Mundulla Common Operations Plan 2018 - 2028

MISTER TUCKER'S
BUSINESS

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1. Introduction

Over many years Tatiara District Council (TDC) has managed Mundulla Common, but has found difficulty balancing community expectations, State (Adelaide and Mt Gambier based) and Federal Government requirements and biodiversity values. On 7 December 2016, TDC met with representatives of the Native Vegetation Council (NVC) to discuss a way forward to streamline the process for operational decisions and avoid the requirements for annual approvals. It was decided a new Operations Plan was required and once approved by NVC, TDC could undertake management actions without the requirement for annual approvals. Due to the nationally Endangered Grey Box (*Eucalyptus microcarpa*) Grassy Woodland vegetation community within Mundulla Common, an Operations Plan would also have to fit within the requirements of the Commonwealth Environment Protection and Biodiversity Conservation (EPBC) Act (1999)**.**

This Operations Plan meets these requirements and provides actions to:

- Undertake weed management;
- Maintain perimeter fuel breaks; and
- Monitor vegetation condition.

This Operations Plan builds on information and direction provided in the 2009 *Draft Management Plan for Moot-Yang-Gunya Swamp and Mundulla Common* written by Department for Environment and Heritage (now Department of Environment, Water and Natural Resources (DEWNR)). Consequently, detailed site information provided in that plan will not be repeated here.

This Operations Plan is for the management of Mundulla Common only and excludes Moot-Yang-Gunya Swamp.

When determining broader native vegetation management options in South Australia, caution needs to be exercised if methods used in the eastern states of Australia are being considered. Those methods are not always directly transferable to South Australian conditions. Unintended consequences may occur due to differences in soil characteristics and species' response. Broad management options include grazing and burning for weed control. Consequently, this Operations Plan takes a conservative approach to vegetation management and is driven by the desire to improve biodiversity values and the overall condition of vegetation within Mundulla Common.

2. Site Description

Mundulla township is located 11km south west of Bordertown, South Australia and lies within the boundary of the Tatiara District Council. Mundulla township is surrounded by Mundulla Common (43 hectares) to the east, south, and north west and Moot-Yang-Gunya Swamp (60 hectares) to the north (Figure 1).

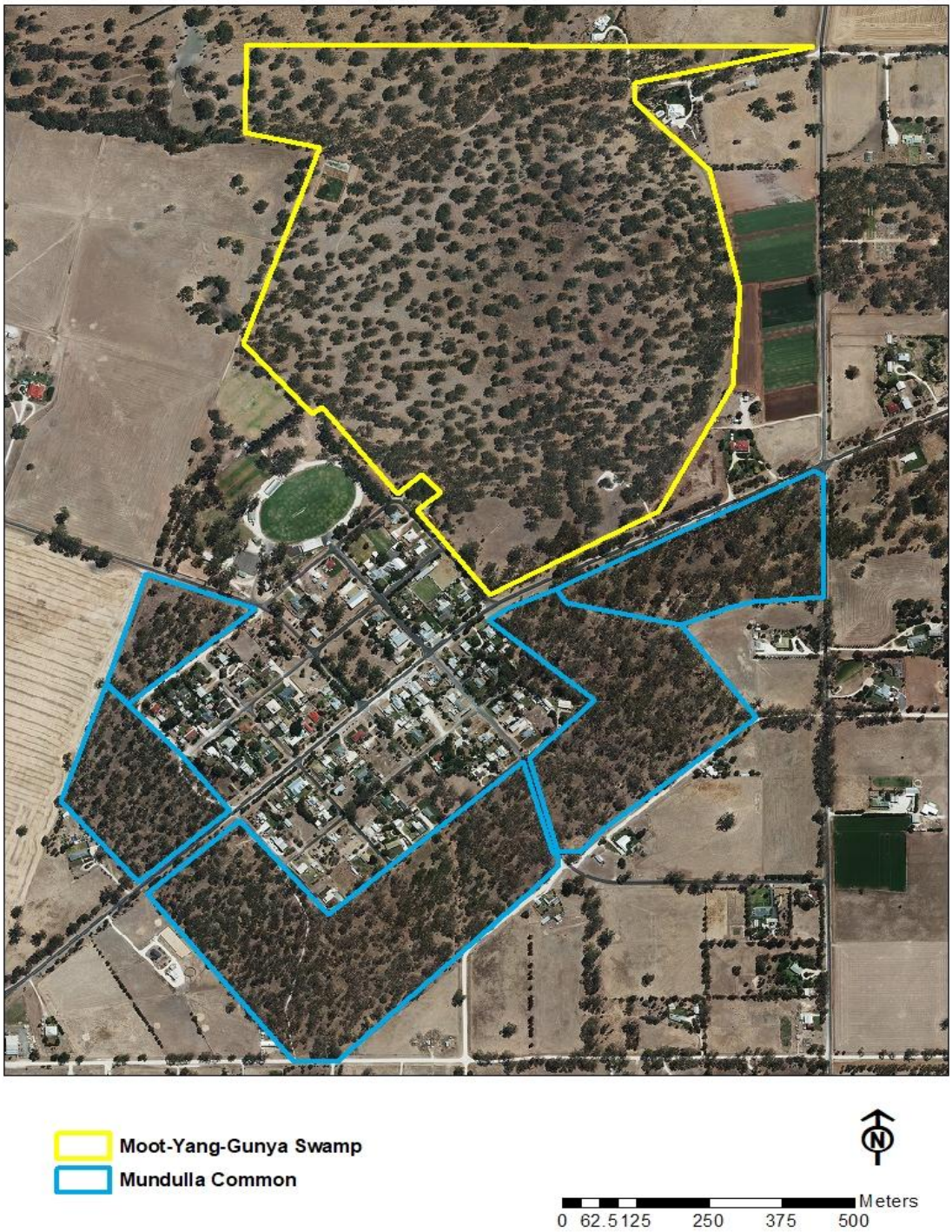

Figure 1 Moot-Yang-Gunya Swamp and Mundulla Common

Three Grassy Woodland communities occur within Mundulla Common:

- Grey Box (*Eucalyptus microcarpa*) 17.80 ha;
- Blue Gum (*Eucalyptus leucoxylon* ssp. *pruinosa*) 14.95 ha; and
- Red Gum (*Eucalyptus camaldulensis* ssp. *camaldulensis*) 9.85 ha.

These are described in Sections 3 and 4.

To assist with managing Mundulla Common, Management Areas (MA) have been assigned to different locations following those nominated by NVC in 2013 (Figure 2). MA1 and 2 occur in Moot-Yang-Gunya Swamp and are not referred to in this Operations Plan.

Table 1: Management Area hectares and vegetation communities.

Management Area	Total Area (hectares)	Grey Box Woodland	Blue Gum Woodland	Red Gum Woodland
MA 3	6.74			6.74
MA 4	10.80		7.69	3.11
MA 5	16.89	10.30	6.59	
MA 6	5.30	5.30		
MA 7	2.87	2.20	0.67	
Total	**42.60**	**17.80**	**14.95**	**9.85**

A list of native plants and weeds identified in Mundulla Common and Moot-Yang-Gunya Swamp is provided in Appendix B.

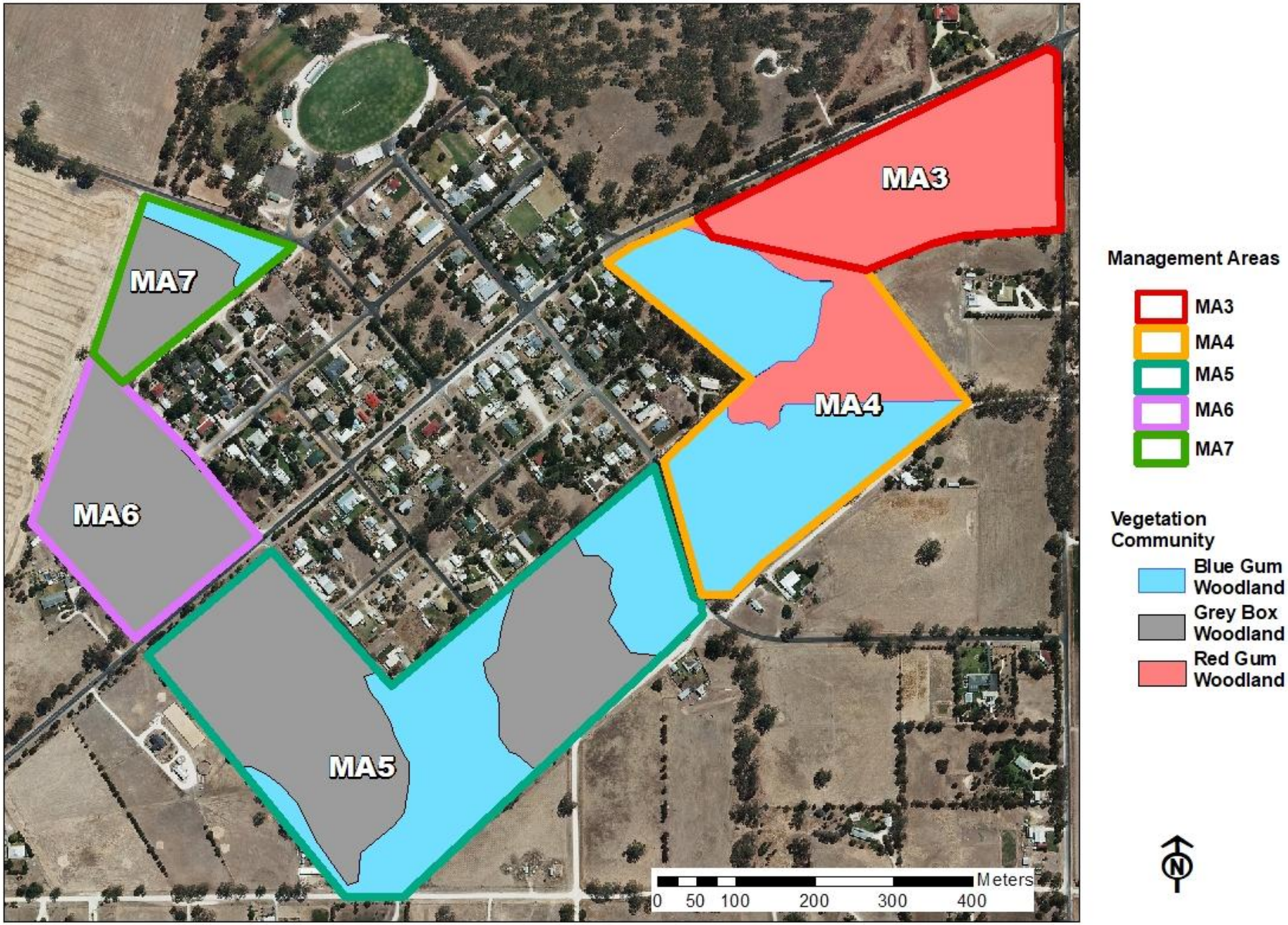

Figure 2 Mundulla Common Management Areas and Vegetation Communities

3. Grey Box Grassy Woodland (and adjoining Blue Gum Woodland), Management Areas 5, 6 and 7

Grey Box (*Eucalyptus microcarpa*) Grassy Woodland is of national importance and is listed as Endangered under the Commonwealth EPBC Act. Grey Box Grassy Woodland has been extensively cleared throughout its range in Australia with only 10 to 15% of its original extent remaining. In South Australia, only 3% of its original extent remains. This is because it grows on heavy, fertile soil that is highly productive for agricultural purposes. In South Australia, Grey Box Woodlands are limited to small areas within the Upper South East, Flinders Ranges and south west area of the Adelaide Hills.

In Mundulla Common, Grey Box Grassy Woodland (17.80 ha) is the dominant vegetation community in MAs 5, 6 and 7 (Figure 3). Blue Gum (*Eucalyptus leucoxylon* ssp. *pruinosa*) Grassy Woodland (7.26) is the other vegetation community within these three MAs. For the purpose of management, both can be considered the same due to similar soil features, weed species and abundance and therefore can be managed together.

Bush Stone-curlew (*Burhinus grallarius*) (Figure 4) inhabit MAs 5, 6 and 7. These birds are listed as Rare in South Australia and Endangered in the South East. Key habitat requirements and (daytime) roosting sites are identified in the *Draft Management Plan for Moot-Yang-Gunya Swamp and Mundulla Common* (2009) (Figure 5).

Figure 3 Example of Grey Box Grassy Woodland in good condition within Mundulla Common.

Figure 4 Bush Stone-curlew (image courtesy of Robert Mock)

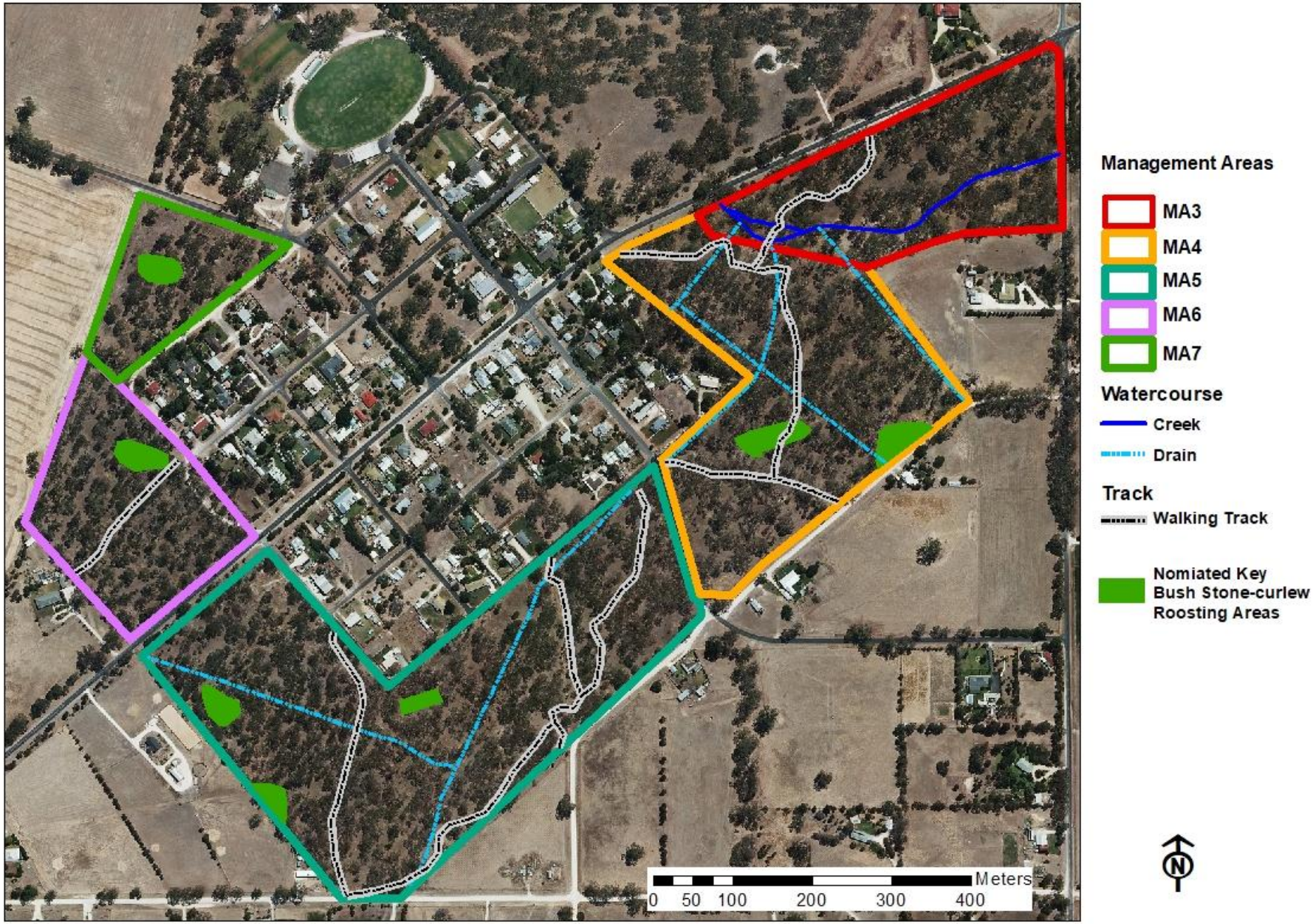

Figure 5. Location of DEWNR nominated Bush Stone-curlew daytime roosting areas

Throughout MAs 5, 6 and much of MA7 there are large patches of undisturbed, intact microphytic crust (moss, lichens and algae) and a diverse range of native plants (Figure 6), many of which are only noticed in spring before they die back over summer. These features determine MAs 5, 6 and much of MA7 are of very high quality. Grazing with hard-hoofed animals can severely damage a delicate microphytic crust, which in turn can provide opportunities for disturbance loving broad leaved weeds such as, thistles, Buchan weed (*Hirschfeldia incana*), Scabiosa (*Scabiosa atropurpurea*) etc to colonise the site. These weeds are large, unsightly and require considerable, prolonged resources (physical and financial) to control. Their response to disturbance is usually underestimated.

MAs 5 and 6 cannot tolerate broad scale treatment options, such as grazing. However, approximately one hectare of MA7 has a high proportion of annual grasses along the western and northern boundaries, plus a small area to the south previously fenced as a NVC grazing exclusion zone. Pulse grazing may be appropriate to control annual grasses in MA7.

The most frequent weeds are exotic grasses, mainly annual grasses, with a minor component of small woody weeds and herbs (Appendix B). Exotic grasses are generally restricted to the base of large trees (rarely exceeding 20m from the trunk of Grey Box (Figure 6) or 30m from Blue Gum (Figure 7), drainage and fence lines. Any weed management option must consider the likely consequence of rapid broadleaf weed establishment. Due to the quality of vegetation and resources required for follow up work, individual patches of weed control should not exceed 900m^2, e.g. 30 x 30m. Table 2 provides a range of control options targeting smaller patches in MAs 5, 6 and 7.

Figure 6 Annual grasses at the base of a Grey Box tree.

Figure 7 Annual grasses at the base of a Blue Gum tree

Management Area 7

The exclusion area in MA7 was heavily dominated by weeds, including various annual grasses, Bridal Creeper (*Asparagus asparagoides*) and Soursob (*Oxalis pes-capre*) (Figure 8). This area was not representative of the overall condition of MA7 and the subdivision fencing has been removed. As per the previous Management Agreement this area will continue to be grazed to maintain the good cover of native grasses and low weed load. Should Curlew

nesting or native vegetation impact occur grazing animals will be removed. The site will be regularly monitored to ensure this does not occur.

Figure 6. MA7 NVC grazing exclusion zone.

Figure 9. Vegetation typical of MA7.

4. Blue Gum and Red Gum Grassy Woodland, Management Areas 3 and 4

Red Gum (*Eucalyptus camaldulensis* ssp. *camaldulensis*) Grassy Woodland (6.74 ha) occurs in MA 3 and both Red Gum (3.11 ha) and Blue Gum (7.69 ha) Grassy Woodlands occur in MA 4 (Figures 10 and 11). Both can be managed similarly due to similarities in soil type, weed species and abundance. Although MA 3 generally has a higher weed load, there are several small patches of very high-quality vegetation.

Figure 10. Example of Red Gum Grassy Woodland in good condition within Mundulla Common.

Figure 7. Example of Blue Gum Grassy Woodland in Mundulla Common.

Both MAs contain patches of high quality vegetation with intact microphytic crust. These patches could easily go unnoticed because many of the native plants are only noticed during spring (Figure 12), after which they die back over summer. Sometimes surrounded by dense and/or tall weeds, these high-quality patches could easily go unnoticed and be damaged by course weed control methods. Careful assessment is required before conducting weed control as it cannot be assumed weedy patches are uniformly weedy.

Figure 8. Dense patch of native herbs in Red Gum Grassy Woodland (MA3); no weeds present.

The most prominent weeds are exotic grasses, both perennial and annual, disturbance loving broad leaved weeds, Bridal Creeper and a minor component of small woody weeds (See Appendix B). The worst patches of exotic perennial grasses are located along the banks of Nalang Creek and drainage lines. Summer active weeds such as Lippia (*Phyla canescens*) and Twining Toadflax (*Kickxia elatine* ssp. *crinita*) occur in areas associated with drainage (Figures 14 and 15).

Figure 13. Lippia a summer active weed

Figure 9. Twining Toadflax a summer active weed colonising bare ground

The *Draft Management Plan for Moot-Yang-Gunya Swamp and Mundulla Common* (2009) identified two Bush Stone-curlew roosting sites. Activity in these roosting areas should be avoided. The Mundulla Community and Bush-stone Curlew Friends Group will be consulted to identify current roosting areas. Generally, problem weeds are sparse in these areas and too much noise and human traffic may disturb any of these birds.

5. Weed Control in Mundulla Common

Protecting and encouraging native plants must always be the focus when controlling weeds in bushland. Over clearing weeds to the point where native plants are unable to move into the space created often results in the space being filled by more weeds. This can create a situation that is worse than before weed control started and is a major reason for failure. Sometimes a patch of dense weeds may even prevent worse weeds from getting started, e.g. annual grasses may prevent establishment of thistles or Buchan weed, and Soursob may prevent annual grasses.

Weed control in bushland requires a different approach to that used in parks and gardens or agriculture. It must be carefully considered and follow a defined strategy. Reactionary weed control in bushland is inefficient and often leads to major problems and negatively impacts biodiversity values. Principles for conducting weed control in bushland are provided in Appendix A.

5.1 APPROACHES TO EXOTIC GRASS CONTROL

There are many reasons for considering different approaches to exotic grass control in native vegetation including:

- Condition of surrounding native vegetation;
- If the grass is annual or perennial or a mixture;
- Advantages and disadvantages of each method;
- Size of area that needs to be controlled; and
- Resources required.

Most approaches require some level of monitoring to:

- Ensure weed control is successful;
- Ensure vegetation condition improves;
- Identify any problems with methods, which could be specific to Mundulla Common; and
- Improve future management decisions.

A monitoring framework is provided in Section 6.

5.1.1 Priority: Perennial vs Annual Weed Grasses

In bushland, perennial weed grasses should be controlled before annual grasses because they have greater impact on biodiversity values. They produce dense tussocks with tall stems, which easily crowd out native plants, preventing their germination and degrade feeding habitat for many birds, e.g. Scarlet Robin and Bush Stone-curlew. In a fire, the perennial weed grasses like Phalaris (*Phalaris aquatica*) burn hotter with a higher flame height compared to native grasses. During a fire, old Phalaris seed heads can become dislodged from the stems and can advance a fire front as they float ablaze on hot winds. The crowns of large perennial weed grasses can smoulder for several days and increase the potential for flare ups after a fire has been contained. Smouldering crowns at the base of mature trees may kill the trees.

To control **perennial weed grasses**, the following ecological priority order is recommended. It is focussed on protecting the entire Mundulla Common from future invasion, then ensuring the best quality vegetation does not degrade further, ensuring the greatest long-term efficiencies will be gained (i.e. best ecological value for money and time) (Figures 16 to 20):

Priority 1) Populations outside of Mundulla Common, abutting the external boundary and extending to immediate roadsides;

a. Abutting MAs 5
b. Abutting MAs 3 and 4

Priority 2) Populations from (1) extending into Mundulla Common;

a. At MAs 5
b. At MAs 3 and 4

Priority 3) Within MAs 5, 6 and 7;

a. Isolated tussocks;

b. Drainage lines;

Priority 4) MA4;

a. Isolated tussocks;

b. Drainage lines and smaller populations;

c. Larger populations;

Priority 5) MA3;

a. Drainage lines;

b. Smaller populations; then

c. Larger populations.

Figure 15. Example of a Priority 1 (a) Perennial Weed Grass location on Hillier Rd.

Figure 10. Example of a Priority 2 (a) Perennial Weed Grass location, spread from Hillier Rd (Figure 16).

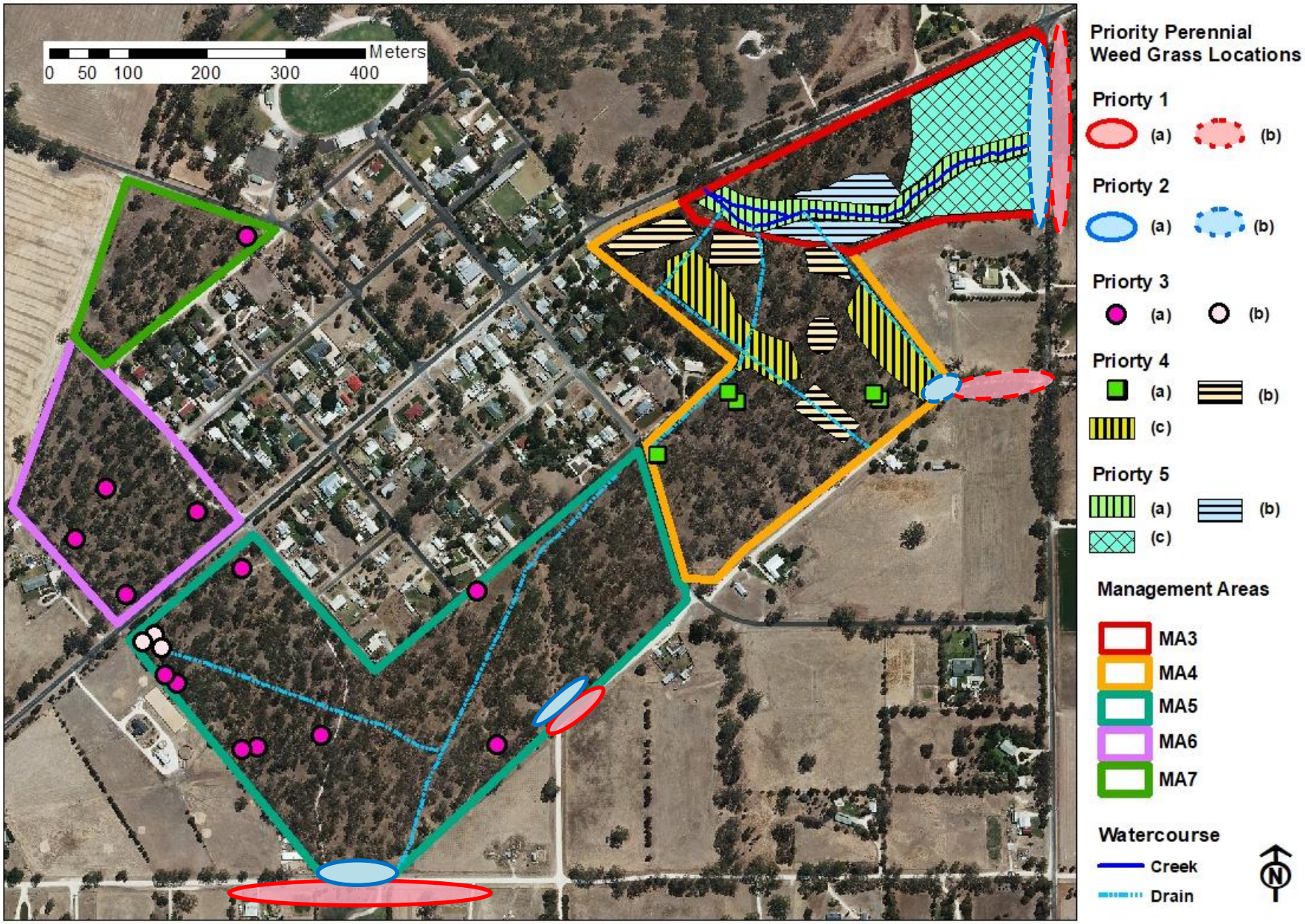

Figure 17. Locations of Perennial Weed Grasses in priority order

Figure 18. Example of a Priority 3(a) isolated Perennial Weed Grass in MA5.

Figure 19. Example of a Priority 4(c) Perennial Weed Grass patch in MA4 (native grasses in foreground).

Similarly, the following ecological priority for **annual weed grass** control is recommended. The following order focuses actions toward the better quality vegetation:

Priority 1) MA7, patches under trees;

Priority 2) MA6, patches under trees;

Priority 3) MA5, patches under trees;

Priority 4) Fencelines of MAs 5, 6 and 7;

Priority 5) MA 4; then

Priority 6) MA3.

5.1.2 Native: Weed Ratio Threshold

Before undertaking control of exotic grasses within Mundulla Common the ratio of native plants to weeds must be established. This will help determine if the proposed weed control fits within acceptable parameters:

- Size of weed control area;
- Response of native plants vs weeds;
- Resource allocation required (human and financial); and
- Time/cost effectiveness.

The method to determine the native to weed ratio is adapted in part from *Native Vegetation Council Bushland Assessment Manual 2017*. The method is based on total understory plant biomass (not projected foliage cover), where bare ground and tree trunks are not included. For consistency and to aid weed control planning at Mundulla Common assessments should be made in spring the year before control. This enables work to be proactive allowing plenty of time to plan and allocate required resources. It is also the best time to observe most native plants, especially those that die back over summer. Assessments may be done at other times with similar results and could be used to broadly select target weed control areas, then repeated in spring to fine tune these areas.

By assessing the ratio of native plants to weeds, an insight will be gained into plants' responses after weed control actions and the level of resources required to manage any likely negative outcomes, i.e. germination of new or different weeds. The aim of weed control is to promote the growth and expansion of native plants, primarily native grasses. Therefore, a proportion of native grasses must be present in the control area because these plants respond to reduced competition (i.e. weed removal), and quickly move to fill niches created. Also, by inference, there will be a degree of native seed within the soil waiting for favourable conditions (i.e. open spaces after weed removal) to germinate. Overtime, with follow-up weed control the balance will shift from weed to native plant dominance. If the native to weed ratio is neglected and there are no native plants to move into the void, the result is likely to be a very short-term improvement in amenity (weeds removed), rapidly followed by excessive growth of new weeds, often different species. This can lead to community distress, frustration (weeds come back worse than before) and fear of increased fire risk.

It is important to choose the treatment method best suited to the native: weed ratio at each patch as some treatment methods may not be appropriate when the ratio is too low for the size of the patch. For example, in MAs 5, 6 and 7, if fire was the preferred method to control a patch of weed grasses $90m^2$, native plants would need to comprise at least 30% of total plant biomass to ensure sufficient native plants will respond and limit new weed growth, preventing the patch from decreasing in condition. Minimum thresholds are provided in Table 2.

	PURPOSE: **Exotic grass control**				
	HAND SHEARS	BRUSH CUTTER	BURN	GRAZE	
Management Areas 5, 6 and 7	Yes	Yes	Possible	Possible	
Treatment patch size	0 – 25m^2	0 – 900m^2	9 – 900m^2 only	1 hectare	
Minimum Native: Weed	10:90	<25m^2 10:90 25m^2 - 100m^2 30:70 100 - 900m^2 40:60	<25m^2 20:80 25 - 100 m^2 30:70 100 - 900m^2 40:60	50:50	Bare ground < 15%
Comment	Small areas only, or more people required Weed follow up required	Hygiene controls Strict compliance Weed follow up **Protect** trees from possible ringbarking	Avoid vehicle use in Common (Hygiene) No fire rakes to be used Avoid curlew habitat Protect trees, especially juvenile trees Greater weed follow up required	Avoid vehicles in Common (Hygiene) **Greatest** weed follow up required.	
Management Areas 3, 4 and 7	Yes	Yes	Possible	Possible	
Treatment patch size	0 – 25m^2	0 – 900m^2	9 – 2500m^2 only	1 – 2 hectares only	
Minimum Native: Weed	10:90	40:60	9 – 900m^2 50:50 900 - 2500m^2 60:40	1ha 50:50 1 – 2 ha 70:30	Bare ground < 15%
Comment	Small areas only, or more people required Weed follow up required	Hygiene controls Strict compliance Weed follow up required **Protect** trees from possible ringbarking	Avoid vehicle use in Common (Hygiene) No fire rakes to be used Small areas only Protect trees, especially juvenile trees Greater weed follow up required Protect high value areas	Avoid vehicle use in Common (Hygiene) Align areas with existing tracks, ease of fencing **Greatest** weed follow up required	

Table 2: Exotic grass control methods and restrictions for Mundulla Common.

5.1.3 Perennial vs Annual Weed Grasses

Perennial Weed Grasses

Perennial grasses grow and seed for more than one season, usually they survive for several years. Correct identification is essential before undertaking control on any perennial grass, as there are several native grasses that look similar to the weed grasses. The native grasses Rigid Panic (*Walwhalleya proluta*) and some of the Spear Grasses in Mundulla Common that grow over one metre tall can look similar to small Phalaris and Cocksfoot plants. Rigid Panic frequently occurs in drainage lines at Mundulla Common and grows amongst perennial weed grasses. Distinctively, Rigid Panic has a very open seed head. Pale Flax-lily (*Dianella longifolia* ssp. grandis), rated as Rare under the National Parks and Wildlife Act 1972 and Vulnerable in the South East, can sometimes look similar to fresh growth of Phalaris. It is important to be familiar with these species so as not to confuse them (Figures 21 and 22).

Figure 20. Perennial weed grass Phalaris and seed head (top right) and another weed Cocksfoot's seed head (bottom right).

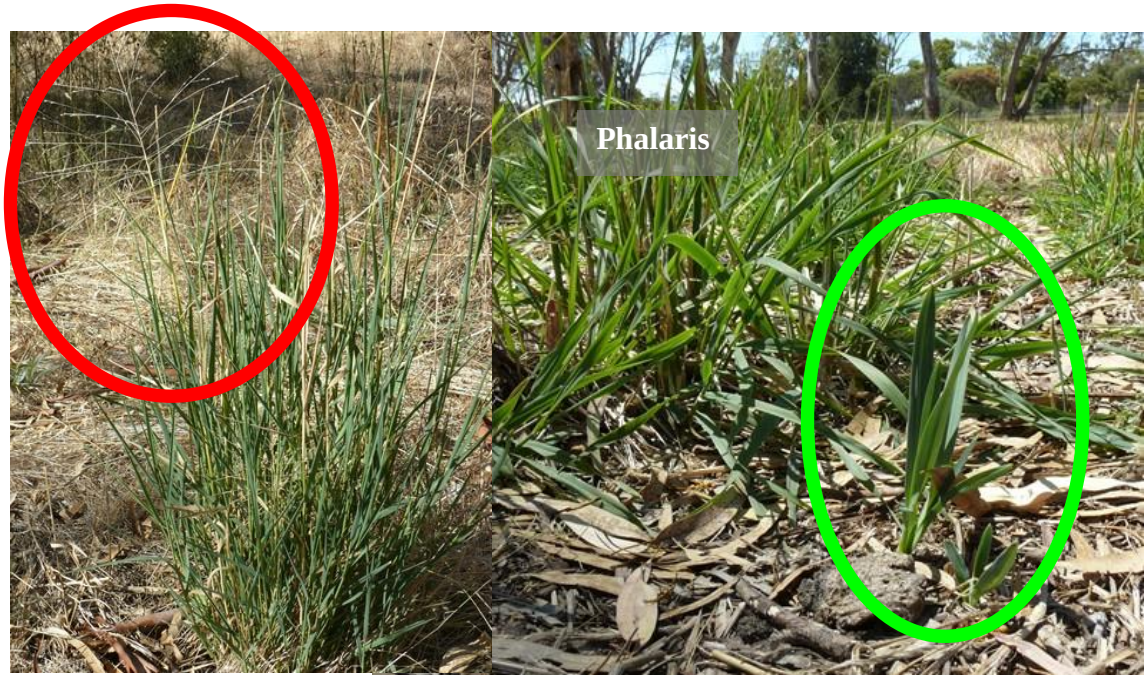

Figure 21. Native Rigid Panic (left), note open seed head (red circle) and native Pale Flax-lily (green circle) with weed Phalaris in background.

Treating perennial weed grasses requires a two-staged approach. Large mature tussocks often retain old flowering stems. These must be removed before herbicide application because they impede the uptake of herbicide and reduce herbicide effectiveness. Herbicide application is the only practical long-term method for their control (Figures 23 and 24). Physical removal of large tussocks by grubbing is never appropriate and must not be used due to physical damage to soil and encouragement of excessive additional weed growth due to the disturbance it creates. In some circumstances, large tussocks contribute to soil stabilisation, which continues once the plant is dead, so it can be an advantage to leave them in situ.

Figure 22. Resprouting Phalaris after defoliation.

Figure 23. Resprouted Phalaris after herbicide application

Isolated tussocks can be cut any time of year, except the middle of summer, and regrowth sprayed as stated above.

Perennial weed grasses within Mundulla Common include:

- Phalaris (*Phalaris aquatica*);
- Cocksfoot (*Dactylis glomerata*);
- Rice Millet (*Piptatherum miliaceum*); and
- Perennial Veldt Grass (*Ehrharta calycina*)

Annual Grasses

Annual grasses grow, seed and die within one season. Preventing the annual replenishment of their seed bank is the most effective way of addressing annual grass dominance. This is done by cutting or grazing before seed develops or destroying seed with fire before it reaches the ground. Timing for each method is different and discussed below. These methods reduce the need for herbicide use.

There are many types of annual grasses within Mundulla Common, the more problematic include,

- Bearded (Wild) Oats (*Avena barbata*)
- Great Brome (*Bromus diandrus*)
- Soft Brome (*Bromus hordeaceus*)
- Sea Barley Grass (*Hordeum marinum*)
- Annual Rye Grass (*Lolium rigidum*)
- Annual Veldt Grass (*Ehrharta longiflora*) and
- Large Quaking-grass (*Briza maxima*)

Mixed Perennial and Annual Grasses

Perennial weed grasses are prioritised over annual grasses, therefore they are treated first. Annual grasses may need to be left for another year.

5.1.4 Timing Of Weed Grass Control

To be effective, it is important that control of weedy grasses occurs at the appropriate time (Table 3). There are several factors that impact this including;

- Whether management is targeting annual or perennial grasses;
- Method chosen for control;
- Subtle seasonal factors such as rainfall and temperature.

Table 3: Timing of weed grass control methods, subtle details for annual grasses provided in text for each method.

Method	Timing				
	Perennial Grass	**Timing Indicator**		**Annual Grass**	**Timing Indicator**
Cutting	Late autumn	Break of season (clover germination)		Late winter / early spring	At tiller (before 'head' emergence)
Grazing	Late autumn	Start: Break of season (clover germination)		Spring	Start: At tiller
		Too Late: once *Arthropodium* emerge			Too Late: Once seed matures (plant will still be green)
Burning	Late autumn	Start: Break of season (clover germination)		Spring / late spring	As seed starts to ripen
		Too late: Once *Arthropodium* emerge			
Herbicide	Winter to early summer	When leafy		Avoid	
Hand Pulling	Late autumn to late spring	Moist soil only	Smallest seedlings	Winter to mid-spring	Moist soil only

5.1.5 Weed Fronts

Weed fronts are where long narrow bands of weed control are used to encircle a large patch of weeds because:

- The patch is too big to be treated in a single event;
- There are too few native plants amongst the weeds to move into spaces created; or
- Resources may be limited.

Treatment may continue over several years allowing native plants to gradually move into treated areas, minimising establishment of broad leaved weeds to easily managed levels. Progressively the large patch becomes smaller and smaller, until eventually it is replaced with native plants. The weed front may meander and wander for a long distance (Figure 25).

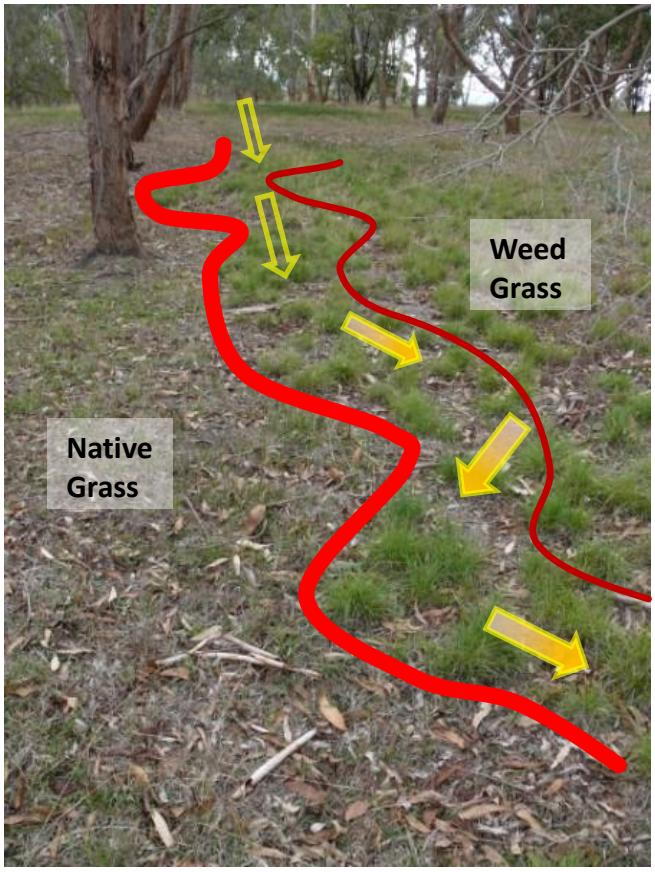

Figure 24. Example weed front; red lines define weed front width and yellow allows define direction of travel for weed control

For perennial grasses, weed fronts should be limited to one metre wide and annual grasses 50cm wide. Perennial weed grass tussocks are usually large and a wider weed front is required, so whole tussocks can be treated. Keeping weed front widths limited prevents other weeds moving into the treated area, while allowing native plants to establish and set seed. Follow up weed control is quickly achieved because the target search area is narrow and focussed.

If control is desired on patches greater than those listed in Table 2, weed fronts may be used or smaller sections on the outside of the patch targeted first. In following years, depending on success of follow up controls, additional patches may be targeted or weed fronts extended inward.

5.2 WEED GRASS CONTROL METHODS

A range of methods are available to control weed grasses and the best method can be determined by considering:

- Size of weed control area (small or large);
- Whether grass is annual or perennial;
- Time of year;
- Condition of surrounding native vegetation; and
- Resources available, including for follow up control.

Each method is discussed in detail below and all are likely to need follow up control actions. Sometimes a combination of methods may be required.

Table 2 lists appropriate treatment methods and patch sizes for each MA within Mundulla Common.

5.2.1 CUTTING

Cutting involves removing tall growth, either to prevent seeding (annual grasses) or to remove old dense stems (perennial grasses) to improve application and absorption of herbicide. Cutting is best used for smaller patches or where weed fronts are to be employed. Its main advantage is less damage to surrounding vegetation and there is no soil disturbance. The main disadvantage is time and labour costs limit it to relatively small areas only.

Cutting is usually done using a brushcutter or hedge shears (very small areas). The target grass is cut 5 – 10cm above ground level. Care needs to be used with either tool to avoid cutting native plants growing amongst the target weed grass. Large perennial weed tussocks often require more physical effort, therefore if cutting more than a few tussocks a brushcutter is easier. However, using a brushcutter requires more concentration because off target damage occurs easily, e.g. small trees can be ringbarked by the cutting line.

Perennial Grasses

Perennial weed grasses are cut in autumn, then when actively growing with leaves to approximately 20cm length, they are sprayed with herbicide. The time between cutting and sufficient leaf growth for herbicide application may take from four to six weeks. Repeat herbicide applications may be required on large tussocks.

Isolated tussocks may be treated any time of year, except the height of summer.

Annual Grasses

The time to cut annual grasses is at the tillering stage. This is when stems emerge, but before flowering begins. Cutting later, after 'heads' can be seen, reduces the effectiveness due to seed set. Sometimes, sufficient resources remain in the stems that mature seed may still develop and replenish the seed bank. The specific time will vary from year to year due to seasonal variation and may change between target species of annual grass. However, optimum time is likely to be from July to August. It is essential to regularly monitor grass growth and development. Once determined it is the right time to act (tillering stage), cutting must occur quickly, before 'heads' can be seen.

Follow up cutting may be required as annual grasses re-sprout and tiller a second or third time in one season and this is most likely in years with a wet spring. Sometimes re-sprouting may continue into summer if the rainfall continues. Regular monitoring is recommended.

5.2.2 Pulse Grazing

Pulse (or High Density Short Duration, HDSD) grazing involves using a large number of sheep confined to a specific area to eat weed grasses for a short period of time. (In weed control terms, the size of the area is large, but in agricultural terms the size of the area is tiny.) There is limited opportunity for sheep to graze selectively. Its main advantage is to reduce all plant biomass, including weed grasses and therefore prevent seeding (annual grasses) or to remove old dense stems to improve application and absorption of herbicide (perennial grasses). A secondary advantage is that relatively large areas can be treated at one time. It is best suited to situations where the native: weed ratio is low (fewer native plants) and the vegetation condition is moderate to low. It comes with a range of disadvantages:

- More logistics to arrange, prepare, monitor and remove sheep;
- Fencing (temporary) is required;
- Soil disturbance;
- Grazing will prevent seeding of some native plants;

Detailed information on sheep grazing is found in the *Draft Management Plan for Moot-Yang-Gunya Swamp and Mundulla Common* (2009). Below is a synopsis from this document pertinent to grazing for weed control with additional points determined from site inspections conducted for this Operations Plan.

No grazing is to occur in MAs 5and 6, which contain very high quality native vegetation. The risk of potential damage from grazing animals' hoofs and resultant weed growth is unacceptable.

Sheep are the preferred grazing animal to be used, ideally Merino or Cross Bred dry sheep equivalent (DSE), **not** Dorper, Dorper Cross or related breeds, which will readily graze young trees and are harder to contain with fences.

Sheep must be purged, for no more than 24 hours, with no feed during this time. This is to ensure sheep will be hungry, be less selective and not introduce new weeds seeds that may be present in their faeces. Water should not be necessary for sheep if grazing is done at the correct time and prior planning has been done. Sheep will only be on site for a short period and sufficient moisture should be gained from the grass they eat. If necessary due to the length of time or dry conditions, temporary watering points will be placed in with the sheep. Water points should be placed in areas with the highest weed load. Water points are never to be placed in better quality native vegetation. Daily monitoring will be required to **ensure the sheep's welfare** and to **minimise damage to native plants and soil**.

Sheep numbers must be high compared to conventional grazing as they will only be on site for a short period of time, and monitored regularly. From the *Draft Management Plan for Moot-Yang-Gunya Swamp and Mundulla Common,* 40 – 60 DSE per hectare will be used. However, a higher number and/or longer duration may be necessary if dry matter equivalent is very high, e.g. rank phalaris, up to a maximum period of 5 days. The final decision on the number of sheep to be used will be determined by consulting on site with an experienced agronomist or grazier and/or Primary Industries and Regions South Australia (PIRSA) one month before sheep enter the patch to be grazed.

Daily monitoring of native vegetation is essential. This ensures sheep do not become selective in their grazing. Specifically, monitoring the native Wallaby Grass (*Rytidosperma* spp.) will determine when sheep need to be removed. Sheep must be removed once 10 – 20% of the Wallaby Grass population is grazed to 5cm height. This may occur before the expected grazing time has lapsed, e.g. on day three instead of day five. However, if Wallaby Grass is not grazed and weed volume is still high, sheep may be left longer. Daily monitoring must still be carried out and sheep removed once Wallaby Grass is grazed to 5cm height, or overall grass height, including weeds, reaches 10cm height.

Sheep will be contained within a specific location by a fence constructed to a standard that will contain sheep, even if they challenge the fence. To minimise damage to soil and native plants, the existing network of walking tracks and drainage lines should be used to locate fences (Figure 26). Additional fencing may be required to protect key high value areas from grazing, e.g. a patch of native plants with few weeds present or to protect an area of microphytic crust. High value locations can be identified with a spring survey the year prior or through consultation with regular local volunteers who have a thorough knowledge of Mundulla Common and its native plants.

Vehicles within Mundulla Common must be minimised. Areas to be grazed will not be more than two hectares and will be fenced. A combination of working dogs and people should be enough to muster sheep. Hidden stumps, logs and abrupt depressions would make driving a vehicle dangerous to the occupant(s). If a vehicle does enter Mundulla Common, it must be

inspected and be free of weed seeds as per Appendix H. This procedure will be worked through as part of the induction for all staff and contractors using a vehicle in the common. Vehicles and machinery regularly spread weeds between properties and regions.

Sufficient resources will be required to manage the resultant weed load once sheep are removed. The purpose of grazing is to reduce weeds. Weed growth after grazing could be extensive and cannot be underestimated. The removal of weed grasses will open up the soil surface to increased sunlight and combined with soil disturbance from sheep hoofs will advantage many weeds. Typically, these will be disturbance loving weeds, such as Thistles, Buchan weed, Scabiosa, Hawksbeard etc. These weeds may not be present before grazing, but their seed is likely to be in the soil, or will blow in from nearby. If left untreated, the grazed area could become an eyesore and considerably worse than before grazing occurred. Consequently, native vegetation and biodiversity values will decrease. In 2016, one hectare was grazed near Chark Road and resultant weed growth was controlled by community volunteers and two Green Army[1] teams over six months. Similar resources may not always be available.

[1] The Green Army is a Federal Government initiative providing six-month programmes for 17-24 year olds to train and work in the environment.

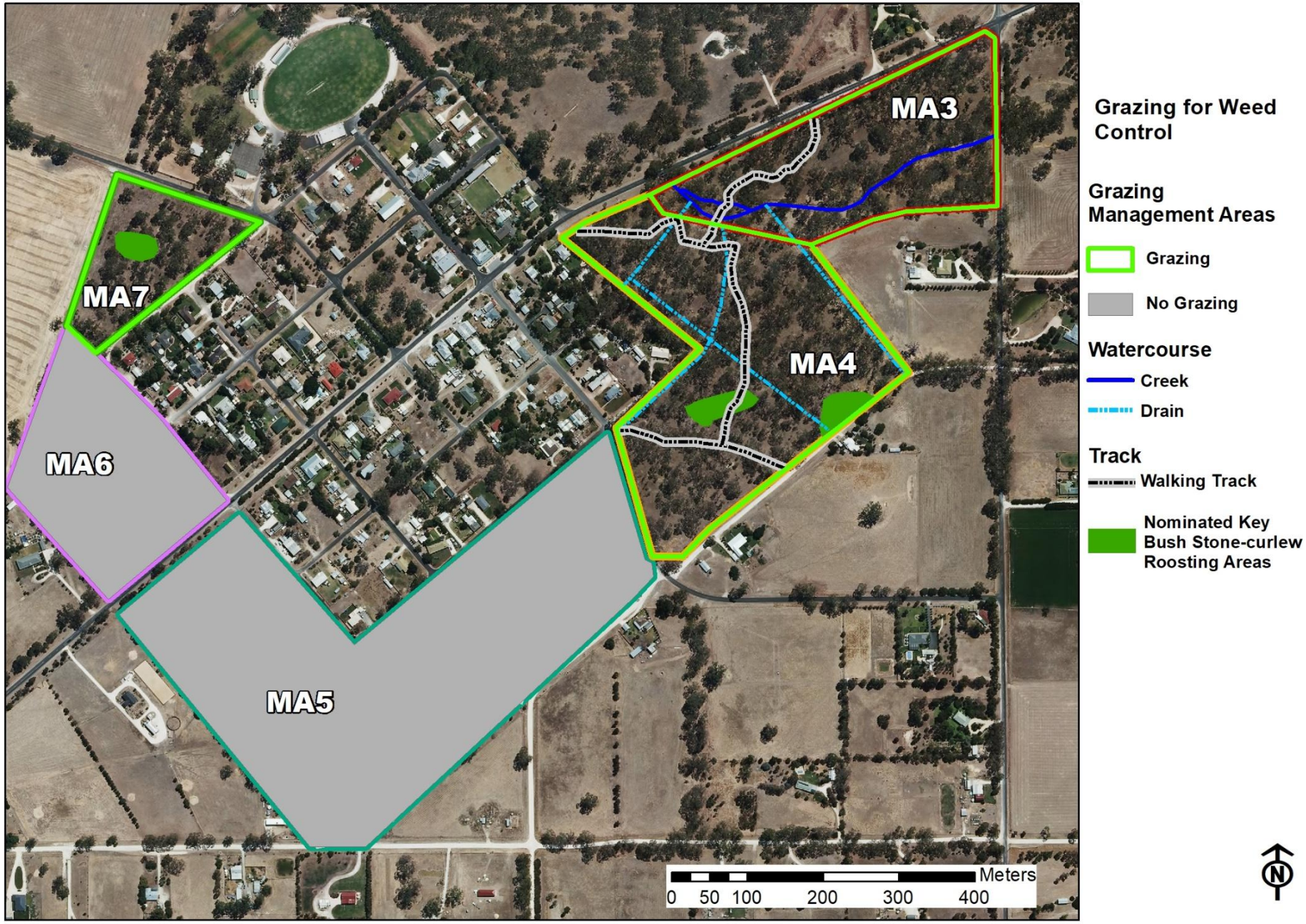

Figure 25. Location of walking tracks, drainage lines and creek within grazing areas MA3, 4 and 7 to guide fence placement for pulse grazing.

The NVC must be notified:

- Before grazing occurs;
- Where it will occur; and
- Once the sheep are removed.

A monitoring framework to detect change in vegetation quality and determine success or failure of treatment method is provided in Section 6. Monitoring information collected from grazed areas will be provided to the NVC. A monitoring summary table detailing when NVC is to be notified is provided in Appendix C.

Do not spray Bridal Creeper where pulse grazing will occur later in the season. This will reduce the effectiveness of control if the herbicide Metsulfuron methyl is used.

Perennial Grasses

Perennial weed grasses are grazed in late autumn to 5 - 10cm height, near break of season, then followed by herbicide application after four to six weeks once leaves reach approximately 20cm in length. Repeat herbicide applications may be required on large tussocks. However, in some sections of MA3 and MA4 it may be appropriate to graze in spring, generally late August to September, in order to control annual grasses at the same time.

Annual Grasses

Timing for grazing annual grasses is later than for the cutting method because potential seed development is halted once sheep eat them. Later timing often means resprouting is less likely to occur. Grazing occurs before seed reaches maturity, this will vary between seasons, but is generally late August to September. Grazing is only used once in a season and cannot be repeated to treat annual grasses that may resprout, because this will cause too much soil disturbance and excessively damage native plants.

5.2.3 Burning

Burning involves using fire to consume above ground biomass of all plants, including weeds. It can be used in small targeted areas of a few square metres to large areas covering many hectares. In addition to consuming weeds its other main advantages are to rejuvenate certain native plants and stimulate germination of others. It comes with several disadvantages, namely:

- More logistics to arrange, prepare and conduct;
- Fire stimulates many weed species to germinate, especially woody weeds;
- Fire may prevent seeding of some native plants; and
- Public notification is essential.

At Mundulla Common due to these disadvantages, particularly the risk of simulating more weeds, burning should be limited to less than 0.25 hectares, at least for the next 10 years until weed and native plant responses can be monitored and assessed.

Background information on fire management can be found in the *Draft Management Plan for Moot-Yang-Gunya Swamp and Mundulla Common* (2009). Information provided here is meant to guide the decision-making process in the context of managing weeds in native vegetation. It does not cover the logistics of undertaking a prescribed burn. Only the CFS and/or DEWNR are to undertake prescribed burns in Mundulla Common.

Burn plans will include;

- where burns are to occur (maps with GPS reference points);
- risk assessment and mitigation;
- resources required; and
- consultation undertaken.

Monitoring is required (Section 6) and information collected from burnt areas will be provided to the NVC. A monitoring summary table detailing when NVC is to be notified is provided in Appendix C. The local community should also be given notice before burning is used in Mundulla Common.

Burning may be appropriate in all MAs within Mundulla Common. Table 2 lists appropriate patch sizes for prescribed burns in each MA. All are relatively small due to resources required to manage consequent weed growth after a prescribed burn. Also, a smaller fire patch size requires less resources to manage.

To protect the biodiversity values within Mundulla Common a number of measures must be adhered to:

- Prescribed burns are only to occur outside the official fire danger season;
- Use of fire rakes are to be minimised because this disturbs the soil, encouraging weeds;
    - Containment lines may be brushcut beforehand and wetted before starting a prescribed burn
- Fire retardant foams are not to be used because they are detrimental to some native plants and encourage weed growth;
- Mature and juvenile trees must be protected prior to burning by:
    - Brushcutting and wetting areas around trees before starting a prescribed burn; and
    - Avoiding burning where large tussocked perennial weed grasses abut trees (these should be treated 12 months beforehand); and
- Vehicles should not be required to enter Mundulla Common (but fire hoses may be dragged over fences if required) due to appropriate preparation;
    - Slashed and wetted containment lines;
    - appropriate resources available; and
    - sufficient people on site;

Implementing these measures will minimise soil disturbance, damage to native plants and limit weed establishment outside of the burn patch. Broad leaved weeds such as thistles,

Buchan weed and scabiosa will respond vigorously after a prescribed burn and woody weeds such as Flinders Ranges wattle and olive may still germinate within a burnt patch. Therefore, it is important that sufficient resources will be available to manage all weeds after a prescribed burn.

Do not spray Bridal Creeper where burning will occur later in the season. This may reduce the effectiveness of control if the herbicide Metsulfuron methyl is used.

Perennial Grasses

Perennial weed grasses are burnt in late autumn, near break of season, then followed by herbicide application after four to six weeks once leaves reach approximately 20cm in length. Repeat herbicide applications may be required on large tussocks. However, in some sections of MA3 and MA4 it may be appropriate to burn in spring (see below) in order to control annual grasses at the same time.

Annual Grasses

Timing for burning annual grasses can occur over a relatively long period: late August to early October. (In a dry year, the cut off time may be late September.) Greatest success is likely by burning toward the end of this period, because annual grasses and their seed will be destroyed, even if it has dropped to the ground, as combustion is more complete. Resprouting is less likely to occur, except in wet years.

5.2.4 HERBICIDE

Herbicides are used to interrupt certain chemical pathways within a plant usually causing death. Herbicides can be used most times of the year depending on weather and the target weed. Whilst in some situations herbicides can be used over large areas, in native vegetation it is best restricted to smaller more targeted areas, or individual plants over a large area. The main advantages are lack of soil disturbance and the ability to treat relatively large areas quickly, thoroughly and cheaply. The main disadvantages are;

- A reasonable level of plant identification knowledge is required to avoid killing native plants;
- Operators require a high level of concentration to avoid killing native plants;
- High risk of off target damage, once applied it cannot be removed (mistakes can't be fixed);
- Knowledge of herbicide(s) to be used is essential;
- Due to exposed soil, weeds may germinate en masse; and
- The vast array herbicide choices can be confusing.

Anybody using herbicides in Mundulla Common must be experienced with using herbicide amongst native vegetation and be knowledgeable of potential damage, such as off target damage to native plants and baring the soil surface.

Perennial Grasses

Perennial weed grasses will need their leaves and stems removed first to 5 – 10cm height, in autumn, then followed by herbicide application after four to six weeks once leaves reach

approximately 20cm in length. Repeat herbicide applications may be required on large tussocks. Isolated tussocks may be treated any time of year, except the middle and end of summer.

Annual Grasses

Generally, herbicides are not a good method to control annual grasses in native vegetation. The risk of off target damage or creating a worse problem with different weeds is very high. This method should be avoided.

5.2.5 Hand Pulling

Hand pulling is when weeds are physically removed from the ground using only one's hands. The main advantage is that it may be the only option available in vegetation of exceptionally high condition, or where endangered plants grow. Also, success is guaranteed, as long as the removed plant is bagged and disposed of off-site. Pulled weeds left lying on the ground often grow roots into the ground and continue to set seed. The main disadvantage is it is very slow and only small areas can be targeted.

Hand pulling can only occur when soils are moist, once dry too much damage is done to the soil. Frequently, plants break off at the soil surface and continue to grow.

Perennial Grasses

Only the tiniest of perennial grass seedlings may be hand pulled. At any other stage of growth too much damage will occur to the soil, or the person's back doing the pulling.

Annual Grasses

Annual grasses may be hand pulled whenever they are actively growing. If seed is present, these must be collected and bagged before pulling the main plant.

5.3 DECISION SEQUENCE FOR WEED GRASS CONTROL

A decision sequence is a useful tool for breaking complex or series of decisions into chronological order, which ensures steps are not missed that could create difficulties later on. Following is a decision sequence for controlling weed grasses in Mundulla Common. This sequence is most relevant for control actions over a larger scale where burning (900 - 2500m^2) or grazing (1 – 2 ha) are to be used. Decisions for less intense methods or smaller patch size may be made with less lead in time. However, all decisions will benefit from following this sequence. It allows time to allocate resources and assess potential unintended consequences. It also ensures actions are proactive and not reactionary. Hasty, reactionary decisions often lead to damaging outcomes for native vegetation and biodiversity values.

Perennial weed grass control should be prioritised over annual grass control.

Spring the Year Before Control

1. Identify and record potential patches for weed control in the following year
2. Undertake a native: weed assessment, and only proceed if actions fit within allowable limits (Table 2)

3. Identify and record high value assets to be protected during weed control (GPS/GIS, pin flags), e.g. trees, rare plants, key habitat etc
4. Record nearby weeds that could be a problem after control, e.g. thistles, Scabiosa, Bridal Creeper
5. Identify and advise relevant agencies (TDC, CFS &/or DEWNR) of the resources required (human and financial)
6. Continue if resources can be made available
7. In patches proposed for **grazing** or **burning** (900 - 2500m^2), undertake baseline monitoring assessments (Section 6)

The Year of Control

8. Confirm resource allocation
9. For **grazing** or **burning** (900 - 2500m^2), notify NVC of actions to occur
10. For **perennial weed grass** control, arrange resources (sheep and fencing or fire crew)
    a. May/June undertake control action
    b. June notify NVC and provide grazing record sheet
    c. June/July follow up herbicide spot spray
    d. Remove fencing if required
11. For **annual grass** control, arrange resources (sheep and fencing or fire crew)
    a. Undertake control action
    b. June notify NVC and provide grazing record sheet
    c. Remove fencing if required
12. Follow up control of perennial or annual grasses using targeted control methods (do not use grazing or burning for follow up control)
13. Spring (after control action) undertake monitoring assessments (Section 6)
14. Notify NVC of monitoring results
15. Spring and summer, control broad leaved weeds (ongoing, as required)

The Year(s) After Control

16. Autumn to winter, control other weeds as required
17. Spring, Year 1 after control, undertake monitoring assessments (Section 6)
18. Assess success or failure based on monitoring assessments
    a. Use results to inform future control actions
    b. Modify future control methods if required
    c. Notify NVC of results
19. Continue monitoring control areas in Year 2, 3 and 5.
    a. Use results to inform future control actions
    b. Modify future control methods if required
    c. Notify NVC of results

5.4 MANAGEMENT OF HEAVILY DEGRADED ZONES

In MA3 and 4 there are three heavily degraded patches containing a high proportion of perennial and annual weed grasses (Figure 27). There is a potential risk that a wildfire in these patches could result in the death of some Red Gum trees due to smouldering tussock crowns.

In 2016 TDC pulse grazed one of these patches (one hectare) located in MA3. Few native plants were visible beforehand and the area would have failed the native: weed ratio assessment (Section 5.1.2). However, due to the availability of two Green Army teams and committed volunteers for follow up weed control the patch has responded well, although still requires ongoing weed control to maintain suppression of perennial weed grasses and large broad leaved weeds (Figure 28). Several very large clumps of native Creeping Mint (*Mentha satureioides*) and a native sedge (*Carex tereticaulis*) were exposed and are flourishing (Figures 29 and 30).

To reduce the risk to mature Red Gum trees TDC may consider pulse grazing using the method described in Section 5.2.2. Before using this option, it will be essential to;

- Search for any patches of native herbs and lilies and install protective fencing; and
- ensure sufficient resources are allocated to control regrowth of perennial weed grasses and broadleaved weeds that will establish.

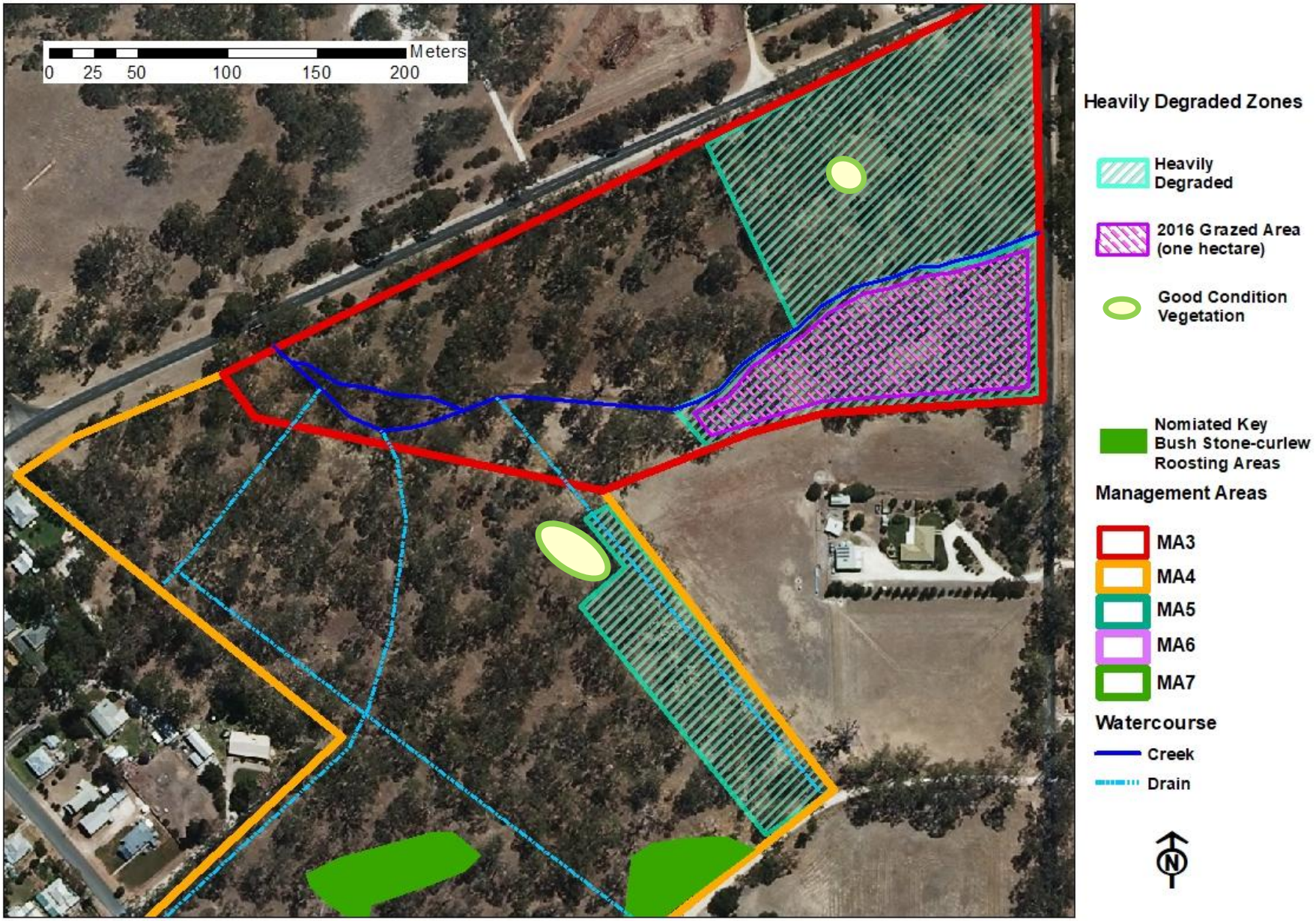

Figure 26. Location of heavily degraded zones in Mundulla Common, highlighting patches of vegetation in good condition that must be protected prior to pulse grazing.

Figure 27 Ongoing control of broad leaved weeds are required for many months after pulse grazing.

Figure 28 and 29. Native mint (left) and a native sedge, *Carex tereticaulis,* flourishing after pulse grazing removed dense Phalaris and annual grasses in MA3, followed by extensive control of Phalaris tussocks by Green Army and volunteers.

Sheep must be removed when grass is at 5 – 10cm height. This will prevent patches of bare ground occurring and maintain a thatch layer over the ground, minimising opportunities for thistles and other broadleaved weeds to establish.

The NVC must be notified:

- Before grazing occurs;
- Where it will occur; and
- Once the sheep are removed (Grazing Record Sheet).

Even though the patches are very degraded, monitoring will be required and a framework is provided in Section 6. Monitoring information collected from grazed areas will be provided to the NVC. A monitoring summary table detailing when NVC is to be notified is provided in Appendix C. Notice should be given to the local community before sheep enter Mundulla Common. Temporary signage would be beneficial to inform visitors to Mundulla the reason for sheep being in Mundulla Common.

Do not spray Bridal Creeper where pulse grazing will occur later in the season. This may reduce the effectiveness of control if the herbicide, Metsulfuron methyl is used.

Native grass seed collected from within Mundulla Common may be broadcast through these degraded areas to encourage a transition to better quality vegetation. This may be done before and after pulse grazing (Section 8).

5.5 OTHER WEEDS

Many weeds other than exotic grasses impact Mundulla Common. The *Draft Management Plan for Moot-Yang-Gunya Swamp and Mundulla Common* describes a range of weeds and their control.

Below are general weed groups and pertinent points relating to their control within Mundulla Common. These are in addition to exotic grasses already discussed. Appendix G lists weeds that have been found in Mundulla Common.

5.5.1 BROAD LEAVED WEEDS

In Mundulla Common broad-leaved weeds are likely to be the first responders to over clearance of exotic grasses. The most frequently occurring and problematic broad-leaved weeds in Mundulla Common include:

- Buchan weed (*Hirschfeldia incana*);
- Gazania (*Gazania linearis*).
- Hawksbeard (*Crepis vesicaria* ssp. *taraxacifolia*);
- Ox-tongue thistle (*Helminthotheca echioides*);
- Pricklefruit buttercup (*Ranunculus muricatus*);
- Ribwort (*Plantago lanceolata*);
- Saffron thistle (*Carthamus lanatus*);
- Scabiosa (*Scabiosa atropurpurea*);
- Slender thistle (*Carduus tenuiflorus*);
- Spear thistle (*Cirsium vulgare*); and
- Wild sage (*Salvia verbenaca var. verbenaca*).

Figure 30. A) Gazania, B) Hawksbeard and C) Ox-tongue Thistle

Figure 31. D) Ribwort, E) Saffron Thistle, F) Scabiosa basal leaves, G) Scabiosa flower, H) Slender Thistle and I) Spear Thistle.

They are more difficult to control than grasses because they,

- Respond to disturbance, as they evolved with hoofed animals and/or agriculture;
- Able to re-sprout from thick taproots;
- Produce vast quantities of seed;
- Spread seeds on the wind, via animals (fur or faeces) or machinery;
- Have seedlings that quickly produce large leaves outcompeting nearby plants; and
- Have some herbicide resistance once flowering begins.

Many other broad leaved weeds are found in Mundulla Common, but are either in small numbers or pose a lower risk to biodiversity values. The key to their control is to:

- Limit soil disturbance as much as possible;
- Not over clear weeds;
- Ensure strict adherence to equipment hygiene;
- Encourage native plants to take their place; and
- Treat with herbicides before their flower buds appear.

5.5.2 Bridal Creeper

Bridal Creeper (*Asparagus asparagoides*) is a Weed of National Significance and has the potential to overwhelm Mundulla Common, especially if other weeds are overcleared or cleared too quickly. The current population is relatively small and could be removed within five to six years of thorough and persistent treatment. Herbicide is the most efficient method to use, but timing of application is critical. Herbicide should be applied at the flowerbud and early flowering stage otherwise efficacy will be considerably reduced and time wasted. Typically, this occurs over a four-week period between late July and August. Exact timing will vary from year to year. After the second year of primary control, seedlings will be the main target and timing will be less critical.

Herbicide application requires great care to ensure native plants are not damaged. Bridal Creeper often grows amongst delicate herbs and lilies, which are equally susceptible to herbicide.

Do not spray Bridal Creeper where burning or pulse grazing will occur later in the season. This may reduce the effectiveness of control if the herbicide, Metsulfuron methyl is used.

Biological control of Bridal Creeper may reduce its cover and abundance but will not eradicate it. At Mundulla Common there are good prospects for total eradication and therefore biological control is not appropriate and efforts should be focussed on using herbicide. Also, the population is too small and scattered for biological control to be fully effective.

Ongoing vigilance will be required as birds and foxes are likely to spread seed from parks and domestic gardens within the Mundulla community.

5.5.3 Woody Weeds

In recent years, the Coorong Tatiara Local Action Plan has funded considerable woody weed control activities within and around Mundulla Common. Consequently, no large woody weed trees exist within Mundulla Common. Woody weeds are limited to juveniles or seedlings of Olive (*Olea europaea*) (Figure 33) and Flinders Ranges Wattle (*Acacia iteaphylla*). A small number of olives and desert ash one to two metres height occur in MAs 5 and 6.

As a result of this work woody weeds are no longer the immediate threat they once were. Vigilance and control effort is still required and will likely be needed for many years due to longevity of seed in the soil and potential for weed seeds to arrive from parks, roadsides and private gardens within Mundulla. Woody weeds usually take two years before producing seed. Consequently, targeted woody weed control can be reduced to each second or third year. Naturally, if found in the course of other weed control activities, young woody weeds should still be removed. Deciduous woody weeds can only be treated in late spring and summer when in full leaf. (Small seedlings may be hand pulled in spring if soil is moist and identification confident).

Figure 32. Typical size of Olive seedlings throughout Mundulla Common.

6. Monitoring and Evaluation

Monitoring is a useful tool when managing native vegetation. It provides feedback to the vegetation manager about success or failure of management decisions, but also provides guidance on when to change management methods. However, monitoring that does not inform future management actions is ineffective and a waste of time and resources. Monitoring methods should be suited to the information required to inform management decisions. Overly simple monitoring that provides no management insight is as ineffective to a vegetation manager as are highly complex methods that only an expert can interpret. Therefore, two monitoring programs are suggested; a basic method for year to year management and a detailed method to determine long term trends in vegetation condition.

The methods proposed for Mundulla Common are detailed in *Native Vegetation Council Bushland Assessment Manual* and are derived from the Nature Conservation Society of South Australia's *Bushland Condition Monitoring* method (Croft *et al*, 2005 – 2009 and Milne, T.I. & Croft, T. (2012).

6.1. BASIC MONITORING TO MEASURE VEGETATION HEALTH

The basic monitoring method is relatively quick to complete. After brief instruction, it can be done by any person with basic plant identification skills. Assessments should be done in spring before management actions occur. However, they can be done any time of year, but must be repeated the same time each year for meaningful and consistent results. The parameters that need to be assessed and recorded, and a guide to their interpretation are outlined below and a field datasheet is provided in Appendix D.

Native: exotic ratio understory biomass

This measure is based on total understory plant biomass (not projected foliage cover). Bare ground and tree trunks are not included. Record the ratio and a score is determined based the percentage of native plants present:

Table 4. Native: Weed ratio score and its significance

Native: Weed Ratio		
Percentage native plants	**Score**	**Significance**
>76%	3	**Very Good**
40 – 75%	2	
5 – 40%	1	
<5%	0	**Bad**

In patches where **grazing** or **burning** (over 900m^2) is to be used, the five most common native plants and five most common weeds with their threat rating are to be recorded starting with the most common as shown in the example (Table 5). Weed threat ratings can be found in the plant species list in Appendix G. The ratings follow those determined for Bushland

Condition Monitoring with higher numbers (maximum 5) being the most threatening, e.g. Bridal Creeper has a rating of five, whereas most annual grasses have a rating of one.

Table 5. Example of top five native plants and weeds in a sample location in Mundulla Common.

Most common native plants	Relative percent of all plants	Most common weeds	Weed threat rating*	Relative percent of all plants
Spear grass	20	Annual veldt grass	1	30
Wallaby grass	10	Phalaris	3	5
Kangaroo grass	5	Capeweed	2	5
Native mint	1	Cretan weed	1	<1
Chocolate lily	<1	Wild sage	2	<1
	36%			40%
Goal to achieve	Higher Percentage	Compared to		Lower Percentage

* Weed threat rating as determined by Bushland Condition Monitoring (1[low] – 5[highest]), Appendix F

As weed management progresses there should be a corresponding increase in native plants compared to weeds. Total weed percentage should decrease and the target weeds should reduce in relative percentage of all weeds. If native: weed ratio decreases (i.e. more weeds) this will highlight a problem with the management method used and a review should take place to identify why this occurred. If necessary, management may need to change. It may be necessary to seek guidance if the native ratio decreases.

Bare Ground

This measure is used to identify soil surface degradation, potential erosion and may indicate future weed problems likely to occur. The measure is only for bare ground and does not include microphytic crust or leaf litter. It is a measure of soil disturbance. Table 6 demonstrates the scoring values and their significance.

Table 6. Bare ground assessment and its significance

Bare Ground Assessment		
Percent Bare Ground	**Score**	**Significance**
>51% of site bare ground	0	**Very bad**
31-50% bare ground	1	
21-30% bare ground	2	
11-20% bare ground	3	
5-10% bare ground	4	
<5% bare ground	5	**Excellent**

This measure will identify if sheep have stayed on the site too long and that management will need to change before grazing is used again. In this situation, the bare ground score will decrease, e.g. move from 5 to 3 or similar. It may indicate fire has consumed annual grasses. If the score decreases, additional resources may be required to control large broad-leaved weeds or woody weeds, e.g. Flinders Ranges Wattle.

Fallen timber/debris

As weeds decrease over a site and condition improves there should be a corresponding increase in fallen timber and debris. This measure is averaged from a one hectare assessment and is used to indicate improving habitat for soil organisms and detritivores (organisms that eat dead plant/animal material). An increase in detritivores will be beneficial for a range of larger animals that feed on them, e.g. Scarlet Robin, Bush-stone Curlew etc.

Table 7. Fallen timber and leaf litter scoring and its significance, assessed over one hectare.

Log diameter	None	Less than 1 per 10 trees	1 or more per 10 trees	Score
Trunk sized	0	2	3	
Branch sized	0	0.5	1	
Litter	Little or none	Sparse and/or patchy	Dense and more or less continuous	
Litter	0	0.5	1	
			Fallen timber/debris score	
Significance			**Bad**	0
			Excellent	5

Photopoint

Photopoints by themselves provide little useable information regarding the condition of vegetation. In Grassy Woodlands, such as Mundulla Common, photopoints are more difficult to interpret due to small plants being unidentifiable in the photos.

For basic monitoring, any photopoint must be accompanied with a description of what is in the photo. The measures discussed above provide a suitable description. When management patches are small (i.e. hedge shears, brushcut or small burns) or where weed fronts are used, photopoints may be temporary. They can be used to track changes over a few years. After the patch has been successfully converted to high quality native vegetation the photopoints can be removed. In this situation, large permanent droppers are unnecessary, a pin flag will suffice, and a photo may be taken from a 1m wooden stake (carried to site each time) and placed next to the pin flag.

A series of photopoints have been established for a number of years at Mundulla Common. These may be incorporated into more detailed monitoring described below.

Grazing and Burning

Where **grazing** or **burning** (over 900m^2), **all** of the above monitoring will be recorded up to five years after the event,

1. Year before event

2. On the year of the event, but after it has occurred
3. First year after the event
4. Second year after the event
5. Fifth year after the event

Monitoring results will be forwarded to NVC within one month of completing each year's monitoring. Table 8 details when NVC is to be notified.

Grazing Only

A grazing record sheet will be required when using this method. It will follow the record sheet provided by NVC in 2013 with minor alterations. An example grazing record sheet is provided in Appendix E.

Resource Allocation (human and financial)

A useful measure to inform future management decisions is resource allocation. This measure will prevent under allocation of resources, which will often be expressed visually as increased weed abundance on the site. This measure is not essential, but is recommended. If adopted, include all volunteer time, including CFS, and support provided by TDC. Monitoring and recording resource allocation is also a useful tool for demonstrating TDC's commitment to Mundulla Common.

Table 8. Summary of monitoring requirements for Mundulla Common

Monitoring Summary					
	Grazing*	**All Burning***	**NVC notification***	**Small treatment area <900m^2**	**NVC notification**
Native: Weed Ratio	✓	✓	✓	✓	X
Most Common Native Plants and Weeds	✓	✓	✓	✓	X
Bare Ground	✓	✓	✓	✓	X
Fallen Timber/ Debris	✓	✓	✓	X	X
Photopoints	✓	✓	✓	Optional	X
Grazing Record Sheet	✓	X	✓	X	X
Resource Allocation	Optional	Optional	X	Optional	X
Detailed Monitoring Method	Optional	Optional	Optional	X	X

* To occur the year before treatment, then years 0, 1, 2 and 5.

6.2. DETAILED MONITORING

Bushland and its management benefit from detailed condition monitoring. This information is useful on a single site basis, but is most powerful when combined with patches of bushland across a landscape. This information can be used to track changes in condition over time. Results can be investigated, compared with other regions and lead to improved native vegetation management across South Australia. Detailed monitoring is an option to be considered by TDC.

The 2017 Native Vegetation Council Bushland Assessment Manual is used to determine Significant Environmental Benefit Hectares. The manual is derived from the Nature Conservation Society of South Australia's *Bushland Condition Monitoring* method (Croft *et al*, 2005 – 2009, Milne, T.I. and McCallum, B. (2012) and Milne, T.I. & Croft, T. (2012). Much of the data captured can be entered directly into the Biological Databases of South Australia (BDBSA).

Even though extensive data is collected, the field component at each site can be collected in about one hour. Historically, Mundulla Common has several permanent photopoints established. These could be used to begin a detailed monitoring program. After the first collection of data, subsequent detailed monitoring would only be required at five year intervals. Data can be maintained by TDC and lodged with NVC.

NVC Bushland Assessment includes measures based on;

- Total plant species (native and weed)
- Cover abundance of weeds
- Cover of native plants
- Native: Weed understory biomass
- Bare ground
- Hollow-bearing trees
- Fallen timber/debris
- Tree health
- Landscape Context
- Vegetation Condition and
- Conservation Significance

7. Boundary Fence Lines as Fuel Breaks

Native Vegetation Regulations 2017 under the Native Vegetation Act 1991 allows for fence line fuel breaks to occur if they are less than five metres wide and undertaken in accordance with an applicable Bushfire Management Plan (Regulation 9 (1)(17)(2)). Trees growing within a fuel break cannot be damaged or removed. In Mundulla Common, the condition of native vegetation tends to deteriorate closer to fence lines (Figure 33), often with an increase in weedy annual grasses and broadleaved weeds, e.g. Scabiosa. A number of fence lines contain native vegetation that is in good condition often with an intact microphytic crust on the soil surface (Figure 34).

Fuel breaks should be sensitive to native vegetation and not create a worse fire hazard in the future. Mineral fuel breaks are not to be used because they destroy native vegetation and resultant soil disturbance will encourage tall, high risk weeds to establish, e.g. thistles, Buchan weed and Scabiosa.

Mowing or slashing may be appropriate methods to establish a fuel break. Machinery hygiene is critical and all mower surfaces must be thoroughly cleaned before starting and between each Management Areas. Weeds are frequently spread by machinery/mowers, e.g. Scabiosa on roadsides. The cutting deck should be set no lower than ten centimetres to prevent soil scalping and to minimise damage to small native plants. Mowing should be carried out by TDC staff. If contractors are used, TDC must ensure strict compliance, especially to ensure machinery hygiene between Management Areas. Confirmation of contractor compliance will require random periodic inspection by TDC staff. In naturally low fuel areas (Figure 34) a mown fire break may not be necessary; a more sensitive approach should be used.

To reduce the risk of spreading weeds into good quality native vegetation, mowing should follow the fence line sequence shown in Figure 36. Permanent galvanised droppers are to be placed near the fence at the beginning and end of each segment. Galvanised droppers are more easily seen than black droppers. A tag similar to a Roadside Marker Scheme label can be fixed to the dropper indicating the beginning and end of each section containing high quality native vegetation and, therefore, less fuel. Operators must be made aware of the droppers and instructed to only mow the sections with lower quality vegetation. Areas shown as ‘Naturally Low Fuel Areas’ in Figure 36 are to be regularly monitored to ensure weed encroachment is not occurring. It must be acknowledged that fuel loads in these areas may vary with seasonal conditions.

Fine fuel from fallen branches should be removed within the fuel break to minimise potential fine embers being emitted from the fuel break zone. Branches up to 5cm diameter should be cut and removed, including all leaves. These can be deposited deeper into Mundulla Common or removed completely. Larger branches that don’t pose an ember threat may be left in the fuel break, or if easily moved by hand, can be deposited deeper into Mundulla Common.

Figure 33. Fence line in MA5 degraded with various weeds including Scabiosa (Paviers Rd in background).

Figure 34. Example of a fence line in MA5 in good condition where a five metre fuel break is unnecessary.

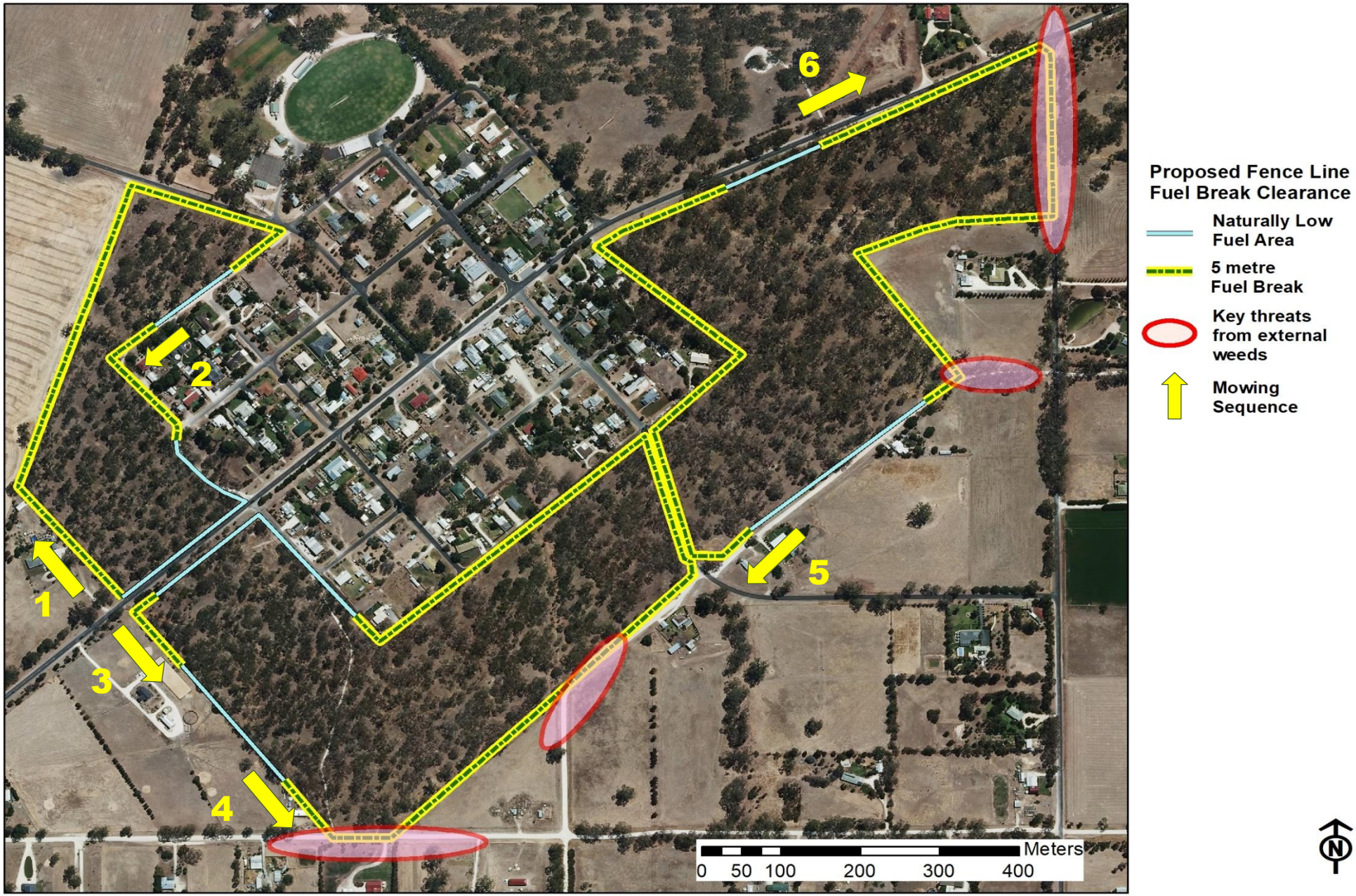

Figure 35. Fuel break locations for Mundulla Common, including proposed mowing sequence and roadsides containing high threat weeds.

Even after following the method described, there is a risk of weeds, like thistles, becoming established in the fuel break. This is because seeds are spread by wind or may already be in the soil. Reduced plant cover after mowing will encourage these weeds to germinate (Figure 37). To address this risk, TDC will need to ensure all fuel breaks are monitored for weed growth and treated accordingly, without damaging native plants. This will be critical in years with summer rain.

Figure 36. Ox-tongue Thistle flower. Within a slashed fence line. A mature, untreated specimen.

Roadside Fuel Loads Threaten Mundulla Common

Several roadside reserves adjoining Mundulla Common contain high threat weeds (Figure 16). For example, Vinens Road, eastern most corner of MA 4, contains a high level of perennial weed grasses (phalaris and cocksfoot). These weeds have invaded Mundulla Common and degraded the quality of vegetation, creating a higher fuel load. These road reserves must also receive regular weed control and maintenance for any fuel breaks within Mundulla Common to be effective. It will also prevent future weed invasion into Mundulla Common.

Adjoining Private Land

Where Mundulla Common abuts private land, the TDC could arrange a shared fuel break with the owner. At least one landholder already creates a mineral fuel break on their side of the fence (Figure 38). Where ever possible this should be encouraged.

Figure 37. Mineral fuel break on private land adjoining Mundulla Common.

8. Revegetation

There is no place for traditional revegetation within Mundulla Common. The natural community is a Grassy Woodland. These are rarely found in good condition in South Australia. Most have been cleared for agricultural pursuits, or degraded by woody weeds. A critical feature of a Grassy Woodland is a lack of middle storey vegetation. Very few to no shrubs are present. It should be possible to view across a Grassy Woodland without the view being obstructed.

In native vegetation, revegetation usually draws people's attention and resources away from the most important actions needed: weed control. That is, encouraging existing native vegetation to flourish. People become fixated on the revegetation when their efforts should be elsewhere.

In Mundulla Common the only appropriate revegetation is to hand broadcast locally collected native grass seed into degraded areas, including fencelines. This will hasten future opportunities to expand restoration work into new areas. Seed can be broadcast on a small scale, e.g. amongst a soursob patch, or over a larger scale, e.g. where sheep may be used in the future. Clearly, anyone collecting native grass seed must be able to identify the difference between native grasses and exotic grasses. Seed is collected from within Mundulla Common, then on the same day, scattered over a degraded area in Mundulla Common. A seed collection permit is not required for this method; confirmed by DEWNR Fauna Permits Unit specifically for Mundulla Common.

9. Mundulla Common Action Schedule

The schedule highlights activities to be undertaken in priority order. Some tasks may only take a short time to complete, but by understanding the lower priority tasks, additional equipment and/or herbicide can be taken on site maximising time efficiencies. That is, if priority one tasks are completed quickly the operator(s) can move on to priority two or three tasks.

Table 9: Mundulla Common weed management action schedule

PRIORITY ONE ACTIONS	PRIORITY TWO ACTIONS	PRIORITY THREE ACTIONS
WINTER June to August	**WINTER June to August**	**WINTER June to August**
MAs 5-7: Bridal Creeper (spray) (Section 5.4.2)	MAs 3&4: Bridal Creeper (spray) (Section 5.4.2)	MA 3&4: annual grass control (Section 5.1.1)
MA 5-7: follow up spray perennial weed grasses (Section 5.1.1)	MA 3&4: follow up spray perennial weed grasses (Section 5.1.1)	
	MA 5-7: annual grass control (Section 5.1.1)	
SPRING September to November	**SPRING September to November**	**SPRING September to November**
Native: Weed Ratio (where required for **following year's** action(s))	MA 5-7: follow up spray perennial weed grasses (Section 5.1.1)	MA 3&4: annual grass control (Section 5.1.1)
Monitoring	All MAs: control broad leaved weeds in weed grass control locations.	5m boundary fence line buffer where required (Section 7)
If grazing/burning (900m^2-0.25ha) used, monitor & report	MA 5-7: annual grass control (Section 5.1.1)	MA 3&4: follow up spray perennial weed grasses (Section 5.1.1)
MA5-7: control broad leaved weeds in weed grass control locations.		All MAs: follow up annual grass control as required (Section 5.1.1)
MA3&4: control broad leaved weeds if grazing or burning used (if required)		
SUMMER December to February	**SUMMER December to February**	**SUMMER December to February**
All MAs: control broad leaved weeds in previous weed grass control locations.	MAs 3&4: juvenile woody weeds (spray) 2 – 3 year intervals	
MAs 5-7: juvenile woody weeds (spray) 2 – 3 year intervals	Confirm resources for burning/grazing if required for following year	
AUTUMN March to May	**AUTUMN March to May**	**AUTUMN March to May**
MAs 5-7: perennial weed grass defoliation (Section 5.1.1)	MAs 3&4: perennial weed grass defoliation (Section 5.1.1)	Confirm resources for burning/grazing if required

Note: This schedule will require amendment in subsequent years to take into consideration changes due to seasonal factors and work already completed. The site should be regularly checked for establishment of new weeds or outbreaks of existing weeds.

10. Useful References

Croft S.J, Milne T.I. and Pedler J.A. (2005-2009) Bushland Condition Monitoring Manual - Southern Mount Lofty Ranges, Murray-Darling Basin, Eyre Peninsula, Northern Agricultural & Yorke Peninsula regions.

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APPENDIX A Weed Management Principles in Bushland

Weed management in bushland should aim to advantage native vegetation. This requires a different approach to that used in a garden, crop or pastoral situation. When the following principles are put into practice, large areas can be improved even when time is limited. Weeding effort should be dictated by the priority rating of a weed species for the given location and native vegetation not our impatience to create perfect bushland.

The regeneration principles that should be followed are:

- Work outward from the good quality native vegetation;
- Disturb the soil as little as possible; and
- Do not over clear weeds.

Detail on how to apply these principles is given below.

Work outward from the good quality native vegetation

In native vegetation, this principle ensures weeds do not move into better quality bushland. It allows native plants to replace weeds.

When working on restoration sites it is best to concentrate on removing smaller populations of priority weeds and work towards larger infestations. Once larger infestations are reached, a weed front should be established with work continuing along the weed front. Work should only advance into the infestation once native vegetation has replaced the weeds. Over time the infestation will diminish and become more easily managed.

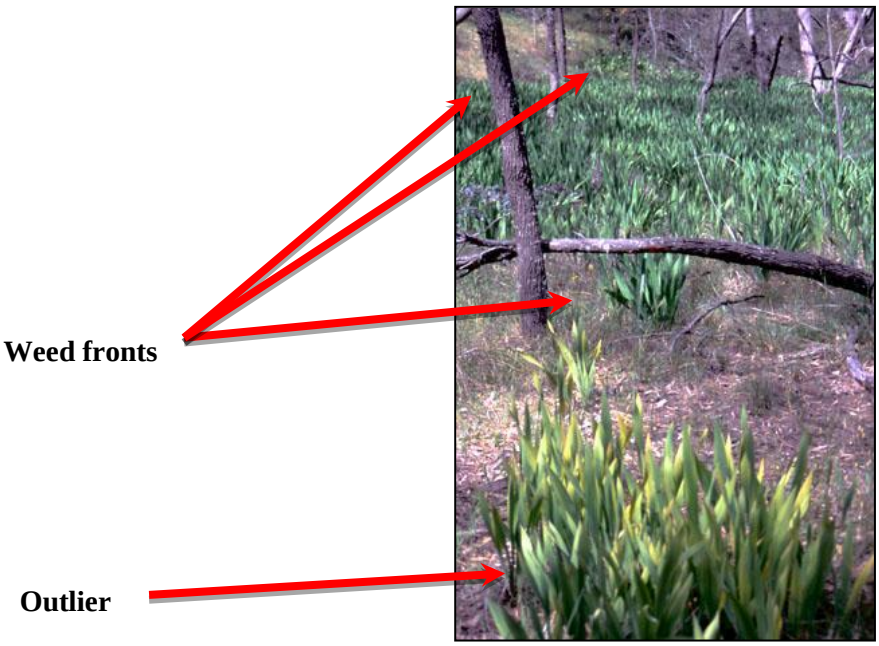


Figure 38 Example of outliers treated in good quality native vegetation first (foreground), then consolidation of establish weed fronts.

Spot Regeneration

Spot regeneration is a method used to encourage one or a few native plants surrounded by a sea of weeds. Normally, effort would not be directed to this situation, because it takes emphasis away from controlling weeds in good quality vegetation. It is most appropriate when only a short amount of time is available, e.g. 15 – 30 minutes.
The aim is to speed up future natural regeneration. A few minutes at each spot regeneration location will keep the immediate weeds at bay, thereby encouraging more native seed to be produced. Over time this builds up native seed in the soil, providing a source for new plants in the future.

It is important not to over clear weeds as this can result in unsustainable levels of follow-up weed control. Often, when large infestations are removed the resultant regrowth of weeds can be extremely difficult to control.

Disturb the soil as little as possible

This does not necessarily mean zero disturbance. Some level of disturbance is unavoidable, however the goal is to cause as little disturbance as possible. This reduces the opportunity for disturbance loving weeds, such as thistles and Salvation Jane to become established.

Figure 39. Proliferation of Salvation Jane after soil disturbance.

Do not over clear weeds

A common problem when people begin restoration is over clearance of weeds. It is difficult to curb our enthusiasm for killing weeds, but essential. Weeds should only be cleared at a pace where native vegetation can re-colonise an area. In restoration, the emphasis is on advantaging native plants not necessarily killing weeds.

Over clearance of weeds results in the need for unsustainable levels of follow-up work to control re-growth of the weeds treated, their seedlings or other unexpected weeds that move into the void. To prevent this, work should aim to target weeds around native plants, then continue outward. Once an infestation has been reached and a weed front established, work

should continue along the weed front, even if it results in the weed front wandering and meandering for hundreds of metres. Do not over clear weeds. Working into weed fronts often results in bare soil or disturbance, and the opportunity for other weeds to take over.

APPENDIX B Summary of Weed Control Treatment Options for Mundulla Common

	Method	Perennial Grass		Annual Grass	Broadleaved Weed	Bridal Creeper	Woody Weed
		Groups	Isolated				
MA 3, 4 & 7	Hand Pull	Autumn	Seedlings Only	Winter/Spring	Winter / Spring	Winter / Spring	Winter / Spring
	Hand Shears	Autumn	Anytime	Tillering			
	Brushcutter	Autumn	Anytime	Tillering			
	Herbicide	Leafy after stem removal			Winter / Spring (Summer**)	Flowering Only (Winter)	Late Spring / Summer
	Burning	Autumn		Tillering to Seeding			
	Grazing	Spring		Flowering			
MA 5 & 6	Hand Pull	Autumn	Seedlings Only	Winter/Spring	Winter / Spring	Winter / Spring	Winter / Spring
	Hand Shears	Autumn	Anytime	Tillering			
	Brushcutter	Autumn	Anytime	Tillering			
	Herbicide	Leafy after stem removal			Winter / Spring (Summer**)	Flowering Only (Winter)	Late Spring / Summer
	Burning	Autumn		Tillering to Seeding			
	Grazing						

* Remove hand pulled annual grasses from Mundulla Common if past tillering stage.
** Timing depends on species, some broadleaved weeds only germinate in summer. Apply herbicide **before** flower stems emerge for all types.

APPENDIX C Summary of Monitoring and Native Vegetation Council notification requirements.

A number of management methods have the potential to seriously damage the condition of native vegetation within Mundulla Common. If the methods following the processes described in this Operations Plan, they can a long way to enhancing and improving the overall quality of native vegetation. Consequently, they require closer monitoring and review. For these reasons, it is necessary to notify the NVC at certain stages. Table 8 & 10 provide a summary of when NVC notification is required.

Table 10. Monitoring and NVC notification requirements per management method.

Monitoring Method*	Native: Weed Ratio	Bare Ground	Fallen Timber	Grazing Record Sheet**	Photopoints	Resource Allocation	Detailed Monitoring	NVC Notification Required
Grazing 1 – 2 hectares	✓	✓	✓	✓	Optional			✓
Grazing Heavily Degraded Zones	X	✓	X	✓	Optional			✓
Burning 900m^2 – 2500m^2	✓	✓	✓		Optional			X
Any method <900m^2	Optional				Optional			X

* Monitoring and NVC notification required five times per management event; 1) the year before, 2) within two weeks of event, 3) the year after, 4) the second year after and 5) five years after the event.

** Grazing record is only required once, in the year grazing occurs.

APPENDIX D Monitoring Datasheets

Date: …… **Recorder(s)** ……

Mundulla Common Management Area:

Native: Weed Ratio		
Percentage native plants	**Score**	**Site Score**
>76%	3	
40 – 75%	2	
5 – 40%	1	
<5%	0	

Bare Ground Assessment		
Percent Bare Ground	**Score**	**Site Score**
>51% of site bare ground	0	
31-50% bare ground	1	
21-30% bare ground	2	
11-20% bare ground	3	
5-10% bare ground	4	
<5% bare ground	5	

GPS corners of control areas of control area

Native Plant and Weed Percentage Cover				
5 Most common native plants	**Relative percent of all plants**	**5 Most common weeds**	**Relative percent of all plants**	**Weed threat rating***
Total %				

* Complete threat rating in office, refer to Mundulla Common Operations Plan for threat rating

Fallen Timber / Debris				
Log diameter	None	Less than 1 per 10 trees	1 or more per 10 trees	Score
Trunk sized	0	2	3	
Branch sized	0	0.5	1	
Litter	Little or none	Sparse and/or patchy	Dense and more or less continuous	Score
Litter	0	0.5	1	
			Site Score	

Datasheet is modified from *Native Vegetation Council (NVC) Bushland Assessment Manual.*

APPENDIX E Grazing Record Sheet

Grazing Record Sheet

Area (Paddock)	Area recorded on GIS	Stock Quarantined Beforehand	Date in	Stock number and type	Average Height of grass (cm)	% Bare Ground	Date out	Average Height of grass (cm)	% Bare Ground	Comments
(Example) Area 3	Yes	Yes	1/10/2013	Merino X 100 wethers	40 cm	<1%	5/10/2013	10 cm	5%	Sheep removed due to grazing on young trees.

APPENDIX F Mundulla Common Native Plant List

Native plant list taken from the *Draft Management Plan for Moot-Yang-Gunya Swamp and Mundulla Common*, DENR (2009), including additional plants observed during field inspections for this Mundulla Common Operations Plan.

Common name	**Species**	**EPBC**	**SA**	**Regional**	**Vegetation Association**		
					Grey Box	Blue Gum	Red Gum
Gold Dust Wattle	*Acacia acinacea*				1		
Coastal Umbrella Bush	*Acacia cupularis*				1		
Golden Wattle	*Acacia pycnantha*				1	2	3
Sheep's Burr	*Acaena echinata*				1	2	3
Buloke	*Allocasuarina luehmannii*			NT	1	2	3
Drooping Sheoak	*Allocasuarina verticillata*			NT		2	
Native Wheat-grass	*Anthosachne scabra*			NT	1	2	3
Nodding Vanilla-lily	*Arthropodium fimbriatum*			NT	1	2	3
Small Vanilla-lily	*Arthropodium minus*			RA			3
Common Vanilla-lily	*Arthropodium strictum*				1	2	3
Common Woodruff	*Asperula conferta*				1		
Cranberry Heath	*Astroloma humifusum*					2	3
Crested Spear-grass	*Austrostipa blackii*			RA			3
Short-crest Spear-grass	*Austrostipa curticoma*			RA			
Swollen Spear-grass	*Austrostipa gibbosa*		R	VU		2	
Balcarra Spear-grass	*Austrostipa nitida*			RA			3
Tall Spear-grass	*Austrostipa nodosa*			RA			
Hybrid Spear-grass	*Austrostipa nodosa* x curticoma						
Fine-hairy Spear-grass	*Austrostipa puberula*			RA		2	
Slender Spear-grass	*Austrostipa scabra ssp. falcata*			NT			
Red-leg Grass	*Bothriochloa macra*		R				3
Swamp Daisy	*Brachyscome basaltica* var. *gracilis*		R	VU	1		
Sweet Bursaria	*Bursaria spinosa* ssp. *spinosa*				1	2	3
Southern Cypress Pine	*Callitris gracilis*			NT			
Lemon Beauty-heads	*Calocephalus citreus*			RA	1		3
Knob Sedge	*Carex inversa* var. *inversa*			RA	1		3
Knob Sedge	*Carex inversa* var. *major*			RA			
Rush Sedge	*Carex tereticaulis*			VU	1		3
Black Oak	*Casuarina pauper*						
Common Sneezeweed	*Centipeda cunninghamii*						

Hairy Centrolepis	*Centrolepis strigosa*			NT			3
Blue Squill	*Chamaescilla corymbosa*			NT		2	
Common Everlasting	*Chrysocephalum apiculatum*				1		3
Old Man's Beard	*Clematis microphylla*				1		
Windmill Grass	*Chloris truncata*			NT	1		
	Convolvulus angustissimus			NT			
Grassland Bindweed	*Convolvulus angustissimus* ssp. *peninsularum*			NT	1	2	3
Australian Bindweed	*Convolvulus erubescens complex*					2	3
Dense Crassula	*Crassula colligata ssp. colligata*						
Crassula	*Crassula* sp.				1	2	
Pale Flax-lily	*Dianella longifolia* var. *grandis*		R	VU	1	2	3
Black-anther Flax-lily	*Dianella revoluta* var. *revoluta*				1	2	3
Sticky Hop Bush	*Dodonaea viscosa* subsp. *spatulata*						
Lignum	*Duma florulenta*			NT	1		
Climbing Saltbush	*Einadia nutans*			NT	1		
Common spike-rush	*Eleocharis acuta*			NT			3
Variable Willow-herb	*Epilobium billardierianum* ssp. *intermedium*			NT			
Barren Cane-grass	*Eragrostis infecunda*		R	RA	1		
Prostrate Blue Devil	*Eryngium vesiculosum*		R	VU	1		
River Red Gum	*Eucalyptus camaldulensis* var. *camaldulensis*			NT	1	2	3
Inland South Australian Blue Gum	*Eucalyptus leucoxylon* ssp. *pruinosa*			NT	1	2	3
Grey Box	*Eucalyptus microcarpa*			NT	1		3
caustic weed	*Euphorbia drummundii*				1		3
Common Eutaxia	*Eutaxia microphylla*			NT	1		
Rough Bedstraw	*Galium gaudichaudii*				1		
Geranium	*Geranium* sp.					2	
Creeping Raspwort	*Gonocarpus micranthus* ssp. *micranthus*		R	RA			
Spreading Goodenia	*Goodenia heteromera*		R	EN	1		
Cut-leaf Goodenia	*Goodenia pinnatifida*			RA	1		
Rough Raspwort	*Haloragis aspera*			NT	1	2	3
Bluish Raspwort	*Haloragis glauca*				1		
Plain Quillwort	*Isoetes drummondi*						
Yellow Rush	*Juncus flavidus*			VU			
Hoary Rush	*Juncus radula*			VU			

Rush	*Juncus* sp.				1		3
Finger Rush	*Juncus subsecundus*						
Scarlet Runner	*Kennedia prostrata*					2	3
Perennial Blown-grass	*Lachnagrostis filiformis*						
Scaly Buttons	*Leptorhynchos squamatus* ssp. *squamatus*			RA			3
Poison Pratia	*Lobelia concolor*		R	NT	1		3
Salt Pratia	*Lobelia irrigua*			NT	1		
Poison Lobelia	*Lobelia pratioides*		R	RA	1		
Small-flower Mat-rush	*Lomandra micrantha ssp. micrantha*			NT			3
Small Mat-rush	*Lomandra nana*			NT	1	2	3
Sword Mat-rush	*Lomandra sororia*			NT	1	2	3
Lesser Loosestrife	*Lythrum hyssopifolia*				1		3
Wingless Fissure-plant	*Maireana enchylaenoides*			NT	1	2	3
Nardoo	*Marsilea* sp.				1		3
Native Pennyroyal	*Mentha satureioides*		R	RA	1		3
Onion Orchid	*Microtis* sp.						3
Slender Monkey-flower	*Mimulus gracilis*			EN	1		
Milfoil	*Myriophyllum* sp.					2	3
Native Sorrel	*Oxalis perennans*				1	2	3
Magenta Pelargonium	*Pelargonium rodneyanum*						
Curved Riceflower	*Pimelea curviflora* var. *gracilis*		R	NT	1		
Low Riceflower	*Pimelea humilis*			NT	1	2	3
Silky Riceflower	*Pimelea micrantha*			VU			
Narrow-leaf Plantain	*Plantago gaudichaudii*			NT	1	2	3
Large Green Pussytail	*Ptilotus macrocephalus*			NT			3
Pussy-tails	*Ptilotus spathulatus* f. *spathulatus*			RA			
Ferny Buttercup	*Ranunculus pumilio* var. *pumilio*			VU	1		
Swamp Dock	*Rumex brownii*				1		
Dock	*Rumex* sp.				1		
Common Wallaby-grass	*Rytidosperma caespitosa*						3
Brown-backed Wallaby-grass	*Rytidosperma duttoniana*			RA			3
Hill Wallaby-grass	*Rytidosperma eriantha*			RA			
Leafy Wallaby-grass	*Rytidosperma fulva*			RA	1		
Kneed Wallaby-grass	*Rytidosperma geniculata*						
Slender Wallaby-grass	*Rytidosperma racemosa* var. *racemosa*			RA			

Small-flower Wallaby-grass	*Rytidosperma setacea*						
Grassland Sida	*Sida corrugata* var. *angustifolia*			RA	1	2	3
Smooth Solenogyne	*Solenogyne dominii*			RA	1		3
Creamy Candles	*Stackhousia monogyna*			RA		2	3
Leafy Templetonia	*Templetonia stenophylla*		V	VU	1	2	3
Grey Germander	*Teucrium racemosum*			NT		2	
Kangaroo Grass	*Themeda triandra*			NT	1	2	
Yellow Rush-lily	*Tricoryne elatior*				1	2	3
Waisted New Holland Daisy	*Vittadinia cervicularis*			VU			
Vittadinia	*Vittadinia australasica*					2	3
Fuzzy New Holland Daisy	*Vittadinia cuneata* var. *cuneata* f. *cuneata*			NT			
Woolly New Holland Daisy	*Vittadinia gracilis*				1	2	3
Tufted Bluebell	*Wahlenbergia communis*			NT	1	2	3
Bluebell	*Wahlenbergia luteola*			RA			
Rigid Panic	*Walwhalleya proluta*			NT	1	2	3

SA conservation ratings: V – Vulnerable; R – Rare
South East conservation ratings: EN – Endangered; VU – Vulnerable; RA – Rare; NT – Near Threatened

APPENDIX G Mundulla Common Weed List

Weed list taken from the *Draft Management Plan for Moot-Yang-Gunya Swamp and Mundulla Common*, DENR (2009), including additional plants observed during field inspections for this Mundulla Common Operations Plan.

Weed Rating*	Common name	Species	Vegetation Association		
			Grey Box	Blue Gum	Red Gum
2	Flinders Range Wattle	*Acacia iteaphylla*		2	3
1	Silvery Hair-grass	*Aira cupaniana*			
-	Slender Fox-tail	*Alopecurus myosuroides*			
1	Blue Pimpernel	*Anagallis arvensis*			
2	Cape Weed	*Arctotheca calendula*			
5	Bridal Creeper	*Asparagus asparagoides*	1	2	3
2	Oat	*Avena sp.*	1	2	3
2	False Brome	*Brachypodium distachyon*	1		
2	Large Quaking-grass	*Briza maxima*	1	2	3
2	Lesser Quaking-grass	*Briza minor*			
1	Great Brome/Ripgut Brome	*Bromus diandrus*	1	2	3
1	Soft Brome	*Bromus hordeaceus* ssp. *hordeaceus*			
1	Compact Brome	*Bromus madritensis*			
1	Red Brome	*Bromus rubens*			
2	Slender Thistle	*Carduus tenuiflorus*			
2	Saffron Thistle	*Carthamus lanatus*	1	2	
1	Fern Grass	*Catapodium rigidum*			
2	Malta Thistle	*Centaurea melitensis*			
1	Centaury	*Centaurium* sp.	1		3
1	Common Mouse-ear Chickweed	*Cerastium glomeratum*	1		
1	Chickweed	*Cerastium pumilum*			
2	Skeleton Weed	*Chondrilla juncea*		2	3
2	Spear Thistle	*Cirsium vulgare*	1	2	3
-	Clematis	*Clematis* sp.		2	
1	Flax-leaf Fleabane	*Conyza bonariensis*	1	2	
-	Hawthorn	*Crataegus monogyna*	1		
1	Dandelion Hawksbeard	*Crepis vesicaria* ssp. *taraxacifolia*	1	2	
2	Couch	*Cynodon dactylon*	1		
2	Rough Dog's-tail Grass	*Cynosurus echinatus*		2	3
2	Cocksfoot	*Dactylis glomerata*	1	2	3
-	Shrubby Daisybush	*Dimorphotheca fruticosa*		2	
3	Lavatory Creeper	*Dipogon lignosus*			
4	Perennial Veldt Grass	*Ehrharta calycina*	1	2	3
2	Annual Veldt-grass	*Ehrharta longiflora*	1	2	3
2	Long Heron's-bill	*Erodium botrys*			
-	Desert Ash	*Fraxinus angustifolia*	1	2	

3	Gazania	*Gazania linearis*		2	
1	Cretan Weed	*Hedypnois rhagadioloides*	1	2	
1	Ox-tongue Thistle	*Helminthotheca echioides*	1	2	3
1	Buchan Weed	*Hirschfeldia incana*			
1	Sea Barley-grass	*Hordeum marinum*			
1	Smooth Cat's Ear	*Hypochaeris glabra*			
2	Rough Cat's Ear	*Hypochaeris radicata*	1	2	3
1	Twining Toadflax	*Kickxia elatine* ssp. *crinita*	1	2	3
2	Prickly Lettuce	*Lactuca serriola*	1	2	3
2	Hairs Tail Grass	*Lagurus ovatus*			3
1	Common Peppercress	*Lepidium africanum*	1		
2	Hybrid Ryegrass	*Lolium perenne* X *Lolium rigidum*			
2	Annual Rye Grass	*Lolium rigidum*		2	3
3	African Boxthorn	*Lycium ferocissimum*	1		3
2	Horehound	*Marrubium vulgare*			3
2	Burr-medic	*Medicago polymorpha* var. *polymorpha*			
2	medic	*Medicago* sp.	1	2	3
1	Pennyroyal	*Mentha pulegium*	1		
2	Thread Iris	*Moraea setifolia*			
3	Olive	*Olea europaea* ssp. *europaea*	1	2	3
3	Soursob	*Oxalis pes-caprae*	1	2	3
-	Witchgrass	*Panicum capillare*	1		3
3	Kikuyu	*Pennisetum clandestinum*	1		
1	Velvet Pink	*Petrorhagia dubia*		2	3
3	Phalaris	*Phalaris aquatica*	1	2	3
-	Paradoxa Grass	*Phalaris paradoxa*			3
2	Lippia	*Phyla canescens*			3
-	Monterey Pine	*Pinus radiata*			
2	rice millet	*Piptatherum miliaceum*	1	2	
1	Hairy Plantain	*Plantago bellardii*		2	3
2	Ribwort	*Plantago lanceolata* var. *lanceolata*	1	2	3
2	Bulbous Meadow-grass	*Poa bulbosa*	1		
1	Annual Milkwort	*Polygala monspeliaca*		2	
1	Wireweed	*Polygonum aviculare*	1		
1	Annual Beard-grass	*Polypogon monspeliensis*			
-	Pricklefruit Buttercup	*Ranunculus muricatus*	1		
2	Onion Grass	*Romulea rosea*			
2	Onion Grass	*Romulea* sp.	1		3
3	Dog Rose	*Rosa canina*		2	
2	Curled Dock	*Rumex crispis*		2	3
2	Wild Sage	*Salvia verbenaca* var. *verbenaca*	1	2	3
2	Pincushion	*Scabiosa atropurpurea*	1	2	3
1	Common Sow Thistle	*Sonchus oleraceus*	1	2	3
2	Narrow-leaf Clover	*Tifolium angustifolium*	1	2	3
2	Hare's Foot Clover	*Trifolium arvense* var. *arvense*	1	2	
2	Hop Clover	*Trifolium campastre*			

2	Cluster Clover	*Trifolium glomeratum*			
2	White Clover	*Trifolium repens*			
2	Rough Clover	*Trifolium scabrum*	1		
2	Star Clover	*Trifolium stellatum*			
2	Knotted Clover	*Trifolium striatum*			
2	Subterranean Clover	*Trifolium subterraneum*			
1	Trailing Verbena	*Verbena supina* var. *supina*	1	2	3
2	Vetch	*Vicia* sp.		2	3
2	Squirrel-tail Fescue	*Vulpia bromoides*			
2	Wall Fescue	*Vulpia muralis*			
2	Rats-tail Fescue	*Vulpia myuros* f. *myuros*			
2	Silver Grass	*Vulpia* sp.	1		
-	Palm			2	

* Weed Ratings follow those prescribed in the Bushland Condition Monitoring Manual (Nature Conservation Society of South Australia 2005 - 2009)

APPENDIX H Buffel Grass Hygiene Fact Sheet – *Weed Hygiene Protocol*

http://www.pir.sa.gov.au/__data/assets/pdf_file/0003/275907/4108_PIRSA_factsheet_Buffel_Grass_Hygiene_4pp_WEB.pdf

FACTSHEET

Buffel Grass – Collective term for *Cenchrus ciliaris*, *C. pennisetiformis*

Buffel Grass Hygiene

Buffel grass has been recognised as one of the greatest pest threats to South Australia. It is often referred to as a transformer species meaning it has the ability to alter entire ecosystems through the alteration of fire regimes and through competition with native flora.

Following introduction into South Australia, buffel grass has invaded a significant portion of the states arid and semi-arid rangelands.

Why is Hygiene Important?

Weeds reduce the quantity and quality of Australia's agricultural products. It is estimated that weeds cost Australian farmers around $1.5 billion a year in weed control activities and a further $2.5 billion a year in lost production.

Hygiene is important to protect agriculture as well as priority assets such as the Flinders Ranges, Great Victorian Desert and other sites of cultural and/or environmental significance.

Buffel grass is a prolific seeder. Due to the seeds small size and fine hairs it has the ability to spread long distances into remote areas via vehicles, earth moving and other machinery, stock, wind, water and other human activities.

Preventing Weed Spread – What Can I Do?

- Ensure vehicles are clean before entering a new site.
- Stay on tracks.
- Avoid areas of high-risk or known buffel grass infestations. If unavoidable, plan a route from areas of low infestation to areas of high infestation.

To Minimise Buffel Grass Spread by Animals and Other Products

- Quarantine any animals suspected of carrying buffel grass seed in a withholding paddock for a minimum of 7 days. Monitor the withholding paddock following summer rains and carry out control as necessary.
- Be sure to decontaminate vehicles used for transportation of stock or other products. If not possible, be sure to undertake regular surveillance and control in the loading and unloading paddocks following summer rains.
- Avoid enabling dogs to run freely though areas infested with buffel grass.
- Avoid stockpiling items close to buffel grass infestations.

PREMIUM FOOD AND WINE FROM OUR CLEAN ENVIRONMENT

SOUTH AUSTRALIA

Government of South Australia

Decontaminate graders and ground engaging machinery

Decontaminate the underside of vehicles

Tools You May Need For Vehicle Inspection and Decontamination

- Mirror.
- Tools to remove covers and guards.
- Torch.
- Probe or rod.
- Wire brush.
- High pressure washer/air hose.
- Scraping implement.
- Broom.
- PPE.
- Container for contaminated material.

Effective Decontamination Options

Wash the Vehicle Down

- Use a hose, high pressure cleaner or spray tank and pump.
- Wash-down adjacent to areas where buffel grass needs to be contained. Choose sites where the land slopes back into an infested area or a site that can be monitored regularly and control of new germinations undertaken as required.
- Air blast hard-to-reach areas such as cavities and joints when the vehicle and contaminants are dry.
- Wash down all potential seed collection points and move the vehicle forward to ensure the entire tyre is clean.
- Sweep/vacuum inside the cab to remove contaminants.

Physical Removal

Where no wash-down facilities are available be sure to physically remove all clods of mud and visible plant material in addition to cleaning the foot-well and cabin of the vehicle.

Use a brush or scraping implement to remove contaminants such as burrs and clods of mud from tyres, mud guards, grader blades, ledges and crevices that could contain contaminants.

Remove buffel grass seed from footwear, socks and clothing

Remove buffel grass seed from tools and camping equipment

Also Consider the Following:

- Clean footwear and remove weed seeds from socks and clothing.
- Clean the vehicle from the top down. Use the compressed air method prior to washing with water in dry conditions.
- Use detergents to assist removal of grease, dirt and mud, which may contain weed contaminants.
- Clean the undercarriage, springs and axles of trailers/caravans etc.
- Use the same site for cleaning and monitor regularly for germinations following summer rains.
- Visually inspect vehicles and camping equipment when leaving an area containing buffel grass.

Vehicle Decontamination Checklist (All types of vehicle)

Cabin:

- Carpet.
- Mats.
- Foot wells.
- Pedals.
- Controls.
- Seats.
- Air Condition filter.

Underside and other parts:

- Guards and belly plates.
- Chassis rails and brackets.
- Recesses.
- The swing-drive area.
- Around counter weight.
- Around the fuel tank.
- Axle housing.

Wheels and Steering:

- Treads.
- Inside and outside of rims.
- Wheel arches.
- Mud flaps.
- Brackets and brakes.
- Steering and suspension components.

Decontaminate wheels and steering

Track Area:

- Shoe.
- Links.
- Sprockets.
- Idler wheels.
- Track adjuster guards.
- Lubrication points.
- Inside the track area.

Blades/Buckets, Arms/Booms:

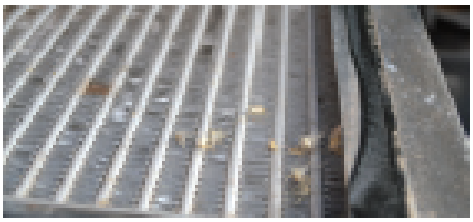
- Front and back of grader blades.
- Teeth.
- Pivot points.
- Turning circle.
- Hydraulic rods and hoses.
- Bucket.
- Wear plates.

Clean foot well and floor mats

Remove belly plates for inspection

Clean track area

Decontaminate front and back of grader blades and hydraulic rods



Decontaminate intercoolers and radiator fins

Decontaminate recesses and crevices on slashers

Engine:

- Intercooler.
- Chain cases.
- Radiator fins and grills.
- In between cooling cores.
- Engine mounts.
- Recesses.
- Engine bay.
- Air filter.
- Battery box.

Attachments:

- Tynes and rippers.
- Support frame.
- Hydraulic hoses.

Slashers:

- Care should be taken to thoroughly decontaminate all recesses and crevices on roadside slashers.
- Air blast prior to high pressure wash in dry conditions.

When to Wash-down and Implement Hygiene Protocols

- If grading, slashing or using any ground engaging machinery.
- When moving stock.
- When receiving goods via rail or road train.
- Moving machinery out of a local area of operation.
- Moving machinery between properties.
- Using machinery along roadsides or along river banks.
- Using machinery to transport soil and quarry materials.
- Using controlled-access vehicle tracks.

Contaminated material must be disposed of in a manner that ensures all weeds and seeds removed cannot spread or grow.

Disposal of Contaminated Material

- Incinerate or burn the plant material.
- Solar radiation can be used to kill the seed by placing in a black plastic bag and leaving in the sun for at least a month.
- Deep burial of at least 0.5m.

For Further Information

For resources and state-wide buffel grass management visit Biosecurity SA – Buffel grass webpage:
www.pir.sa.gov.au/biosecurity/weeds_and_pest_animals/plant_pests_in_south_australia/weed_id/plant_id_notes/buffel_grass

For regional buffel grass management and advice contact your local Natural Resources SA office:
www.naturalresources.sa.gov.au/home

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