, 11)	West (99, 12)	South (159, 19)	
2018					
10/01	0	0	0	0	SMRC
February – April records unavailable					SMRC
03/05	0	0	0	0	SMRC
06/06	0	0	0	0	SMRC
26/07	0	0	0	0	SMRC
16/08	0	0	0	0	SMRC
11/09	0	0	0	0	SMRC
19/10	0	0	20	0	SMRC
27/11	0	14	0	0	SMRC
19/12	0	15	0	0	SMRC

Stock grazing in 2019

The management zone 3 paddocks at the offset sites were grazed by stock for the period February - September 2019 (SMRC pers. comm.). Stock were present at the sites in October-December 2018 and may also have been present in January 2019, outside the approved February - September grazing period. 2019 stock grazing recorded on leaseholder reports is summarised in Table 2-4. Leaseholder monitoring reports were available for 28 July, 10 August, 19 August, 31 August and 2 September 2019. Leaseholder reports were not available for the period January – June 2019. Council monthly inspection reports were available for February, March, April and June 2019. No Council reports were available for January, May and July-September.

The number of stock are not specified for one or more paddocks on most of the leaseholder reports. The 10 August report has 9 bulls in the East paddock and 36 heifers in the combined West/North paddock. The grazing in the combined West and North paddocks exceeds the maximum stocking rate prescribed in the OMP and PVP (a combined 31 heifers). The maximum stocking rate was exceeded in the South paddock in February and April, based on Council records. Gaining bullocks have a DSE range of 12 - 16, and store bullocks are 8-10 DSE (Agriculture Victoria 2019). Depending on the stock, the 9 bulls in the East paddock may also exceed the maximum stocking rate.

Grazing occurred in the South paddock in June despite the Council inspection report showing grass height below the grazing threshold specified in the OMP and PVP.

Cattle were observed in the protected riparian zone (management zone 2) in June 2019 (one bull) and near site NG2 during the November monitoring survey (five heifers), outside the grazing season and approved grazing area. Cowpats were recorded in the riparian zone in the Natural Temperate Grassland CEEC at NG2 and high quality Snow Gum – Candlebark Woodland CEEC secondary grassland at site GH3 (refer section 4.6).

Table 2-4 Stocking records 2019 (OMP breaches shaded, red outline is non-grazing period)

Date	Paddock (max stocking rate - DSE, 300-350 kg cows/heifers)				Reported by
	North (164, 19)*	East (94, 11)	West (99, 12)*	South (159, 19)	
2019					
	January and May records unavailable				
26/02	2 sheep	0	0	30	Council
26/3	0	0	0	19	Council
29/4	0	0	0	20	Council
13/6	0	0	17	17 1 bull in zone 2	Council
28/07	Stock no. not specified				Leaseholder
10/08	36 heifers (West/North)	9 bulls (c. 144 DSE)	36 heifers (West/North)	0	Leaseholder
19/08	West/North destocked 17-18 Aug	9 bulls (c. 144 DSE)?	West/North destocked 17-18 Aug	Unspecified no. stock	Leaseholder
16/08	0	9 bulls (c. 144 DSE)?	0	0	Leaseholder
31/08	0	9 bulls (c. 144 DSE)?	0	Unspecified no. stock	Leaseholder
02/09	0	9 bulls (c. 144 DSE)	0	Unspecified no. stock	Leaseholder

* West and North paddocks combined in 2019

2.6. WEED INSPECTION AND CONTROL

Council's Biosecurity Officer inspected the offset sites on 1 August 2019 (SMRC 2019). Three priority weeds were identified on the property, listed in Table 2-5.

Table 2-5 Priority weeds identified at the offset sites 2019

Common name	Scientific name	Degree of infestation	Locations
Serrated Tussock	*Nassella trichotoma*	Isolated	Along the fenceline adjacent to the Monaro Highway.
African Lovegrass	*Eragrostis curvula*	Isolated	North-eastern end of the property among native *Poa* tussocks, and a few small patches elsewhere.
Sweet Briar	*Rosa rubiginosa*	Established	Growing in gullies.

The 2019 Council weed inspection found that the offset sites have relatively few and minor weed problems, although the weeds present are high priority. Serrated Tussock and African Lovegrass have been controlled throughout the property in the past by Council's Biosecurity team. More recently, patches of African Lovegrass have been sprayed along the highway by Council's roadside weed spraying contractor. No other weed control work was evident on the property during the inspection.

The *Biosecurity Act 2015* provides specific legal requirements for State level priority weeds. The South East Regional Strategic Weed Management Plan 2017-2022 (SELLS 2017) prioritises weeds based on risk, impact and feasibility of control. Serrated Tussock is a State priority weed and African Lovegrass is a Regional priority weed. These species must be managed in accordance with published weed management plans.

In discharging their General Biosecurity Duty, land managers must fully and continuously suppress and destroy isolated infestations where it is reasonably practicable to do so in accordance with Section 16 of

the *Biosecurity Act 2015*. Council requires all land managers to eliminate isolated infestations of priority weeds at paddock, property and landscape level (SMRC 2019). The growth of established priority weeds must be controlled in a manner that continuously inhibits the ability of the plant to spread (SMRC 2019).

The weed inspection report concluded that the priority weeds do not currently pose a serious biosecurity risk but if left unaddressed could become one. If the lease arrangements continue, the lessee must be held accountable for weed control; if not, Council's weed spraying contractors will need to control the weeds (SMRC 2019). In order to effectively discharge Council's General Biosecurity Duty, the report advises that control of Serrated Tussock, African Lovegrass and Sweet Briar must be undertaken by 31 January 2020 to prevent seedset and minimize further spread (SMRC 2019).

3. MONITORING METHODS

The vegetation monitoring methods are based on the NSW BioBanking Assessment Methodology (BBAM) (OEH 2014a), with additional data collection relevant to the OMP condition targets. The 2019 monitoring survey was conducted on 11 and 13 November over 15.25 hours by NGH ecologist Paul McPherson with assistance from SMRC Environmental Project Officer Pam Vipond.

It is noted that the BBAM has now been superseded by the Biodiversity Assessment Method (BAM; OEH 2017) for the assessment of biodiversity values and impacts in NSW. BioMetric vegetation types have been superseded by the BioNet Vegetation Classification (Plant Community Types) (OEH 2019). The BBAM methodology and BioMetric classification have been retained in this report for consistency.

3.1. PLOT LOCATION

Twelve representative monitoring plots have been established in the TEC vegetation units:

- Snow Gum – Candlebark Woodland structural woodland (SW)
- Snow Gum – Candlebark Woodland secondary grassland high quality (GH)
- Snow Gum – Candlebark Woodland secondary grassland low quality (GL)
- Natural Temperate Grassland (Wet Tussock Grassland) (NG).

The locations of the plots are shown on Figure 3-2 and Figure 3-3. Areas available for grazing (management zone 3) and stock exclusion areas (management zones 1 and 2) are both sampled. Areas with localised and atypical agricultural impacts such as fencelines, watering points and stock camps were avoided. Map references for the transect posts are provided in Table 3-1.

Table 3-1 Map references for the monitoring transects

Monitoring site	Transect end post (quadrat end)	Orientation[1]	Management zone
SW1	706790 5951052 (south end)	327°	1
SW2	707320 5949829 (north end)	235°	3
GH1	706462 5951594 (north end)	141°	1
GH2	706837 5950531 (south end)	324°	3
GH3	707026 5950116 (north end)	192°	2
GH4	707590 5949021 (north end)	202°	3
GL1	706435 5951086 (north end)	122°	3

Monitoring site	Transect end post (quadrat end)	Orientation[1]	Management zone
GL2	707578 5949785 (north end)	216°	3
GL3	706937 5949562 (north end)	126°	3
GL4	707847 5948460 (north end)	168°	2
NG1	707844 5949780 (north end)	118°	2
NG2	708054 5949069 (north end)	117°	2

[1] from floristic quadrat end, magnetic north

For efficiency, floristic plot data collected during the 2013 offset site assessment survey was used to provide baseline data for the 2014 monitoring. The original assessment survey sites were recorded with GPS map references and photographs, but were not permanently marked. The location of the permanent sites established for the monitoring program may vary slightly (by up to 5 metres) from the original assessment sites, however the sites were located in relatively uniform vegetation away from vegetation boundaries and this discrepancy is unlikely to greatly affect the monitoring results. Sites SW1, SW2, GH1, GH4 and GL1 were established and surveyed for floristics during the 2014 survey.

The number of sites was reduced from 14 to 12 from the 2017 survey to reduce redundancy and allow more time for the orchid survey and general site inspection over a two-day monitoring period. The sites referenced in past reports as SW1 and GH4 were removed, the sites previously referred to as SW2 and SW3 became SW1 and SW2, and the former GH5 became GH4. The change affects the monitoring of the NSW Snow Gum – Candlebark Woodland TEC, and approval for the reduction in monitoring sites was sought and received from OEH in March 2016.

From 2017, the southern transect post at site GH2 has been moved 7 metres upslope to increase distance from the riparian zone fenceline, which was constructed following the establishment of the plot. Similarly, the GH3 floristic plot was moved 3 metres to the south to avoid the creek crossing laneway fenceline. The vegetation at these sites is relatively uniform and the slight adjustments are not likely to substantially affect monitoring results.

3.2. PLOT LAYOUT AND DESIGN

The layout of the BBAM plot and transect is shown in Figure 3-1 below.

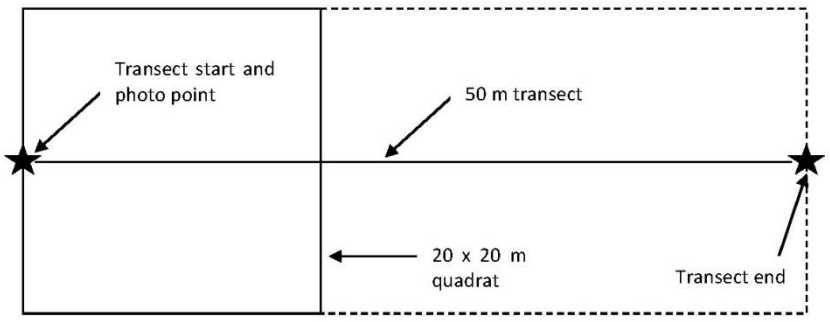

Figure 3-1 Survey plot and transect layout

3.3. SURVEY METHODS

3.3.1. General floristics and cover

Plot and transect surveys were used to measure 10 site condition attributes:

20 metre x 20 metre (0.04 ha) plot

- Native plant richness

50 metre x 20 metre (0.1 ha) plot

- Number of trees with hollows
- Total length of fallen logs (metres)

50 metre line transect

- Native overstorey cover (10 points)
- Native mid-storey cover (10 points)
- Native ground cover - grasses (50 points)
- Native ground cover - shrubs (50 points)
- Native ground cover - other (50 points)
- Exotic plant cover (50 points)
- Bare ground, rock and litter (50 points).

The survey sites were permanently marked using steel posts established at the floristic quadrat end of the 50 metre transect. Native plant richness was surveyed using relative cover/abundance based on visual estimates of foliage cover (Carnahan 1997), scored using a seven point Braun-Blanquet scale modified to allow the calculation of Floristic Site Value (Rehwinkel 2007). Up to 30 minutes were spent on the floristic survey in each quadrat.

Native mid-storey and overstorey cover are recorded as foliage cover to the nearest 5%, and expressed as average cover values for each transect. A 10cm long, 4cm diameter plastic sighting tube was used to standardise the overstorey cover viewfield. The native ground cover categories are recorded as simple presence/absence; the number of 'hits' along the transect is divided by the number of transect points (50) to give a frequency score. One hit is recorded per measuring point for groundcover, being the first species intercepted by a vertical wire. The transect posts are 50 metres apart and the 50th record is taken 20 centimetres before the end post.

3.3.2. Live native groundcover and Kangaroo Grass cover

The BBAM transects were used to collect data on total live native cover and Kangaroo Grass cover. Kangaroo Grass and River Tussock were identified to species when they were intercepted at one of the 50 cover transect points.

3.3.3. Average grass height

A ruler was used to measure the prevailing grass height (excluding flowering stems) at 5 metre intervals on the BBAM transect. The measuring points were moved on 0.5m when rock, temporary bare areas caused by local pig or cattle damage, cowpats, shrubs and the taller *Poa labillardierei* tussocks were encountered. The final measurement at the 50 metre end post was taken 20 centimetres before the end. The recorded heights were averaged for each transect to provide an indication of groundlayer biomass.

3.3.4. Floristic Site Value

The Floristic Site Value scores calculated from the 20 metre quadrat monitoring data for each site are based on number, type and cover/abundance of significant species which indicate site quality in grassy ecosystems in the Monaro sub-region (Rehwinkel 2007). It is noted that the Floristic Site Value method has now been revised to include scores for all native plant species present, rather than only 'significant species' (Rehwinkel 2015). The original method has been retained for this survey to maintain comparability with earlier survey results. The scores are grouped into floristic value classes based on the categorisation in Mulvaney (2012).

3.3.5. Grazing-sensitive species

Grazing over a long period is likely to have reduced the abundance of grazing-sensitive flora species, particularly shrubs, legumes, geophytes and taller forbs. Candidate species from these groups occurring at the offset sites were selected as indicators to monitor the status and recovery of grazing-sensitive species. The selected species were not considered likely to be naturally rare at the offset sites. Cover/abundance scores recorded in the 20 metre floristic quadrats will be monitored for comparison between survey years and to identify trends over the monitoring period.

3.3.6. Pest plants and animals

Pest animal scats and noxious weeds were recorded at all points where they intersected with the 50 metre transect tape at each BBAM monitoring plot. The cover/abundance scores of noxious weeds in the 20 metre floristic quadrats were extracted for weed abundance monitoring. Noxious weeds and pest animal sign were also recorded informally during the monitoring survey when moving between sites.

3.3.7. Soil erosion

Four soil erosion sites are monitored using photographs. The erosion sites were initially identified during the offset site assessment. Two of the sites have been remediated although some active erosion continues at all of the sites. The property was not systematically searched, and there may be other erosion sites which will also need remediation. The locations of the monitored erosion sites are provided in Table 3-2.

Table 3-2 Locations of monitored erosion sites

Erosion site	Map reference	Offset site	Management zone
E1	706491 5950589	Lake Wallace block	3 (fenced)
E2	706839 5949709	Southern blocks	3
E3	706884 5949711	Southern blocks	3
E4	707730 5949096	Southern blocks	2 (moving into 3)

3.3.8. Photopoints

Photopoint photographs were taken along the transect line from the floristic quadrat end of the plot (usually the northern end). Photographs were taken approximately 1.5 metres back from the transect post, with the top of the post in the lower foreground (1/3 of the way up the frame) and with the camera angled parallel to the ground.

3.3.9. Informal observations

In addition to plot-based monitoring, a field checklist was used to record informal observations of key condition attributes and potential management issues. The checklist includes:

- noxious weeds
- pest animals sign
- significant species
- soil erosion sites
- excessively dense tree or shrub regeneration (evidenced by thinning groundcover)
- damaged or incomplete infrastructure (such as fencing, gates, tracks).

These observations were made while moving between vegetation condition and erosion monitoring sites. The observations were used to extend the areal coverage of the monitoring program and supplement the plot data to evaluate management at the offset sites. Condition and management factors are also noted during regular Council compliance inspections, outside the condition monitoring cycle.

3.3.10. Small Snake Orchid monitoring

Colony census

Search transects 2 metres wide were used to search for and census flowering Small Snake Orchid plants. The search covered the fenced area and a radius of approximately 20 metres surrounding the fence. The number of individual plants and each plant's reproductive status (bud, flowering or spent) were recorded. Non-flowering plants have not been included in the survey because of difficulty finding and reliably identifying orchid leaves within the grass sward. Incidental observations regarding associated species, habitat, area of occupancy and any impacts or threats to the colony were also made and updated as required.

Groundcover and grass height survey

Annual groundcover monitoring using the quantitative and repeatable step point method was initiated for the 2016 survey. A line transect was run between the south-east and north-west corner posts of the fenced plot. 54 points were sampled at 0.5 metre intervals, starting from the 1 metre point at the south-east corner and ending at 27.5 metres at the north-west corner. Live cover recording categories included native tree, native shrub, native grass, native herb (other), exotic grass and exotic herb (other). Dominant native grass species were also noted.

The additional measurement of grass height was commenced in the 2017 survey. At five metre intervals along the groundcover transect, the prevailing grass height (excluding flowering stems) was measured using a ruler. The recorded heights were averaged to provide a broad indication of overall groundlayer biomass.

Photographs

Photographs were taken in and around the orchid colony, including comparative shots of groundcover inside and outside the orchid fence.

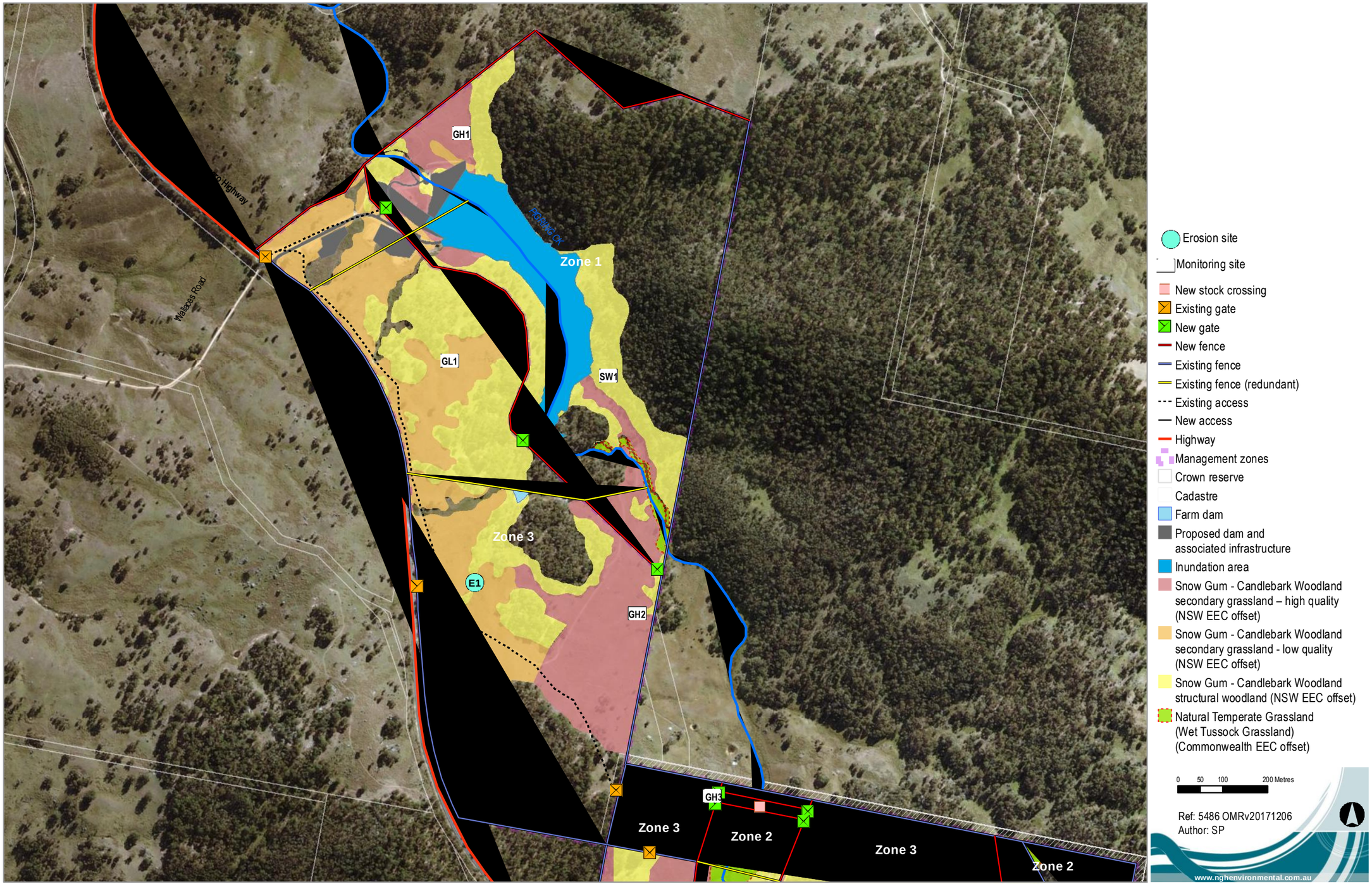

Figure 3-2 Lake Wallace offset site monitoring sites

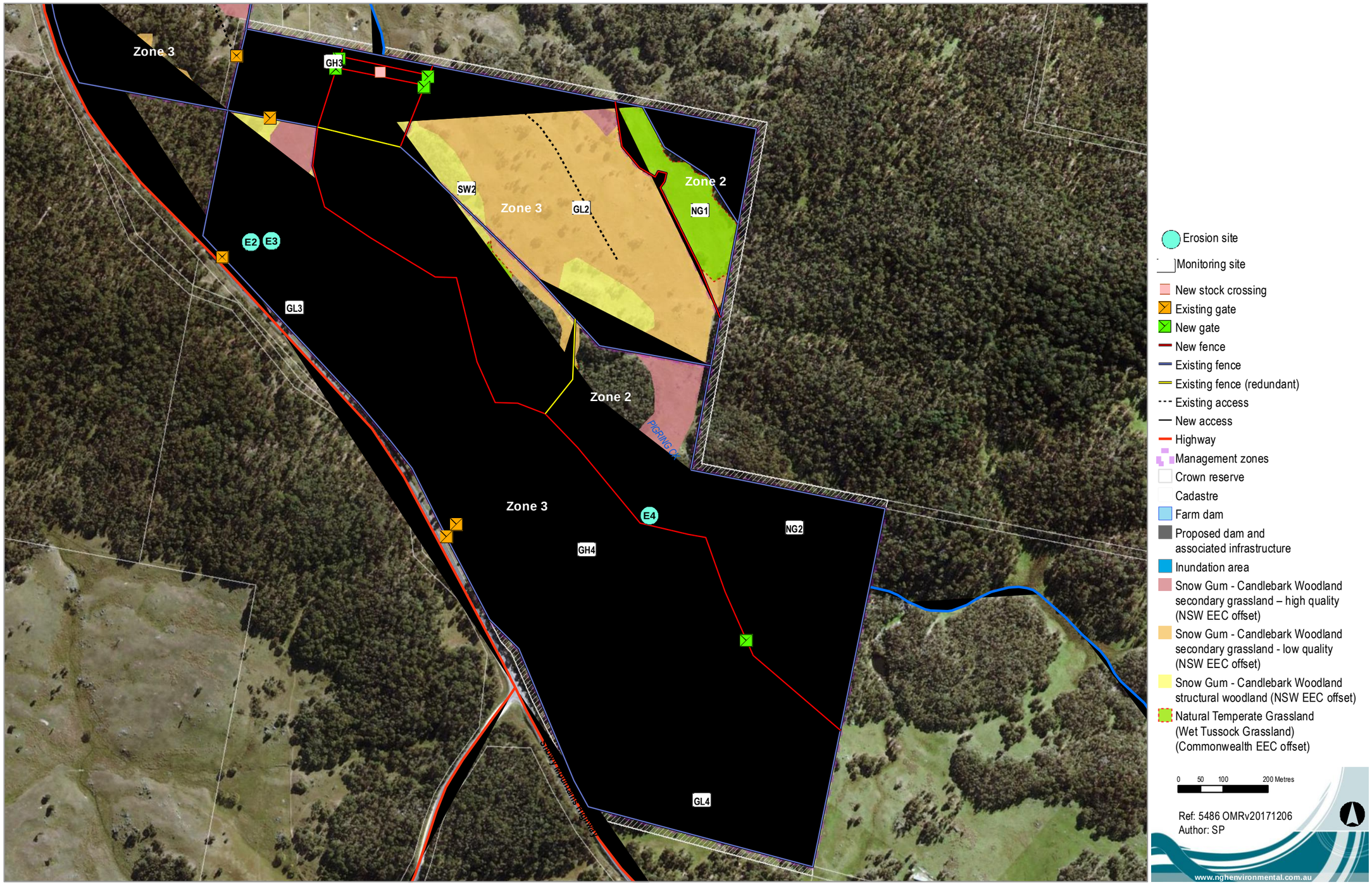

Figure 3-3 Southern blocks offset site monitoring sites

4. MONITORING RESULTS

4.1. BIOMETRIC BENCHMARKS

Monitoring data collected during the survey is provided in Appendix A.

The Snow Gum – Candlebark Woodland at the offset sites corresponds to the following Biometric vegetation types (OEH 2014b):

SR637 Snow Gum - Candle Bark woodland on broad valley flats of the tablelands and slopes, South Eastern Highlands

SR610 River Tussock - Tall Sedge - Kangaroo Grass moist grasslands of the South Eastern Highlands.

A comparison of the monitoring results against the condition benchmarks for the communities is provided in Table 4-1 below. Scores which fall outside the benchmark range are shaded.

Compared to the 2017 results, most sites are either stable or continuing a downward trend for richness. The grazed sites GL2 and GL3 fell below benchmark for the first time. GH1 and GH4 showed increased recorded richness in 2019.

The sites generally meet or are close to benchmark for mid-storey, grass, shrub and other native cover. Grass cover at SW2 is approaching the benchmark minimum. Non-grass groundcover remains low for all sites, well down on the 2015 figures, reflecting the prolonged dry period.

Much of the offset site area has been cleared historically and remains below benchmark for overstorey cover, tree hollows and fallen logs. Two woodland monitoring sites (SW1 and SW2) are above benchmark for overstorey cover because the stands comprise denser regrowth.

Table 4-1 Summary of condition attributes against Biometric benchmarks 2019

Site	Richness	Overstorey cover	Mid-storey cover	Grass cover	Shrub cover	Cover other	Trees with hollows	Fallen logs (m)
SR637	**20**	**15-30**	**0-15**	**5-70**	**0-10**	**5-30**	**2**	**25**
SW1	46	33.5	0	38	4	6	1 (possible)	35
SW2	35	35.5	0	8	0	4	1	66
GH1	29	0	0	62	0	10	0	0
GH2	26	0	0	90	4	2	0	0
GH3	31	0	0	64	0	18	0	0
GH4	32	0	0	80	0	0	0	0
GL1	23	0	0	32	2	4	0	0
GL2	16	0	0	38	0	8	0	0
GL3	18	0	0	40	0	4	0	0
GL4	27	0	0	66	0	12	0	0
SR610	**16**	**0-5**	**0-0**	**30-80**	**0-5**	**5-40**	**0**	**0**
NG1	18	0	0	32	0	10	0	0
NG2	18	0	0	34	0	24	0	17

4.2. NATIVE GROUND COVER

The monitoring results obtained from the 50 metre transects for total live native groundcover, Kangaroo Grass cover and bare ground are presented in Table 4-2.

Native cover in 2017 had declined since 2015, with most sites well below the 80% cover target. In 2019, native groundcover has further declined at sites SW2, GL1, GL3, NG1 and NG2. Native groundcover has increased since 2017 at sites GH2, GH3 and GL4, and remained stable at other sites. All sites except GH2, GH3 and GH4 are below target for native groundcover.

Kangaroo Grass cover has increased at GH1-4, GL1, GL2 and GL4 since 2017, but remains below target for all sites except GH2 and GH4. (It is noted that the Kangaroo Grass target may not be achievable at the woodland sites SW1 and SW2 due to shading and high litter cover.)

Bare ground has increased at half the sites, especially SW2 and GL1. GL1 was the only below-target site for bare ground. No sites were below target in 2017.

Table 4-2 Native groundcover, Kangaroo Grass cover and bare ground results

Site	Native groundcover (%)				Kangaroo Grass cover (%)				Bare ground			
	2014	2015	2017	2019	2014	2015	2017	2019	2014	2015	2017	2019
Targets	**≥80**				**≥50**				**≤10**			
SW1	62	52	46	44	0	2	2	2	10	6	0	0
SW2	44	46	18	12	0	2	2	2	0	0	0	6
GH1	68	74	72	72	20	16	6	40	0	0	0	2
GH2	86	66	78	92	60	44	56	70	0	0	0	0
GH3	92	84	74	82	48	36	20	44	10	0	0	0
GH4	78	88	82	80	44	48	48	68	4	2	0	2
GL1	64	68	56	36	4	16	14	26	0	4	4	18
GL2	76	64	46	46	16	10	10	16	0	0	6	0
GL3	64	58	60	44	0	4	8	4	0	0	2	6
GL4	88	76	66	78	14	12	16	20	2	12	2	6
NG1	100	88	54	42	NA	NA	NA	NA	2	2	8	4
NG2	94	86	64	58	NA	NA	NA	NA	0	6	0	0

4.3. AVERAGE GRASS HEIGHT

The average grass heights for the secondary grassland monitoring sites are presented in Table 4-3. These data are used to indicate grass biomass. The target range for grass height at the offset sites is 5-10 centimetres. The Meat and Livestock Australia Pasture Ruler indicates that this range roughly equates to 1.4 – 2.2 tonnes/hectare of green dry mass.

The management zone 3 paddocks at the offset sites were grazed by stock for the period February - September 2019. Cattle were also present in the protected riparian zone (management zone 2) at various times (refer section 2.5).

In 2017, grass height was down for all sites, grazed and ungrazed. Grass heights have remained low in 2019 for GH1 (ungrazed), and GL1, GL2 and GL3 (grazed), which are below target. Heights have increased at sites GH2 (grazed), GH3 (ungrazed) and GL4 (grazed).

Table 4-3 Average grass height at the monitoring sites 2014, 2015 and 2017

Site	Average grass height (cm)			
	2014	2015	2017	2019
Target	**5-10cm**			
SW1	NA	NA	NA	NA
SW2	NA	NA	NA	NA
GH1	2.7	7.9	5.45	4.8
GH2	8.3	6.4	5.4	12.75*
GH3	4.3	5.5	5.4	10.2*
GH4	2.8	4.3	3.9	9.15
GL1	2.6	4.3	2.85	3.4
GL2	4.8	4.7	2.25	3.45
GL3	6.4	2.9	2.85	3.6
GL4	5	3.8	3.65	6.85
NG1	NA	NA	NA	NA
NG2	NA	NA	NA	NA

* above target height range

4.4. FLORISTIC SITE VALUE

The Floristic Site Value scores calculated from the 20 metre quadrat monitoring data for each site for the 3 monitoring years are presented in Table 4-4 below. Table 4-4 also provides the corresponding floristic value class for each site, based on the categorisation in Mulvaney (2012):

<5	little floristic value, and dominated by exotic species and/or common native species
5–9	low floristic value
10–14	moderate floristic value with a few significant species
15–19	moderate to high floristic value
20–24	high floristic value, many significant species present
25–35	very high floristic value
35+	exceptional floristic value, site of very high diversity with numerous significant species.

The Offset Management Plan sets the minimum condition target of the high floristic value class (Floristic Value Score ≥20) for all sites.

There is an overall declining trend for Floristic Value Scores at the offset sites. Floristic Value Scores in 2017 had generally declined compared to 2015 and 2014 scores. In 2019, most sites have further declined. Sites GH1 and GH4 increased their scores on 2017 but have not returned to 2015 levels. The grazed sites GL1-4 and the natural grassland sites NG1 and NG2 were below target for FVS in 2019.

Table 4-4 Floristic Site Value (FSV) scores for the monitoring plots

	2014		2015		2017		2019	
Site	**FSV**	**Value class**	**FSV**	**Value class**	**FSV**	**Value class**	**FSV**	**Value class**
Target	**FSV ≥20, value class ≥ high**							
SW1	45	Exceptional	62	Exceptional	53	Exceptional	48	Exceptional
SW2	23	High	44	Exceptional	29	Very high	28	Very high
GH1	26	Very high	30	Very high	16	Mod-high	23	High
GH2	24	High	32	Very high	25	Very high	23	High
GH3	37	Exceptional	52	Exceptional	53	Exceptional	29	Very high
GH4	29	Very high	43	Exceptional	17	Mod-high	22	High
GL1	12	Moderate	21	High	20	High	15	Mod-high
GL2	17	Mod-high	15	Mod-high	11	Moderate	8	Low
GL3	6	Low	15	Mod-high	12	Moderate	5	Low
GL4	10	Moderate	21	High	17	Mod-high	15	Mod-high
NG1	21	High	31	Very high	20	High	17	Mod-high
NG2	17	Mod-high	26	Very high	22	High	14	Moderate

4.5. GRAZING-SENSITIVE SPECIES

Cover/abundance scores for grazing-sensitive species in monitoring plots measured in 2013/2014, 2015 and 2017 are provided in Table 4-5 below. Cover/abundance assessments are scored using a modified Braun-Blanquet 7-point scale:

Braun-Blanquet cover-abundance scale	
r	Solitary (1-3 individuals), <5% cover
+	Few (4-15), <5% cover
1	Numerous/scattered, <5% cover
2	5 – 25% cover
3	26- 50% cover
4	51 – 75% cover
5	76 – 100% cover

Cover scores and abundances for the indicator species have generally declined in 2019, at both grazed and ungrazed sites.

Table 4-5 Cover scores for grazing-sensitive indicator species

Species	Site	2013/2014	2015	2017	2019
Target: abundance maintained or increased between years and over monitoring period					
Shrubs, subshrubs					
Discaria pubescens	GH3	+	r	1 (21 plants)	1 (18 plants)
Hovea heterophylla	SW1	r	r	r	r
	SW2	r	r	r	-
	GH3	r	r	+	r

Species	Site	2013/2014	2015	2017	2019
Target: abundance maintained or increased between years and over monitoring period					
	GH4	r	r	-	-
Forbs					
Calotis scabiosifolia	SW1	+	+	r	r
	SW2	-	r	-	-
	GH3	1	1	+	r
Craspedia canens	SW1	+	+	1	+
Dianella longifolia	SW2	r	r	r	-
Diuris monticola	GL4	-	r	r	-
Swainsona monticola	GH3	+	1	r	-
	GH4	+	+	-	r
	GL3	+	r	-	-

Figure 4-1 Mountain Golden Moths (*Diuris monticola*) recorded at site GL4 in 2017 but not in 2019.

Figure 4-2 Black-tip Greenhood (*Pterostylis bicolor*) recorded at site GH2 in 2017, not recorded in 2019.

4.6. PEST PLANTS AND ANIMALS

4.6.1. Monitoring plots and transects

The percentage cover of noxious and invasive weeds and animal scats recorded using the 50 metre transect and 20 metre floristic plots are summarised in Table 4-6 and Table 4-7. The condition targets in the Offset Management Plan are zero occurrences for noxious weeds and pest animal sign.

In 2017, the invasive shrub *Rosa rubiginosa* had increased its abundance at sites SW2, GH3 and GL3. The weed has maintained its presence at sites SW2, GH3 and GL3 in 2019, and re-appeared at site GH1.

Table 4-6 Noxious weed data summary

Site	2014		2015		2017		2019	
	Transect	Quadrat	Transect	Quadrat	Transect	Quadrat	Transect	Quadrat
Target	**Zero pest plants on transect and in plot**							
SW1	0	*Rosa* - r	0	*Rosa* - r	0	0	0	
SW2	0	*Rosa* - r	0	*Rosa* - r	0	*Rosa*– + (6)	0	*Rosa*– r (3)
GH1	0	0	0	*Rosa* - r	0	0	0	*Rosa*– r (1)
GH2	0	0	0	0	0	0	0	

Site	2014		2015		2017		2019	
	Transect	Quadrat	Transect	Quadrat	Transect	Quadrat	Transect	Quadrat
GH3	0	*Rosa* - r	0	*Rosa* - r	0	*Rosa* - + (4)	0	*Rosa*– + (4)
GH4	0	0	0	0	0	0	0	
GL1	0	0	0	0	0	0	0	
GL2	0	0	0	0	0	0	0	
GL3	0	0	0	*Rosa* - r	0	*Rosa* - + (4)	0	*Rosa*– + (4)
GL4	0	0	0	0	0	0	0	
NG1	0	0	0	0	0	0	0	
NG2	0	0	0	0	0	0	0	

Figure 4-3 Pig digging in site GH4, with diverse native grassland replaced by the exotics Sheep Sorrel, Catsear, Sweet Vernal Grass and Haresfoot Clover.

Figure 4-4 Cows in the riparian zone during the monitoring survey

Macropod scats had increased at GH3 and declined at GH2, GL1 and GL2, remaining stable elsewhere. Rabbit scats were detected in SW2, GL1, GL2, GL3 and NG1. Pig scats were recorded at site GH4 and part of the site had been excavated by pigs (refer Figure 4-3). Goat scats were detected at SW1, and large goat flocks were observed at the offset sites during the survey. Cowpats were observed in SW2, GH3, GH4, GL2-4 and NG2. Sites GH3 and NG2 are located within the riparian management zone 2, which is excluded from stock grazing under the OMP and PVP (Figure 4-4).

Table 4-7 Animal scats recorded on the monitoring transects

Site	2014	2015	2017	2019
Target	**Nil pest animal scats on transect**			
SW1	0	Cow - 2	Macropod – 4 Wombat - 1	Macropod - 4 Wombat – 1 Goat - 1
SW2	0	Cow – 4 Macropod - 3	Cow – 2 Macropod - 10	Macropod - 8 Wombat – 1 (cow and rabbit in plot)
GH1	0	Macropod - 2	Macropod - 15	Macropod - 18

Site	2014	2015	2017	2019
GH2	0	Cow - 2 Macropod - 1	Cow - 3 Macropod - 10	Macropod - 5
GH3	0	Cow - 2 Macropod - 2	Macropod - 6 (rabbit scats in plot)	Cow - 4 Macropod - 14
GH4	Rabbit - 2	Rabbit - 1, Cow - 1, Macropod – 3	Cow - 2 Macropod - 5	Macropod - 3 Cow - 3 (pig scats in plot)
GL1	0	Rabbit -1, Cow - 4, Macropod - 6	Cow - 1 Macropod -17 Rabbit - 20	Macropod - 9 Rabbit - 11
GL2	0	Cow - 8 Macropod - 3	Cow - 3 Macropod - 33	Cow - 3 Macropod - 17 Rabbit - 3
GL3	0	Cow - 6 Macropod - 2	Cow - 4 Macropod - 13	Cow - 7 Macropod - 12 Rabbit - 2
GL4	0	Cow - 4 Macropod - 1	Cow - 4 Macropod - 4	Cow - 5 Macropod - 5
NG1	0	Cow - 6	Macropod - 14 Wombat – 2	Macropod - 12 Rabbit - 3
NG2	0	Cow - 2 Macropod - 1	Macropod - 3	Cow - 5 Macropod - 3

4.7. INFORMAL OBSERVATIONS

4.7.1. Noxious weeds

During the 2014 and 2015 surveys, a large patch of Sweet Briar (*Rosa rubiginosa*) was observed on rocks in the Pigring Creek channel in the southern blocks offset site at 707787 5949117. The area was not revisited during the 2017 and 2019 surveys. This weed is bird-dispersed and requires general control across the sites.

4.7.2. Pest animals

Council inspection records noted an expansion in wild pig impact across the offset sites in 2018 (NGH Environmental 2019). Pig damage was found to be widespread at the offset sites in 2019, with older patches marked by the replacement of native grassland with exotic groundcover (refer Figure 4-3).

The wombat burrow observed below a small farm dam in the Southern Blocks offset site at 707655 5949055 in 2017 is still present but does not appear to be active in 2019. The burrow is available for use and remains a threat to the integrity of the dam wall and water quality in Pigring Creek.

4.8. SOIL EROSION

The locations of four gully heads recorded at the offset sites are shown on Figure 3-2 and Figure 3-3. Photographs of each site taken during the 2019 survey are provided below.

The remediation of the major gully erosion at site E1 prior to 2017 has been effective and the head cut has been stabilised. Minor sheet erosion at the site is likely to reduce over time as the groundlayer vegetation re-establishes. Most Snow Gums planted in the gully at the site have survived but growth rates have been slow. One tree stem had recently been snapped off at the time of the 2019 survey.

Site E2 has not deteriorated and appears stable.

The groundcover at site E3 has improved, though heavily grazed, and the erosion appears to be stabilising. However, the head cut face remains bare and there is some deposition at its foot.

Site E4 is still actively eroding under the riparian fenceline. Logs have been placed along the base of the fence to control stock access (Figure 4-16). Coir logs placed across the top of the gully head and in the gully below the head cut before the 2017 survey have broken down and are no longer effective.

Figure 4-5 Lake Wallace block erosion site E1 in 2015

Figure 4-6 Lake Wallace block erosion site E1 in 2017

Figure 4-7 Lake Wallace block erosion site E1 in 2019

Figure 4-8 Southern blocks erosion site E2 in 2015

Figure 4-9 Southern blocks erosion site E2 in 2017

Figure 4-10 Southern blocks erosion site E2 in 2019

Figure 4-11 Southern blocks erosion site E3 in 2015

Figure 4-12 Southern blocks erosion site E2 in 2017

Figure 4-13 Southern blocks erosion site E2 in 2019

Figure 4-14 Lake Wallace block erosion site E4 in 2015

Figure 4-15 Southern blocks erosion site E4 in 2017

Figure 4-16 Southern blocks erosion site E4 in 2019

4.9. PHOTOPOINTS

Photopoint photographs taken at each monitoring plot are provided in Appendix B.

4.10. SMALL SNAKE ORCHID MONITORING

4.10.1. Ecology and habitat

The Small Snake Orchid (*Diuris subalpina*) is a tuberous geophyte inhabiting grassy slopes or flats, often on peaty soils in moist areas, on shale and fine granite, and among boulders. The life cycle typically involves the seasonal emergence of a leaf and flower stem, and the annual renewal of an underground tuber.

The flowering period of the species is stated to be between August and October (Jones 1999, pers. comm in DSEWPAC 2012), although it has been recorded flowering in mid-November in the study area, and at Adaminaby in similar habitat at 1180m ASL (NGH Environmental 2003). Pollination is by sexual deception, with the Small Snake-orchid attracting mostly males of the insect *Halictus lanuginosus*, even though the plants produce nectar and emit a strong scent that usually attracts numerous pollinators (Jersáková et al. 2006 in DSEWPAC 2012). The flowers of some *Diuris* species are believed to mimic native pea flowers to attract pollinators (for example *D. maculata* and *D. aequalis*). Members of the Snake Orchid group most likely mimic yellow lilies such as *Hypoxis* and *Bulbine* species (Bishop 2000).

On the Southern Tablelands, the Small Snake Orchid has been recorded at Bredbo, Adaminaby, Countegany and the ACT. There are no records in the OEH Atlas or Atlas of Living Australia (ALA) online databases within 10 kilometres of the study area. The Lake Wallace colony is the southernmost record for *Diuris subalpina* in the ALA database.

Figure 4-17 Small Snake Orchid at the site in 2019

Figure 4-18 Dense grass and litter cover inside the exclosure fence in 2019

4.10.2. Lake Wallace orchid colony

The Small Snake Orchid was recorded at the Lake Wallace site as a single colony comprising 15 flowering plants on 15-17 November 2010 (Eco Logical Australia 2011). The colony occurs on a gentle southwest-facing lower slope in woodland dominated by Black Sallee (*Eucalyptus stellulata*) with Snow Gum (*E. pauciflora*). The groundlayer is dominated by the grasses Weeping Grass (*Microlaena stipoides*), Snow Grass (*Poa sieberiana*) and the exotic Sweet Vernal Grass (**Anthoxanthum odoratum*). The groundlayer is relatively diverse, including *Ajuga australis, Asperula*

scoparia, Craspedia canens, Euchiton japonicus, Haloragis heterophylla, Hypericum gramineum, Leptorhynchos squamatus, Oreomyrrhis eriopoda, Plantago varia, Ranunculus lappaceus, Solenogyne gunnii and *Viola betonicifolia,* with exotic forbs *Hypochaeris radicata* and *Trifolium* species. Scattered shrubs include *Leptospermum myrtifolia* and *Pimelea curviflora*. The composition and condition of vegetation adjacent to the orchid colony has been documented in the monitoring data collected for the offset monitoring site SW1.

The Lake Wallace dam project has potential to affect the colony indirectly by reducing grazing and grass biomass removal. In some cases, rare species have been observed to decline following the cessation of stock grazing (e.g. Scarlett and Parsons 1982 and 1990, Cropper 1993, Morgan 1995 in Lunt 2005), which has been attributed to competition from the dominant grasses. However, past research suggests that most geophytes, such as terrestrial orchids, decline when grazed and recover when fenced (Dorrough 2012).

Consistent with the project approval conditions, a fence around the orchid colony was constructed in late 2014, applying a 10 metre buffer around the colony visible in November 2014. A permanent fence with wire mesh, rather than a temporary fence, was constructed because of the threat posed by wild pigs, evidenced by diggings close to the orchid colony.

Table 4-8 Survey timing, effort and conditions in 2014-2019

	2014	2015	2016	2017	2018	2019
Date	18 November	17 November	9 November	14 November	16 November	11 November
Start	8.30 am	9.30 am	1.00 pm	9.15 am	11.30 am	1.44 pm
Weather	Warm, sunny, light winds	Warm, sunny, light winds	Mild, calm, partly cloudy	Mild, calm, partly cloudy	Mild, calm, partly cloudy	Warm, sunny, light winds
Effort	0.75 person hrs	0.5 person hrs	1 person hr	1 person hr	1.25 person hrs	1.25 person hrs

4.10.3. Population size and reproductive status

The population size and reproductive status of the colony recorded in the six survey years are summarised in Table 4-2.

Eco Logical Australia (2011) recorded 15 flowering plants at the site in 15-17 November 2010. The total number of flowering or fruiting plants recorded in the colony during the monitoring surveys was 9 in 2014, 17 in 2015, 26 in 2016, 8 in 2017, 0 in 2018 and 3 in 2019. No plants were recorded outside the exclosure fence in 2015, 13 were recorded outside the fence in 2016, 1 was recorded outside the fence in 2017, 0 in 2018 and 3 plants were recorded outside the fence in 2019.

The 3 flowering plants recorded outside the fence in 2019 were at 706802 5951018, approximately 7 metres south of the south-east corner of the fence (Figure 4-20).

Table 4-9 Population size and age structure of the Small Snake Orchid colony (2014 - 2019)

	Bud	Flowering	Spent flowers	Fruit	Split capsules	Total
2014						
No. plants	0	8	1	0	0	9
Total	0	8	1	0	0	9
% visible colony	0	88.9	11.1	0	0	100
2015						
No. plants (all inside fence)	0	14	3	0	0	17

	Bud	Flowering	Spent flowers	Fruit	Split capsules	Total
Total	0	14	3	0	0	17
% visible colony	0	82.4	17.6	0	0	100
2016						
No. plants - inside fence	1	12	0	0	0	13
No. plants - outside fence	1	12	0	0	0	13
Total	2	24	0	0	0	26
% visible colony	7.7	92.3	0	0	0	100
2017						
No. plants - inside fence	0	7	0	0	0	7
No. plants - outside fence	0	1	0	0	0	1
Total	0	8	0	0	0	8
% visible colony	0	100	0	0	0	100
2018						
No. plants - inside fence	0	0	0	0	0	0
No. plants - outside fence	0	0	0	0	0	0
Total	0	0	0	0	0	0
% visible colony	-	-	-	-	-	-
2019						
No. plants - inside fence	0	0	0	0	0	0
No. plants - outside fence	0	3	0	0	0	3
Total	0	3	0	0	0	3
% visible colony	-	100	-	-	-	100

4.10.4. Area of occupancy

Eco Logical Australia (2011) recorded an area of occupancy for the orchid of approximately 150 metres^2. The visible colony in 2014 occupied a reduced area approximately 6 metres x 3 metres, centred on 706786 5951036. This area was extended during the 2015 survey with the recording of additional plants in the north-west corner of the fenced area. No plants were recorded outside the fenced area in 2015.

In 2016, the area of occupancy of the colony was observed to cover the central, northern and western (lower) parts of the fenced area (13 plants). Additional plants (13) were recorded outside the fence, up to 6 metres from the north-west corner and western fenceline. A single plant was recorded 2 metres to the south of the fenced area. The visible area of occupancy for the orchid at the site in 2016 was approximately 160 m^2.

In 2017 the 7 records within the exclusion fence were confined to approximately 20 m^2 in the central west of the area, and a single plant was recorded outside the fence, 9 metres south of the SE corner. No plants were recorded in 2018, inside or outside the fence. No plants were recorded inside the fence in 2019. Three plants were recorded outside the fence, in a group approximately 7 metres south of the south-east corner post, at 706802 5951018, occupying around 4 m^2.

4.10.5. Groundcover

During the 2015 survey, the favourable season had resulted in abundant flowering of the exotic perennial Sweet Vernal Grass (**Anthoxanthum odoratum*), estimated to be 15-20% foliage cover. Grass height within the orchid habitat was 10-12 cm, and live Sweet Vernal Grass inflorescences were 30-50cm high. Sweet Vernal Grass was abundant both inside and outside the then-new orchid fence, reflecting the favourable growing season.

In 2016, Sweet Vernal Grass inflorescences were not as prevalent. The fenced area had a high density of old inflorescence stems of the later-flowering native Weeping Grass, indicating a prolific 2015/2016 summer following construction of the fence (refer Figures 4-1 to 4-4). Native grasses (Weeping Grass - *Microlaena stipoides* and Snow Grass - *Poa sieberiana*) made up 63% of the cover. Exotic grasses represented 18.5% of the cover (predominantly Sweet Vernal Grass). Grass height within the fence was around 10 centimetres (excluding Sweet Vernal Grass inflorescence stems).

By 2017, both native grass and exotic grass cover had reduced, and litter cover had tripled. Native grasses were 44.4% of the cover. In terms of grass composition, Snow Grass constituted 56.6%, Sweet Vernal Grass was 20% and Kangaroo Grass made up 16.6% of all grass records. Grass height averaged 12 centimetres. The change was likely the result of the preceding dry period, and the tendency for the Snow Grass sward to thicken and exclude other plants.

Figure 4-19 Contrasting grass cover inside and outside the orchid exclosure fence

Figure 4-20 Orchid plant recorded outside the exclosure in 2019

In 2019, native grass and forb cover has remained relatively constant, but exotic grass cover (principally Sweet Vernal Grass) has declined substantially. This may be the result of the prolonged dry growing conditions at the site. Average grass height has also declined, reflecting the drought and the ageing native grass sward. Recorded litter cover has increased slightly. The results of the 2016 - 2019 groundcover transect surveys are summarised in Table 4-10.

Table 4-10 Groundcover transect survey results 2016 - 2019

Stratum	Percent cover			
	2016	2017	2018	2019
Native trees/shrubs (<1m)	0	1.8	0	1.8
Native grasses	63.0	44.4	64.8	62.9
Native herb (other)	7.4	12.9	3.7	7.4
Exotic grass	18.5	11.1	11.1	1.8
Exotic herb (other)	1.8	0	0	0
Litter	9.3	27.7	22.2	25.9

Rock (E- embedded, S – surface)	0	0	0	0
Bare ground	0	0	0	0
Total native (%)	**70.4**	**60.9**	**68.5**	**72.2**
Proportion of cover native (%)	**77.6**	**84.6**	**88.1**	**97.5**
Average grass height	-	12 cm	9.4 cm	7.8

4.10.6. Impacts and threats

The pig-proof fence has largely removed a significant threat to the orchid colony. There were no recent pig diggings close to the orchid colony in 2019 but evidence of pig activity was apparent elsewhere in the Lake Wallace block, and has been observed to have been increasing across the offset sites in recent years. Pigs remain a potential threat at the site, and the exclusion fence may still be required to protect the colony.

The fence does however introduce a potential threat from increased competition and crowding from grasses caused by reduced herbivory. This has been manifested by a thick mat of grass tussocks and litter in the exclosure. A comparison of grass growth inside and outside the exclosure is shown in Figure 4-19.

The flowering of terrestrial orchids can be spatially and temporally variable between years. Terrestrial orchids are known to miss flowering seasons during unfavourable conditions, but multi-seasonal dormancy has been linked with mortality in some species (for example, Coates *et al.* 2006). The sharp decline in orchid flowering at the site may be due to the combined impact of drought and excessive grass biomass affecting the core of the colony inside the exclosure fence.

Snow Grass and Kangaroo Grass needs some form of biomass control outside the orchid flowering and seeding period. Biomass control can be achieved by:

- slashing, raking and removal of cuttings
- small-scale ecological burning
- opening the fence to grazing by wild herbivores.

Changes in fire frequency will have implications for grass composition. *Poa* species recover more slowly after fire and tend to gradually replace Kangaroo Grass in moister grassland sites in the absence of fire (Prober *et al.* 2007). This is likely to be beneficial for inter-tussock herbs (Prober and Lunt 2008), including the Small Snake Orchid. Disturbance by burning has also been documented as a trigger which promotes flowering and presumably interrupts dormancy in orchids (Collier and Garnett 2013, Jones *et al.* 1999).

The Early Snake Orchid (*Diuris chryseopsis*) has been observed to have a 6 week flowering period and a 6 week fruiting and seed release period on the Far South Coast (author pers obs). Applying conservative pre-flowering and fruiting/seeding buffers, biomass could be reduced by slashing or burning during the period April - June or opening the exclosure to wild grazing for the period February - June.

Any seasonal opening of the fence would need to be undertaken in association with regular monitoring and timely closure if nearby pig activity is detected.

Eucalypt seedlings are also being promoted by the exclusion of large herbivores, and would negatively impact the orchid colony over time. Sweet Vernal Grass is likely to remain a recurring threat during wet years. It is fast-growing, shade-tolerant, copes well with nutrient-poor (especially low phosphorous) soils, produces allelopathic chemicals and large quantities of seed, and has a flowering period coinciding with the Small Snake Orchid.

5. ASSESSMENT AGAINST CONDITION TARGETS

5.1. MONITORING SITES

The management guidelines in the Offset Management Plan are intended to produce continuing improvement in the condition of grassy groundcover at the offset sites. The condition targets and proposed achievement timeframes set out in the plan are summarised in section 2.4. The status of each monitoring site is summarised in the tables below.

The target for grazing-sensitive species is comparative between monitoring years, and has not been included in the 2014 table. Grass height is a specific condition indicator for Snow Gum – Candlebark Woodland secondary grassland.

Some condition parameters in grassy communities are heavily influenced by climatic conditions, particularly rainfall. This will produce variation between monitoring years which is unrelated to background condition trends. Some caution should therefore be applied when interpreting monitoring results from a small number of repeat surveys.

Based on the 2019 monitoring results:

- native groundcover has continued to decline at many sites and remains below target at most sites
- Kangaroo Grass cover remains below target for all but two sites
- all sites except 1 meet the ≤10% target for bare ground
- grass heights remained low and below target for 3 sites, but increased at 3 sites (2 sites were above the target range)
- most sites are either stable or continuing a downward trend for richness, and 2 sites fell below the richness benchmark for the first time. 2 sites showed increased richness.
- Floristic Value Scores have continued to decline, with 6 sites falling below benchmark
- most sites failed to meet the pest animal scat target, with sign of rabbits, pigs and goats, as well as unapproved stock grazing and high macropod scat counts
- grazing-sensitive species were depressed in 2019 – all sites were below target (grazed and ungrazed)
- the Small Snake Orchid continued showing greatly reduced visible colony size and area of occupancy in 2019.

Table 5-1 Assessment against offset site condition targets - 2014

	SW1	SW2	GH1	GH2	GH3	GH4	GL1	GL2	GL3	GL4	NG1	NG2
Management zone	**1**	**3**	**1**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**2**	**2**
Native groundcover	No	No	No	Yes	Yes	No	No	No	No	Yes	Yes	Yes
Kangaroo Grass	No	No	No	Yes	No	No	No	No	No	No	NA	NA
Bare ground	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes
Grass height	NA	NA	No	Yes	No	No	No	No	Yes	Yes	NA	NA
Floristic richness	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Floristic Value Score	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No	No	Yes	No

	SW1	SW2	GH1	GH2	GH3	GH4	GL1	GL2	GL3	GL4	NG1	NG2
Pest animal scats	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes
Noxious weed count	No	No	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table 5-2 Assessment against offset site condition targets - 2015

	SW1	SW2	GH1	GH2	GH3	GH4	GL1	GL2	GL3	GL4	NG1	NG2
Management zone	**1**	**3**	**1**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**2**	**2**
Native groundcover	No	No	Yes	No	No	Yes	No	No	No	No	Yes	Yes
Kangaroo Grass	No	No	No	No	No	No	No	No	No	No	NA	NA
Bare ground	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes
Grass height	NA	NA	Yes	Yes	Yes	No	No	No	No	No	NA	NA
Floristic richness	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Floristic Site Value	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No	Yes	Yes	Yes
Grazing sensitive species	Yes	Yes	NA	NA	No	Yes	NA	NA	No	Yes	NA	NA
Pest animal scats	Yes	Yes	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Yes	Yes
Noxious weed count	No	No	No	Yes	No	Yes	Yes	Yes	No	Yes	Yes	Yes

Table 5-3 Assessment against offset site condition targets - 2017

	SW1	SW2	GH1	GH2	GH3	GH4	GL1	GL2	GL3	GL4	NG1	NG2
Management zone	**1**	**3**	**1**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**2**	**2**
Native groundcover	No	No	No	No	No	Yes	No	No	No	No	No	No
Kangaroo Grass	No	No	No	Yes	No	No	No	No	No	No	NA	NA
Bare ground	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Grass height	NA	NA	Yes	Yes	Yes	No	No	No	No	No	NA	NA
Floristic richness	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Floristic Site Value	Yes	Yes	No	Yes	Yes	No	Yes	No	No	No	Yes	Yes
Grazing sensitive species	No	No	NA	NA	No	No	NA	NA	No	Yes	NA	NA
Pest animal scats	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes
Noxious weed count	Yes	No	Yes	Yes	No	Yes	Yes	Yes	No	Yes	Yes	Yes

Table 5-4 Assessment against offset site condition targets - 2019

	SW1	SW2	GH1	GH2	GH3	GH4	GL1	GL2	GL3	GL4	NG1	NG2
Management zone	**1**	**3**	**1**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**2**	**2**
Native groundcover	No	No	No	Yes	Yes	Yes	No	No	No	No	No	No
Kangaroo Grass	No	No	No	Yes	No	Yes	No	No	No	No	NA	NA
Bare ground	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes
Grass height	NA	NA	No	No	No	Yes	No	No	No	Yes	NA	NA
Floristic richness	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No	No	No	No
Floristic Site Value	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No	No	No	No

	SW1	SW2	GH1	GH2	GH3	GH4	GL1	GL2	GL3	GL4	NG1	NG2
Grazing sensitive species	No	No	NA	NA	No	No	NA	NA	No	No	NA	NA
Noxious weed count	Yes	No	No	Yes	No	Yes	Yes	Yes	No	Yes	Yes	Yes
Pest animal scats	No	Yes	Yes	Yes	No	No	No	No	No	No	No	No

Table 5-5 Correlation of condition attributes in 2019 (shaded = failed to meet target)

Site	Stock grazing	Grass height	FSV	Pest animal scats	Sensitive species
SW1		NA			
SW2		NA			
GH1					NA
GH2		above target range			NA
GH3		above target range			
GH4					
GL1					NA
GL2					NA
GL3					
GL4					
NG1		NA			NA
NG2		NA			NA

6. CONCLUSIONS AND RECOMMENDATIONS

6.1. VEGETATION CONDITION

The continuing decline in key indicators at the offset sites at both grazed and ungrazed sites suggests that universal factors such as low rainfall and wild herbivory are affecting the offset sites. However, stock grazing and pest animal impacts are likely to be exacerbating conditions for sensitive flora species. Indicators show particularly poor results in the lower quality grazed areas (the GL sites); these are areas which are intended to be restored and improved under the Offset Management Plan and Property Vegetation Plan. Sites GL1, GL2 and GL3 showed a correlation of stock grazing, below-target grass height, pest animal scats and declining Floristic Value Scores.

There is no doubt that low rainfall has impacted growing conditions and monitoring results. October was the driest on record for southern Australia. Nimmitabel Wastewater Treatment Facility recorded its lowest winter total rainfall since 1980 (BOM 2019a). Root zone soil moisture during the survey period was very much below average at 2% in the study area (BOM 2019b).

Under climate change, average temperatures are predicted to continue to rise in all seasons and lower cool season rainfall is projected for the region. Increased time spent in drought is also projected (CSIRO and BOM 2019). This will place increasing stress on natural ecosystems. Conservation areas such as the Lake Wallace offset sites will need to be as resilient as possible to minimise biodiversity losses.

6.2. PROGRESS TOWARD CONDITION TARGETS

A summary of progress toward the condition targets in the Offset Management Plan (OMP) for the offset sites overall is provided in Table 6-1. None of the targets have been achieved based on the 2019 monitoring results. Bare ground and floristic richness had been achieved in 2017 but have slipped back in 2019.

Table 6-1 Status of progress toward condition targets

Condition indicator	Condition target	Achievement target	Status
Native groundcover	≥80%	December 2017	Not achieved
Bare ground cover	≤10%	December 2017	Not achieved
Average grass height	5-10 cm	December 2017	Not achieved
Kangaroo Grass cover	≥50%	December 2019	Not achieved
Floristic richness	SR637 – 20, SR610 - 16	December 2019	Not achieved
Floristic Value Score	≥ high floristic value category	December 2019	Not achieved
Pest animal scat count	No occurrences	December 2017	Not achieved
Noxious weed count	No occurrences	December 2017	Not achieved
Grazing-sensitive flora	Abundance maintained or increased	Continuing	Not achieved
Small Snake Orchid	Abundance and area maintained or increased	Continuing	Not achieved

6.3. RECOMMENDATIONS

The following recommendations aim to promote resilience and arrest factors which have been adversely affecting the significant biodiversity values of the offset sites.

6.3.1. Stock grazing

The primary management objective for the offset sites is biodiversity conservation. The Offset Management Plan allows for the use of stock grazing as a tool to control grass growth where this is required to maintain and enhance grassland biodiversity. It is noted that the current leaseholder appears to have repeatedly breached the rules set out in the Offset Management Plan, including grazing outside the approved grazing period, over-stocking and grazing within the protected riparian zone (NGH Environmental 2019).

Based on the monitoring results, stock grazing is not currently required to control grass biomass and present grazing practices are damaging biodiversity values at the sites.

Consistent with recommendations in the 2017 monitoring report, it is recommended that all stock grazing be ceased at the offset sites until monitoring and ecological advice indicates that stock grazing is required to control grass biomass. It is recommended that the current lease arrangements be terminated.

6.3.2. Pest animal control

Pest animal impacts are also likely to be contributing to the decline in condition monitoring indicators, and affects the long term resilience of the offset site communities.

In line with recommendations in previous monitoring reports, it is recommended that Council develop and implement a pest animal management plan for the sites, including the active control of goats, rabbits and pigs.

6.3.3. Small Snake Orchid

The Small Snake Orchid habitat within the orchid exclosure fence requires grass biomass reduction. This can be achieved by slashing, burning or wild grazing outside the orchid reproductive period. Guidelines for conducting ecological burns in native grassy ecosystems are provided in Appendix C. Biomass reduction may need to be repeated every 3-5 years, subject to monitoring.

Grass and litter biomass within the Small Snake Orchid exclosure should be reduced by:

- careful ecological burning (protecting the mature trees), or slashing to 10cm height and removing grass cuttings, during the April-June orchid dormancy period, or
- opening the exclosure to wild grazing for the period February – June (subject to pig control or the absence of any evidence of local pig activity).

The growth of eucalypt saplings within the exclosure presents a longer term risk to the orchid colony, from increasing shade and competition for water and nutrients.

Eucalypt saplings within the Small Snake Orchid exclosure should be removed using careful cut stump glyphosate application.

6.3.4. General

The wombat burrow below a small farm dam in the Southern Blocks offset site (refer section 4.6) should be remediated or filled with rocks to protect the integrity of the dam wall. If recent wombat activity is evident at the burrow entrance, the wombat should be humanely excluded, or removed and relocated prior to the works.

Sweet Briar should be controlled at the offset sites using a low impact technique, such as cut-stump glyphosate application.

The active gully erosion at site E4 should be remediated as soon as possible.

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APPENDIX A MONITORING DATA

Monitoring sites established in each TEC vegetation unit are represented by the following descriptors:

TEC vegetation unit	Monitoring sites
Snow Gum – Candlebark Woodland structural woodland	SW1, SW2 and SW3
Snow Gum – Candlebark Woodland secondary grassland high quality	GH1, GH2, GH3, GH4 and GH5
Snow Gum – Candlebark Woodland secondary grassland low quality	GL1, GL2, GL3 and GL4
Wet Tussock Grassland	NG1 and NG2

A.1 NATIVE PLANT RICHNESS – FLORISTIC QUADRAT SURVEY

Cover/abundance assessments are based on visual estimates of foliage cover (Carnahan 1997), scored using a modified Braun-Blanquet 7-point scale:

Braun-Blanquet cover-abundance scale	
r	Solitary (1-3 individuals), <5% cover
+	Few (4-15), <5% cover
1	Numerous/scattered, <5% cover
2	5 - 25% cover
3	26- 50% cover
4	51 - 75% cover
5	76 - 100% cover

Introduced species or non-local native species are denoted by an asterisk. Noxious weeds declared for the Cooma-Monaro control area under the *Noxious Weeds Act 1993* are indicated with a '†' symbol.

Where uncertainty exists due to the unavailability of reproductive material, the taxon is preceded by a question mark, or plants are identified to genus level only.

Botanical nomenclature follows Harden (1990-2002) and the Sydney Royal Botanic Gardens' PlantNet website. The family classification follows Angiosperm Phylogeny Group III (2009).

A1.1 Snow Gum Woodland structural woodland

Total number of native species (2014, 2015 and 2017 totals in brackets):

SW1 - 46 (46, 62, 44)
SW2 - 35 (31, 44, 33)

Floristic value scores (2014, 2015 and 2017 scores in brackets):

SW1 - 48 (45, 62, 53)
SW2 - 28 (23, 44, 29)

Scientific name	Common name	Family	Cover/abundance	
			SW1	SW2
TREES				
Eucalyptus pauciflora	Snow Gum	Myrtaceae	2	3
Eucalyptus rubida	Candlebark	Myrtaceae		r
Eucalyptus stellulata	Black Sally	Myrtaceae	3	
SHRUBS, SUB-SHRUBS				
Acrotriche serrulata	Honeypots	Ericaceae	r	r
Bossiaea foliosa	Leafy Bossiaea	Fabaceae		+
Epacris gunnii	Coral Heath	Ericaceae	2	
Hovea heterophylla	Variable Hovea	Fabaceae	r	
Leptospermum myrtifolium	Myrtle Tea-tree	Myrtaceae	2	
Leucopogon fraseri		Ericaceae	r	
Melicytus angustifolius ssp *divaricatus*	Tree Violet	Violaceae		r
Mirbelia oxylobioides	Mountain Mirbelia	Fabaceae	1	
†*Rosa rubiginosa*	Sweet Briar	Rosaceae		r
VINES AND TWINERS				
Glycine clandestina	Twining Glycine	Fabaceae		r
FORBS				
Acaena sp		Rosaceae	1	1
**Acetosella vulgaris*	Sheep Sorrel	Polygonaceae		1
Ajuga australis	Austral Bugle	Lamiaceae		r
Asperula conferta	Woodruff	Rubiaceae	+	r
Asperula scoparia	Prickly Woodruff	Rubiaceae	1	1
Brachyscome decipiens	Field Daisy	Asteraceae	+	
?Brachyscome scapigera	Tufted Daisy	Asteraceae	r	
Calotis scabiosifolia var *integrifolia*	Rough Burr-Daisy	Asteraceae	r	
Chrysocephalum semipapposum	Clustered Everlasting	Asteraceae	+	
**Cirsium vulgare*	Black Thistle	Asteraceae	r	r
Coronidium scorpioides	Button Everlasting	Asteraceae	1	1
Craspedia canens	Grey Billy Buttons	Asteraceae	+	
Cymbonotus preissianus	Austral Bear's Ear	Asteraceae	+	+
Desmodium varians	Slender Tick-trefoil	Fabaceae	r	
Dichondra repens	Kidney Weed	Convolvulaceae	1	1
Euchiton japonicus	Creeping Cudweed	Asteraceae	1	
Galium liratum		Rubiaceae	r	r
**Gamochaeta coarctata*	Cudweed	Asteraceae	+	
Geranium antrorsum	Rosetted Crane's-bill	Geraniaceae	1	
Geranium solanderi	Native Geranium	Geraniaceae	r	+

Scientific name	Common name	Family	Cover/abundance	
			SW1	SW2
Gonocarpus tetragynus	Raspwort	Haloragaceae	+	r
Hydrocotyle laxiflora	Stinking Pennywort	Araliaceae	1	1
Hypericum gramineum	Grassy St John's Wort	Hypericaceae	r	
**Hypochaeris radicata*	Catsear, Flatweed	Asteraceae	1	1
Leptorhynchos squamatus ssp squamatus	Scaly Buttons	Asteraceae	1	
Oreomyrrhis eriopoda	Native Carraway	Apiaceae	r	r
Oxalis perennans	Wood Sorrel	Oxalidaceae	r	+
Plantago varia	Variable Plantain	Plantaginaceae	1	1
Poranthera microphylla	Small Poranthera	Euphorbiaceae	1	+
Rumex brownii	Native Dock	Polygonaceae	r	
Scleranthus biflorus	Two-flowered Knawel	Caryophyllaceae		r
Scleranthus fasciculatus	Knawel	Caryophyllaceae		+
Solenogyne gunnii	Hairy Solenogyne	Asteraceae	+	
Stylidium graminifolium	Trigger Plant	Stylidiaceae	+	
**Taraxacum officinale*	Dandelion	Asteraceae	r	r
**Trifolium dubium*	Yellow Suckling Clover	Fabaceae	r	r
**Trifolium repens*	White Clover	Fabaceae	+	
**Trifolium* sp		Fabaceae	r	+
Veronica calycina	Hairy Speedwell	Plantaginaceae	r	+
Viola betonicifolia	Purple Violet	Violaceae	1	r
GRASSES				
**Aira caryophyllea*	Hair Grass	Poaceae		1
Anthosachne scabra	Wheat Grass	Poaceae	+	
**Anthoxanthum odoratum*	Sweet Vernal Grass	Poaceae	1	2
Microlaena stipoides	Weeping Grass	Poaceae	2	1
Poa labillardierei	Silver or River Tussock	Poaceae	r	r
Poa sieberiana	Snowgrass	Poaceae	4	2
Rytidosperma sp	Wallaby Grass	Poaceae	1	1
Themeda triandra	Kangaroo Grass	Poaceae	1	r
SEDGES AND RUSHES				
Carex appressa	Tall Sedge	Cyperaceae	+	r
Lomandra longifolia	Spiny-headed Mat-rush	Asparagaceae		+
Luzula densiflora	Woodrush	Juncaceae	+	+
Schoenus apogon	Bog Sedge	Cyperaceae	+	
FERNS				
Asplenium flabellifolium	Necklace Fern	Aspleniaceae		r

A1.2 Snow Gum Woodland secondary grassland - high diversity

Total number of native species (2014, 2015 and 2017 totals in brackets):

GH1 - 29 (38, 46, 22)
GH2 - 26 (23, 34, 29)
GH3 - 31 (43, 48, 39)
GH4 - 32 (43, 44, 25)

Floristic value scores (2014, 2015 and 2017 scores in brackets):

GH1 - 23 (26, 30, 16)
GH2 - 23 (24, 32, 25)
GH3 - 29 (37, 52, 53)
GH4 - 22 (29, 43, 17)

Scientific name	Common name	Family	Cover/abundance			
			GH1	GH2	GH3	GH4
SHRUBS, SUB-SHRUBS						
Acrotriche serrulata	Honeypots	Ericaceae				r
Discaria pubescens	Australian Anchor Plant	Rhamnaceae			1	
Hovea heterophylla	Variable Hovea	Fabaceae			r	
Leptospermum myrtifolium	Myrtle Tea-tree	Myrtaceae	+			
Leucopogon fraseri	Beard-heath	Ericaceae	r	r	r	r
Melicytus dentatus	Tree Violet	Violaceae			r	
Mirbelia oxylobioides	Mountain Mirbelia	Fabaceae		2		
Pimelea linifolia ssp *caesia*	Slender Rice Flower	Thymelaeaceae			r	
†**Rosa rubiginosa*	Sweet Briar	Rosaceae	r		+	
Rubus parvifolius	Native Raspberry	Rosaceae			+	
FORBS						
Acaena sp		Rosaceae	1	1	1	1
**Acetosella vulgaris*	Sheep Sorrel	Polygonaceae	1	1	1	1
Ajuga australis	Austral Bugle	Lamiaceae			+	
Arthropodium milleflorum	Vanilla Lily	Asparagaceae			r	
Asperula conferta	Woodruff	Rubiaceae	1			1
Asperula scoparia	Prickly Woodruff	Rubiaceae	1		1	1
Calotis scabiosifolia var *integrifolia*	Rough Burr-Daisy	Asteraceae			r	
**Centaurium erythraea*	Common Centaury	Gentianaceae		r		
Chrysocephalum apiculatum	Yellow Buttons	Asteraceae	r	1	1	1
Chrysocephalum semipapposum	Clustered Everlasting	Asteraceae	r	r		
**Cirsium vulgare*	Spear Thistle	Asteraceae	r			r
Convolvulus angustissimus	Bindweed	Convolvulaceae		r		
Coronidium scorpioides	Button Everlasting	Asteraceae	1			
Crassula sieberiana	Australian Stonecrop	Crassulaceae				1
Cymbonotus sp	Bear's Ear	Asteraceae	+		+	
Epilobium billardierianum ssp *cinereum*	Willow Herb	Onagraceae		+	+	
**Erodium cicutarium*	Common Stork's-bill	Geraniaceae	1			
Euchiton japonicus	Creeping Cudweed	Asteraceae				+
Euchiton sphaericus		Asteraceae				r
**Gamochaeta calviceps*	Silky Cudweed	Asteraceae	1			1
**Gamochaeta coarctata*	Cudweed	Asteraceae	1			1
Geranium antrorsum	Rosetted Crane's-bill	Geraniaceae	+	+	1	1
Geranium solanderi	Native Geranium	Geraniaceae	1		r	
Gonocarpus tetragynus	Raspwort	Haloragaceae	+	1	r	+
Hydrocotyle laxiflora	Stinking Pennywort	Araliaceae		1		1
Hydrocotyle sibthorpioides	Shining Pennywort	Araliaceae				+
Hypericum gramineum	Native St John's Wort	Hypericaceae		1		
**Hypochaeris radicata*	Catsear, Flatweed	Asteraceae	1	1	+	1

Scientific name	Common name	Family	Cover/abundance			
			GH1	GH2	GH3	GH4
Leptorhynchos squamatus ssp *squamatus*	Scaly Buttons	Asteraceae		1	1	
**Myosotis* sp	Forget-me-not	Boraginaceae				r
Oreomyrrhis eriopoda	Australian Carraway	Apiaceae	+			
Oxalis perennans	Wood Sorrel	Oxalidaceae	r	+		
Plantago varia	Variable Plantain	Plantaginaceae	1	1	1	1
Rumex brownii	Native Dock	Polygonaceae	r			r
Scleranthus biflorus	Two-flowered Knawel	Caryophyllaceae	1	+	1	1
Scleranthus fasciculatus	Knawel	Caryophyllaceae				r
Solenogyne gunnii	Hairy Solenogyne	Asteraceae	r	1	1	+
Stylidium graminifolium	Grass Trigger-plant	Stylidiaceae			r	r
Swainsona monticola	Notched Swainson-pea	Fabaceae				r
**Taraxacum officinale*	Dandelion	Asteraceae	+			
Trachymene humilis	Alpine Trachymene	Araliaceae			1	
**Trifolium arvense*	Haresfoot Clover	Fabaceae	1	1	1	1
**Trifolium dubium*	Yellow Clover	Fabaceae	+	r	+	1
**Trifolium subterraneum*	Subterranean Clover	Fabaceae	1			+
**Trifolium* sp		Fabaceae	+			
**Verbascum thapsus*	Great Mullein	Scrophulariaceae	r			
Veronica subtilis	Slender Speedwell	Plantaginaceae	1			
Viola betonicifolia	Purple Violet	Violaceae	r			
Vittadinia muelleri	New Holland Daisy	Asteraceae	r	1	r	r
Wahlenbergia planiflora	Flat Bluebell	Campanulaceae			+	+
GRASSES						
**Aira caryophyllea*	Hair Grass	Poaceae	1	1	1	1
Anthosachne scabra	Wheat Grass	Poaceae	+			
**Anthoxanthum odoratum*	Sweet Vernal Grass	Poaceae	2	1	1	2
?Bothriochloa macra	Red Grass	Poaceae	+			
**Holcus lanatus*	Yorkshire Fog	Poaceae				r
Lachnagrostis aemula	Blown Grass	Poaceae		r		
Microlaena stipoides	Weeping Grass	Poaceae	2	2	1	2
Poa labillardierei	Silver or River Tussock	Poaceae	2	r		2
Poa sieberiana	Snowgrass	Poaceae	2	2	3	2
Rytidosperma sp	Wallaby Grass	Poaceae	1	1	1	+
Sorghum leiocladum	Wild Sorghum	Poaceae		1	1	
Themeda triandra	Kangaroo Grass	Poaceae	4	4	4	4
**Vulpia sp*		Poaceae				1
SEDGES AND RUSHES						
Carex incomitata		Cyperaceae	+			+
Carex sp		Cyperaceae		r		r
Juncus filicaulis	Pinrush	Juncaceae				r
Juncus sp		Juncaceae				r
Luzula densiflora	Woodrush	Juncaceae		1	r	
Luzula sp	Woodrush	Juncaceae				+

A1.3 Snow Gum Woodland secondary grassland - low diversity

Total number of native species (2014, 2015 and 2017 totals in brackets):

GL1 - 23 (30, 41, 24)
GL2 - 16 (26, 34, 25)
GL3 - 18 (19, 33, 20)
GL4 - 27 (27, 31, 26)

Floristic value scores (2014, 2015 and 2017 scores in brackets):

GL1 - 15 (12, 21, 20)
GL2 - 8 (17, 15, 11)
GL3 - 5 (6, 15, 12)
GL4 - 15 (10, 21, 17)

Scientific name	Common name	Family	Cover/abundance			
			GL1	GL2	GL3	GL4
SHRUBS, SUBSHRUBS						
Acrotriche serrulata	Honeypots	Ericaceae	r			
Leptospermum myrtifolium	Myrtle Tea-tree	Myrtaceae		r		
Mirbelia oxylobioides	Mountain Mirbelia	Fabaceae	+			
†**Rosa rubiginosa*	Sweet Briar	Rosaceae			+	
FORBS						
Acaena sp		Rosaceae	1	1	+	+
**Acetosella vulgaris*	Sheep Sorrel	Polygonaceae	1	1	1	1
Asperula conferta	Woodruff	Rubiaceae		1		1
Chrysocephalum apiculatum	Yellow Buttons	Asteraceae				r
Chrysocephalum semipapposum	Clustered Everlasting	Asteraceae	r			
Convolvulus angustissimus	Bindweed	Convolvulaceae			r	
Coronidium scorpioides	Button Everlasting	Asteraceae				+
Crassula sieberiana	Australian Stonecrop	Crassulaceae	+			1
Cymbonotus preissianus	Austral Bear's Ear	Asteraceae		+	r	+
Epilobium billardierianum ssp *cinereum*	Willow Herb	Onagraceae	+			r
Euchiton japonicus	Creeping Cudweed	Asteraceae				+
Euchiton sphaericus	Cudweed	Asteraceae			r	
**Gamochaeta calviceps*	Cudweed	Asteraceae	1			
Geranium antrorsum	Rosetted Crane's-bill	Geraniaceae	+	1	r	1
Geranium solanderi	Native Geranium	Geraniaceae	r			
Hydrocotyle laxiflora	Stinking Pennywort	Araliaceae				1
Hypericum gramineum	Grassy St John's Wort	Hypericaceae				+
**Hypochaeris glabra*		Asteraceae	+		r	
**Hypochaeris radicata*	Catsear, Flatweed	Asteraceae	1	1	1	1
Oxalis perennans	Wood Sorrel	Oxalidaceae	r		r	r
Plantago varia	Variable Plantain	Plantaginaceae	1	1	1	+
Rumex brownii	Native Dock	Polygonaceae	r	r		r
**Salvia verbenaca*	Wild Sage	Lamiaceae			+	
Scleranthus biflorus	Two-flowered Knawel	Caryophyllaceae	1	1	1	+
Scleranthus fasciculatus	Knawel	Caryophyllaceae	r			r
Solenogyne gunnii	Hairy Solenogyne	Asteraceae		1	+	1
**Taraxacum officinale*	Dandelion	Asteraceae			+	
**Trifolium arvense*	Haresfoot Clover	Fabaceae	1	1	2	1

Scientific name	Common name	Family	Cover/abundance			
			GL1	GL2	GL3	GL4
**Trifolium dubium*	Yellow Clover	Fabaceae			+	1
**Trifolium repens*	White Clover	Fabaceae				1
**Trifolium subterraneum*	Subterranean Clover	Fabaceae		+		1
**Trifolium* sp		Fabaceae	1			
Vittadinia muelleri	Fuzzweed	Asteraceae	1	r	r	
GRASSES						
**Aira caryophyllea*	Hair Grass	Poaceae	1	1	1	1
Anthosachne scabra	Wheat Grass	Poaceae	r			2
**Anthoxanthum odoratum*	Sweet Vernal Grass	Poaceae	1	3	2	2
Austrostipa sp	Spear Grass	Poaceae	+			
Bothriochloa macra	Red Grass	Poaceae			1	
**Holcus lanatus*	Yorkshire Fog	Poaceae				1
Microlaena stipoides	Weeping Grass	Poaceae	3	2	4	4
Poa labillardierei	Silver or River Tussock	Poaceae	+	2	3	2
Poa sieberiana	Snowgrass	Poaceae	2	3	1	3
Rytidosperma sp	Wallaby Grass	Poaceae	1	1	+	1
Sorghum leiocladum	Native Sorghum	Poaceae	+		+	
Themeda triandra	Kangaroo Grass	Poaceae	3	3	1	2
**Vulpia* sp		Poaceae			1	
SEDGES AND RUSHES						
Carex appressa	Tall Sedge	Cyperaceae				+
Carex breviculmis	Short-flowered Sedge	Cyperaceae	+			+
Carex sp		Cyperaceae				+
Juncus filicaulis	Pinrush	Juncaceae		r		
Juncus sp	Rush	Juncaceae			r	
Luzula sp	Woodrush	Juncaceae				+

A1.4 Natural Temperate Grassland (Wet Tussock association) - NG

Total number of native species (2014, 2015 and 2017 totals in brackets):

NG1 - 18 (21, 28, 22)

NG2 - 18 (22, 24, 18)

Floristic value scores (2014, 2015 and 2017 scores in brackets):

NG1 - 17 (21, 31, 20)

NG2 - 14 (17, 26, 22)

Scientific name	Common name	Family	Cover/abundance	
			NG1	NG2
FORBS				
Acaena sp		Rosaceae	1	1
**Acetosella vulgaris*	Sheep Sorrel	Polygonaceae		1
**Aphanes arvensis*	Parsley-piert	Rosaceae	r	
Asperula conferta	Woodruff	Rubiaceae	2	1
?Brachyscome scapigera	Tufted Daisy	Asteraceae	+	
**Cerastium vulgare*	Mouse-ear Chickweed	Caryophyllaceae		r
**Cirsium vulgare*	Black Thistle	Asteraceae	r	+

Scientific name	Common name	Family	Cover/abundance	
			NG1	NG2
Dichondra repens	Kidney Weed	Convolvulaceae	r	1
Euchiton japonicus	Creeping Cudweed	Asteraceae	1	1
Geranium antrorsum	Rosetted Crane's-bill	Geraniaceae	+	r
Geranium solanderi	Native Geranium	Geraniaceae	r	r
Haloragis heterophylla	Rough Raspwort	Haloragaceae	1	
Hydrocotyle sibthorpioides	Shining Pennywort	Araliaceae	1	2
Hypericum japonicum	Small St John's Wort	Hypericaceae	1	1
**Hypochaeris radicata*	Catsear, Flatweed	Asteraceae	1	1
Ranunculus pimpinellifolius	Bog Buttercup	Ranunculaceae	+	1
Solenogyne gunnii	Hairy Solenogyne	Asteraceae		r
Stellaria angustifolia	Swamp Starwort	Caryophyllaceae		1
**Taraxacum officinale*	Dandelion	Asteraceae	1	1
**Trifolium dubium*	Yellow Clover	Fabaceae	1	
**Trifolium repens*	White Clover	Fabaceae	1	1
GRASSES				
**Anthoxanthum odoratum*	Sweet Vernal Grass	Poaceae	2	2
**Holcus lanatus*	Yorkshire Fog	Poaceae	1	2
Microlaena stipoides	Weeping Grass	Poaceae	3	3
**Paspalum dilatatum*	Paspalum	Poaceae	+	+
Poa labillardierei	Silver or River Tussock	Poaceae	3	3
Themeda triandra	Kangaroo Grass	Poaceae	1	1
SEDGES AND RUSHES				
Carex appressa	Tall Sedge	Cyperaceae		r
Carex chlorantha	Green-top Sedge	Cyperaceae	1	1
Carex gaudichaudiana	Fen Sedge	Cyperaceae		1
Juncus falcatus	Sickle-leaf Rush	Juncaceae	1	
Juncus ?usitatus	Common Rush	Juncaceae	+	2
Schoenus apogon	Bog Sedge	Cyperaceae	1	

A.2 COVER RESULTS

A2.1 Snow Gum Woodland structural woodland – SW1

Ground cover and understorey

Stratum	Percent cover		
	2015	2017	2019
Native groundcover (grasses)	42	36	38
Native groundcover (other)	10	8	6
Native shrubs (<1m)	2	2	4
Exotic species (groundcover)	30	10	6
Exotic species (mid/overstorey)	0	0	0
Litter	16	44	46
Rock (E- embedded, S – surface)	0	0	0
Bare ground	0	0	0
River Tussock cover (%)	0	0	0
Kangaroo Grass cover (%)	2	2	2
Total native groundcover (%)	52	46	44
Proportion native groundcover (%)	63	82	88

Midstorey and overstorey cover

Stratum	Percent foliage cover (average)		
	2015	2017	2019
Midstorey	0	0	0
Overstorey	39	35.5	33.5

A2.2 Snow Gum Woodland structural woodland – SW2

Ground cover and understorey

Stratum	Percent cover		
	2015	2017	2019
Native groundcover (grasses)	34	12	8
Native groundcover (other)	12	2	4
Native shrubs (<1m)	0	4	0
Exotic species (groundcover)	26	10	2
Exotic species (mid/overstorey)	0	0	0
Litter	20	64	74
Rock (E- embedded, S – surface)	6 (E)	8 (E)	2(E)
Bare ground	0	0	6
River Tussock cover (%)	6	0	0
Kangaroo Grass cover (%)	2	2	2
Total native groundcover (%)	46	18	12
Proportion native groundcover (%)	64	64.3	85.7

Midstorey and overstorey cover

Stratum	Percent foliage cover (average)		
	2015	2017	2019
Midstorey	0	0	0
Overstorey	39.5	40	35.5

A2.3 Snow Gum Woodland secondary grassland high diversity - GH1

Ground cover and understorey

Stratum	Percent cover		
	2015	2017	2019
Native groundcover (grasses)	60	68	62
Native groundcover (other)	14	4	10
Native shrubs (<1m)	0	0	0
Exotic species (groundcover)	24	10	10
Exotic species (mid/overstorey)	0	0	0
Litter	2	18	14
Rock (E- embedded, S – surface)	0	0	0
Bare ground	0	0	2
River Tussock cover (%)	26	10	4
Kangaroo Grass cover (%)	16	6	40
Total native groundcover (%)	74	72	72
Proportion native groundcover (%)	76	87.8	87.8

Midstorey and overstorey cover

Stratum	Percent foliage cover (average)		
	2015	2017	2019
Midstorey	0	0	0
Overstorey	0	0	0

Groundcover grass height (cm)

Maximum (cm)			Minimum (cm)			Ave. grass height (cm)		
2015	2017	2019	2015	2017	2019	2015	2017	2019
13	6	7	4	4.5	2.5	7.9	5.45	4.8

A2.4 Snow Gum Woodland secondary grassland high diversity – GH2

Ground cover and understorey

Stratum	Percent cover		
	2015	2017	2019
Native groundcover (grasses)	58	68	90
Native groundcover (other)	8	8	2
Native shrubs (<1m)	10	2	4
Exotic species (groundcover)	22	10	2
Exotic species (mid/overstorey)	0	0	0
Litter	2	12	2
Rock (E- embedded, S – surface)	0	0	0
Bare ground	0	0	0
River Tussock cover (%)	2	0	0
Kangaroo Grass cover (%)	44	56	70
Total native groundcover (%)	66	78	92
Proportion native groundcover (%)	75	88.6	97.8

Midstorey and overstorey cover

Stratum	Percent foliage cover (average)		
	2015	2017	2019
Midstorey	0	0	0
Overstorey	0	0	0

Groundcover grass height (cm)

Maximum (cm)			Minimum (cm)			Ave. grass height (cm)		
2015	2017	2019	2015	2017	2019	2015	2017	2019
10	7	20	4	4	9	6.4	5.4	12.75

A2.5 Snow Gum Woodland secondary grassland high diversity – GH3

Ground cover and understorey

Stratum	Percent cover		
	2015	2017	2019
Native groundcover (grasses)	70	62	64
Native groundcover (other)	14	12	18
Native shrubs (<1m)	0	0	0
Exotic species (groundcover)	8	10	8
Exotic species (mid/overstorey)	0	0	0
Litter	2	8	4
Rock (E- embedded, S – surface)	8 (E)	8 (E), 2 (S)	6 (E)
Bare ground	0	0	0
River Tussock cover (%)	2	2	2
Kangaroo Grass cover (%)	36	20	44
Total native groundcover (%)	84	74	82
Proportion native groundcover (%)	91	88.1	91.1

Midstorey and overstorey cover

Stratum	Percent foliage cover (average)		
	2015	2017	2019
Midstorey	0	0	0
Overstorey	0	0	0

Groundcover grass height (cm)

Maximum (cm)			Minimum (cm)			Ave. grass height (cm)		
2015	2017	2019	2015	2017	2019	2015	2017	2019
12	7	31	0	2.5	4.5	5.5	5.4	10.2

A2.6 Snow Gum Woodland secondary grassland high diversity – GH4

Ground cover and understorey

Stratum	Percent cover		
	2015	2017	2019
Native groundcover (grasses)	76	76	80
Native groundcover (other)	12	6	0
Native shrubs (<1m)	0	0	0
Exotic species (groundcover)	6	6	12
Exotic species (mid/overstorey)	0	0	0
Litter	4	12	6
Rock (E- embedded, S – surface)	0	0	0
Bare ground	2	0	2
River Tussock cover (%)	4	4	2
Kangaroo Grass cover (%)	48	48	68
Total native groundcover (%)	88	82	80
Proportion native groundcover (%)	94	93.2	86.9

Midstorey and overstorey cover

Stratum	Percent foliage cover (average)		
	2015	2017	2019
Midstorey	0	0	0
Overstorey	0	0	0

Groundcover grass height (cm)

Maximum (cm)			Minimum (cm)			Ave. grass height (cm)		
2015	2017	2019	2015	2017	2019	2015	2017	2019
7	5	17	1	3.5	3	4.3	3.9	9.15

A2.7 Snow Gum Woodland secondary grassland low diversity - GL1

Ground cover and understorey

Stratum	Percent cover		
	2015	2017	2019
Native groundcover (grasses)	40	48	32
Native groundcover (other)	28	8	4
Native shrubs (<1m)	2	0	2
Exotic species (groundcover)	18	6	12
Exotic species (mid/overstorey)	0	0	2
Litter	8	34	30
Rock (E- embedded, S – surface)	0	0	0
Bare ground	4	4	18
River Tussock cover (%)	0	0	0
Kangaroo Grass cover (%)	16	14	26
Total native groundcover (%)	68	56	36
Proportion native groundcover (%)	79	90.3	75

Midstorey and overstorey cover

Stratum	Percent foliage cover (average)		
	2015	2017	2019
Midstorey	0	0	0
Overstorey	0	0	0

Groundcover grass height (cm)

Maximum (cm)			Minimum (cm)			Ave. grass height (cm)		
2015	2017	2019	2015	2017	2019	2015	2017	2019
8	4	6	3	2	1.5	4.3	2.85	3.4

A2.8 Snow Gum Woodland secondary grassland low diversity – GL2

Ground cover and understorey

Stratum	Percent cover		
	2015	2017	2019
Native groundcover (grasses)	54	42	38
Native groundcover (other)	10	4	8
Native shrubs (<1m)	0	0	0
Exotic species (groundcover)	26	22	28
Exotic species (mid/overstorey)	0	0	0
Litter	0	16	18
Rock (E- embedded, S – surface)	10	10	8
Bare ground	0	6	0
River Tussock cover (%)	14	10	2
Kangaroo Grass cover (%)	10	10	16
Total native groundcover (%)	64	46	46
Proportion native groundcover (%)	71	67.6	60.5

Midstorey and overstorey cover

Stratum	Percent foliage cover (average)		
	2015	2017	2019
Midstorey	0	0	0
Overstorey	0	0	0

Groundcover grass height (cm)

Maximum (cm)			Minimum (cm)			Ave. grass height (cm)		
2015	2017	2019	2015	2017	2019	2015	2017	2019
12	5	6	1	1	1	4.7	2.25	3.45

A2.9 Snow Gum Woodland secondary grassland low diversity – GL3

Ground cover and understorey

Stratum	Percent cover		
	2015	2017	2019
Native groundcover (grasses)	48	50	40
Native groundcover (other)	10	10	4
Native shrubs (<1m)	0	0	0
Exotic species (groundcover)	36	16	30
Exotic species (mid/overstorey)	0	0	0
Litter	4	22	20
Rock (E- embedded, S – surface)	0	0	0
Bare ground	0	2	6
River Tussock cover (%)	12	8	8
Kangaroo Grass cover (%)	4	8	4
Total native groundcover (%)	68	60	44
Proportion native groundcover (%)	52	78.9	59.5

Midstorey and overstorey cover

Stratum	Percent foliage cover (average)		
	2015	2017	2019
Midstorey	0	0	0
Overstorey	0	0	0

Groundcover grass height (cm)

Maximum (cm)			Minimum (cm)			Ave. grass height (cm)		
2015	2017	2019	2015	2017	2019	2015	2017	2019
5	5	5	1.5	1.5	2.5	2.95	2.85	3.6

A2.10 Snow Gum Woodland secondary grassland low diversity – GL4

Ground cover and understorey

Stratum	Percent cover		
	2015	2017	2019
Native groundcover (grasses)	52	58	66
Native groundcover (other)	24	8	12
Native shrubs (<1m)	0	0	0
Exotic species (groundcover)	10	24	12
Exotic species (mid/overstorey)	0	0	0
Litter	2	6	4
Rock (E- embedded, S – surface)	0	0	0
Bare ground	12	2	6
River Tussock cover (%)	6	4	0
Kangaroo Grass cover (%)	12	16	20
Total native groundcover (%)	76	66	78
Proportion native groundcover (%)	88	73.3	86.6

Midstorey and overstorey cover

Stratum	Percent foliage cover (average)		
	2015	2017	2019
Midstorey	0	0	0
Overstorey	0	0	0

Groundcover grass height (cm)

Maximum (cm)			Minimum (cm)			Ave. grass height (cm)		
2015	2017	2019	2015	2017	2019	2015	2017	2019
5	5	10.5	3	3.5	3.5	3.8	3.65	6.85

A2.11 Wet Tussock Grassland - NG1

Ground cover and understorey

Stratum	Percent cover		
	2015	2017	2019
Native groundcover (grasses)	44	26	32
Native groundcover (other)	44	28	10
Native shrubs (<1m)	0	0	0
Exotic species (groundcover)	10	30	22
Exotic species (mid/overstorey)	0	0	0
Litter	0	8	30
Rock (E- embedded, S – surface)	0	0	0
Bare ground	2	8	4
River Tussock cover (%)	32	10	6
Kangaroo Grass cover (%)	0	0	6
Total native groundcover (%)	88	54	42

Proportion native groundcover (%)	90	64.3	65.6

Midstorey and overstorey cover

Stratum	Percent foliage cover (average)		
	2015	2017	2019
Midstorey	0	0	0
Overstorey	0	0	0

Wet Tussock Grassland - NG2

Ground cover and understorey

Stratum	Percent cover		
	2015	2017	2019
Native groundcover (grasses)	28	20	34
Native groundcover (other)	58	44	24
Native shrubs (<1m)	0	0	0
Exotic species (groundcover)	8	32	42
Exotic species (mid/overstorey)	0	0	0
Litter	0	2	0
Rock (E- embedded, S – surface)	0	0	0
Bare ground	6	0	0
River Tussock cover (%)	20	12	14
Kangaroo Grass cover (%)	0	0	4
Total native groundcover (%)	86	64	58
Proportion native groundcover (%)	91	66.7	58

Midstorey and overstorey cover

Stratum	Percent foliage cover (average)		
	2015	2017	2019
Midstorey	0	0	0
Overstorey	0	0	0

APPENDIX B PHOTOPOINT PHOTOGRAPHS 2019

SW1

SW2

GH1

GH2

GH3

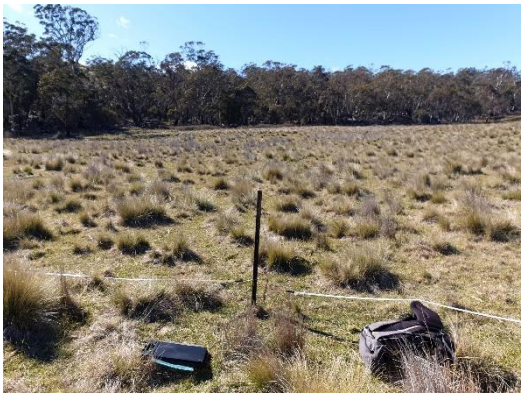
GH4

GL1

GL2

GL3

GL4



NG1

NG2

APPENDIX C ECOLOGICAL BURNING GUIDELINES

The following general guidelines apply to temperate grassy ecosystems in southern Australia. Specific control measures should be developed to suit each site, considering assets, topography, species composition, life cycles of significant species and potential weed responses.

The guidelines have been drawn from government policies and research (such as Kitchin 2008), the Lake Wallace Offset Management Plan (NGH Environmental 2014) and fire management guidelines developed for grassy ecosystems at other sites (NGH Environmental *et al.* 2012, McPherson and Dorrough 2013, McPherson 2014).

The seasonal timing for ecological burning should generally be autumn-winter. Spring burns can be used to control early-flowering exotic weeds in some years, where these weeds are abundant or increasing.

Fuel and weather conditions should produce a low-moderate intensity fire, producing for example a 0.5-1.5 metre flame height, and running quickly over the ground. Ideally, grass will be thick and dry and soils will be slightly moist to protect the seed bank.

Burns should be patchy at the paddock scale, aiming to achieve 30% unburnt (in patches), 70% burnt and less than 10% mature crown scorch in trees.

Trees should be specifically protected from damage by raking away litter and wetting down during the burn as required. Logs, stags and tree hollows should also be protected during the burn.

Where practicable burns should proceed downslope to avoid increased intensity on upper slopes.

Burns should be lit from one side, and large areas should be divided into isolated burn patches, to allow animals to escape.

Ploughing, mineral earth rake hoe lines or fire-fighting foam should not be used to control the fire.

Grazing pressure should be reduced following the burn by excluding stock and controlling rabbits and other introduced herbivores.

Heavy fire-fighting appliance traffic should be avoided or minimised in high conservation value grasslands and woodland. Work from outside the patch using hoses where possible.

Vehicles and equipment used during the burn should be clean, and not carry soil and weed seed into the site.