THE LODDON FALLS

RIPARIAN VEGETATION MANAGEMENT PLAN

NORTH CENTRAL
CATCHMENT
MANAGEMENT AUTHORITY

Our Waterways Matter

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RIPARIAN VEGETATION

MANAGEMENT PLAN

NORTH CENTRAL CATCHMENT MANAGEMENT AUTHORITY

2000

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SUMMARY & RECOMMENDATIONS

Riparian Australia was contracted by the North Central Catchment Management Authority (NCCMA) to write a Vegetation Management Plan for the Loddon Falls Remnant in July 2000. The remnant is located on public land on the upper reaches of the Loddon River two kilometers north of Glenlyon. To produce this Vegetation Management Plan an investigation was conducted that involved a field assessment of the existing indigenous and introduced vegetation, review of relevant literature, and consultation with professionals in weed and vermin control.

The remnant vegetation within the study area is typified by Manna Gums (*Eucalyptus viminalis*) towering over a blanket of Tussock Grasses and Austral Bracken, with Blackwoods, River Bottlebrush lining the river. The remnant provides habitat for a range of native animals including a number of Black Wallabies. The falls are located in a gorge formed by sheer faced basalt columns that are a unique geological feature. Below the gorge the slope of the bank recedes but remains fairly steep.

Blackberry is the most prevalent weed and poses the greatest threat to the values of the remnant. Crack willows are found in abundance along one section of the remnant. Gorse is found in abundance in the top section of the remnant and is steadily spreading downstream. Upstream of the remnant Gorse and Blackberry dominate the riparian zone. The adjacent land is used for grazing, stock are excluded from most of the remnant by fencing to avoid stock loss in the steep rocky areas. Fencing is patchy upstream of the remnant and sheep are grazing within the riparian zone. Large numbers of rabbits were observed within the remnant and in adjacent farmland.

Management of weeds, stock and rabbits using techniques that reinforce each other is required to protect and enhance the Loddon Falls remnant. Blackberry, Crack Willows and Gorse are the major weeds that require control within the remnant. Blackberry, and Gorse are the major weeds that require control upstream of the remnant to prevent further spread downstream. To promote regeneration of indigenous vegetation within the remnant rabbit control and stock exclusion is required. Upstream of the remnant grazing by stock should be utilised as a tool for weed control.

The remnant displays a rare example of intact indigenous vegetation modestly invaded by introduced weeds. Through the declaration as a Streamside Reserve the State recognises the value of the Loddon Falls vicinity. The site has an established plant community composed of indigenous and introduced species along the river and extending up the steep slopes. While there is evidence of some direct management of introduced vegetation species for the most part the retention of the indigenous vegetation has occurred by default. The rich compliment of indigenous vegetation has been saved by the steep slopes and limited agricultural worth, however within the riparian zone few seedlings were noted indicating a low level of regeneration. At more accessible locations within the site (upstream of the falls), with small river flats, clearing and grazing to the bank has occurred.

Low regeneration as a result of vigorous weed growth and rabbit grazing pressure suggests that current management will fail to sustain the present population of indigenous vegetation. This plans primary aim is to introduce an integrated system of management designed to assist natural regeneration in order to protect and enhance the indigenous riparian vegetation within the remnant. The plan is based on the predicted responses to management actions observed elsewhere. To tailor management to the site, ongoing, systematic monitoring of the plant responses is included as an essential component of management.

Management aims to;

- introduce an integrated system designed to assist natural regeneration in order to protect and enhance the indigenous riparian vegetation within the remnant;
- establish weed control directed at controlling woody weeds present in the remnant and preventing the reintroduction of woody weeds from upstream by creating a buffer zone;

- control woody weeds with a view to incrementally improving the conditions for the growth and regeneration of indigenous vegetation with careful consideration being given to ecological issues (e.g. habitat value);
- establish regeneration management to protect regenerating indigenous vegetation from grazing and browsing pressure; and
- produce indigenous seed for downstream germination.

The approach required to achieve the aims is integrated restoration management involving the following actions:

- Weed management
- Regeneration management
- Regular monitoring and ongoing maintenance

The integrated restoration management principles are to:

- assist in the restoration of a disturbed and diminished natural ecosystem;
- establish partnership agreements between stakeholders;
- undertake weed control and regeneration management to facilitate natural regeneration of indigenous vegetation within the Loddon Falls remnant;
- ensure that the removal of one weed does not lead to its replacement by another;
- ensure that regeneration management enhances natural regeneration of indigenous vegetation and not weed regeneration; and
- use techniques that reinforce each other to protect and enhance the regeneration of indigenous vegetation within the Loddon Falls remnant (integrate weed and regeneration management).

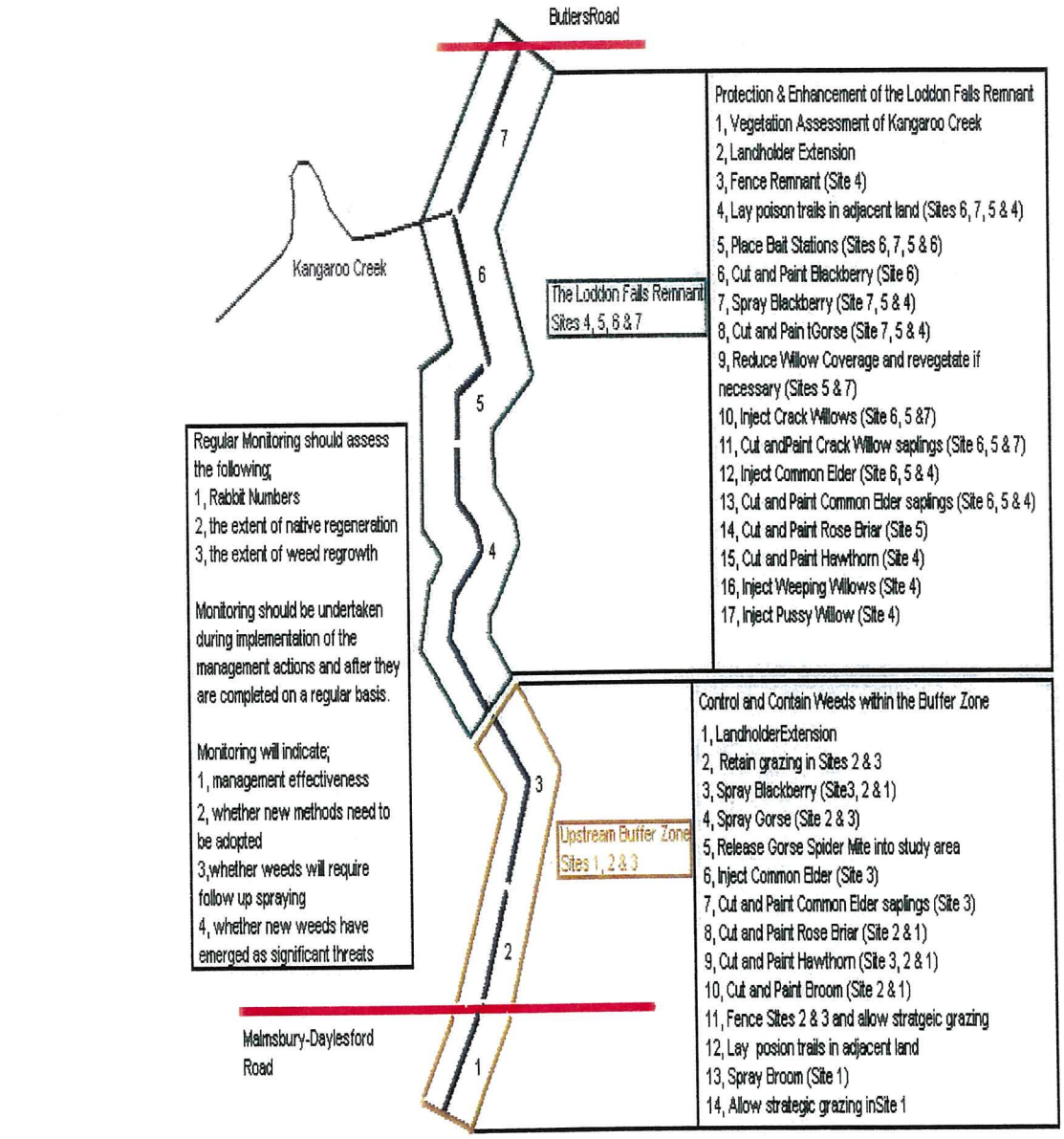
The recommended management plan stipulated in this report is an adaptive low level management plan to be conducted over a long time period rather than an intense project orientated plan. This plan relies on the promotion of regeneration for indigenous species but has the capacity to be adapted based on observations to include planting in locations where regeneration fails. Initial management actions should be conducted over a period of 3-4 years. Consistent and persistent monitoring and maintenance over many years is required to effectively adapt and implement management actions to protect and enhance the values of the Loddon Falls remnant in the long-term.

The recommended actions are shown diagrammatically on the following page accompanied by pictures that typify the conditions of the remnant and the upstream buffer zone. Priority is given to the management of the remnant with subsequent management being aimed at the upstream buffer zone. Monitoring and ongoing maintenance should be undertaken concurrently with these actions.

View looking downstream in Buffer Zone (Site 2)

View looking downstream in remnant (Site 6)

Recommended Management Actions for the Loddon Falls Study Area.



1 INTRODUCTION

1.1 GENERAL

The North Central Catchment Management Authority (NCCMA) contracted Riparian Australia to produce a vegetation management plan focused on the riparian zone for the Loddon Falls remnant in July 2000. The Loddon Falls study area runs along the Loddon River from just upstream of the Malmsbury-Daylesford Road Crossing to the Butlers Road Bridge as shown in Figure 1. The width of the study area is determined by the width of the riparian vegetation (approximately fifty meters at its widest point) and runs along each side of the Loddon River for approximately 3 kilometers.

The Draft Vegetation Management Plan (NCCMA, 2000) identifies the protection and enhancement of existing remnant vegetation as the highest priority for vegetation conservation in the region.

The Loddon Falls remnant, is a unique geological feature that hosts a diverse range of indigenous flora and fauna. The remnant is located on public land near two state forests, Wombat State Forest to the south and Loddon State Forest to the North amidst grazing properties. The Loddon Falls remnant is a stream side reserve with three major stakeholders;

- the NCCMA
- Parks Victoria and
- adjacent private landholders.

The unique characteristics of the Loddon Falls remnant, in terms of location, management, geological and biological significance make this site a prime candidate for protection and enhancement as per the Draft Vegetation Management Plan (NCCMA, 2000).

1.2 OBJECTIVES

In order to protect and enhance the Loddon Falls remnant, it is required that the existing woody weeds be identified, assessed and managed with a view to incrementally improving the conditions for the growth and regeneration of indigenous vegetation. As such the objectives are:

- Assess the threat and identify the location of existing woody weeds;
- Manage the site to protect and enhance the existing conditions;
- Establish an environmental woody weed control program directed at controlling woody weeds present in the remnant and preventing the reintroduction of weeds from upstream areas;
- Control woody weeds with a view to incrementally improving the conditions for the growth and regeneration of indigenous vegetation with careful consideration being given to ecological issues (e.g. habitat value); and
- Establish regeneration management to protect regenerating indigenous vegetation from grazing and browsing pressure.

In order to achieve the objectives the following tasks were completed;

- Background analysis.
- Site analysis:
  - Identify the location and assess the abundance of existing woody vegetation at the site; and
  - Identify the location and assess the abundance of stock and vermin at the site.
- Presentation of results of site assessment.
- Identification of values, threats and associated management issues.
- Production of a vegetation management plan.

1.3 SCOPE

The scope of this study focused on the issues identified within and impacting on the study area although it is recognised that other factors outside the study area might influence the management required. For example, a vegetation management plan may be required along Kangaroo Creek and adjacent land to ensure that weeds do not spread into the remnant.

To produce the Loddon Falls Management Plan the following research was undertaken:

- two days of field assessment;
- review of management plans written for the NCCMA;
- investigation of current literature on weed control;
- investigation of DNRE & CSIRO literature on rabbit control;
- consultation with weed and vermin control professionals; and
- organisational management.

1.4 THIS REPORT

This report contains three major sections:

- introduction;
- site analysis; and
- management plan.

The site analysis and the management plan form the bulk of this report.

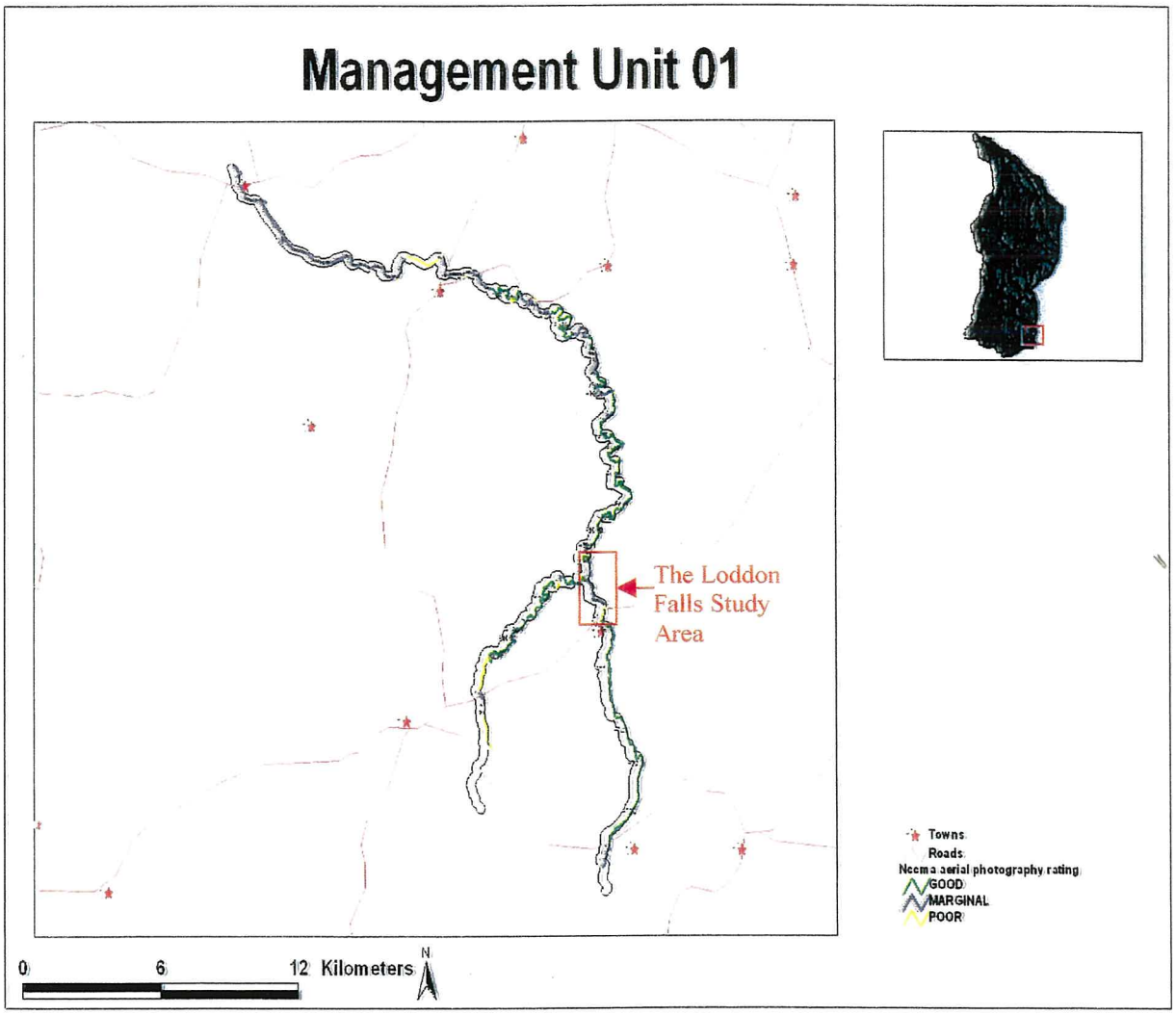
The site analysis consists of the following elements:

- background;
- site assessment;
- values and threats; and
- management issues.

The management plan consists of the following elements:

- the approach;
- integrated restoration management principles;
- division of responsibilities;
- weed management;
- regeneration management;
- recommended management actions; and
- the recommended management actions over time.

Figure 1: Context map showing the study area within the Loddon catchment.



Source: The Loddon Riparian Vegetation Investigation: GIS, (2000).

2 SITE ANALYSIS

2.1 BACKGROUND

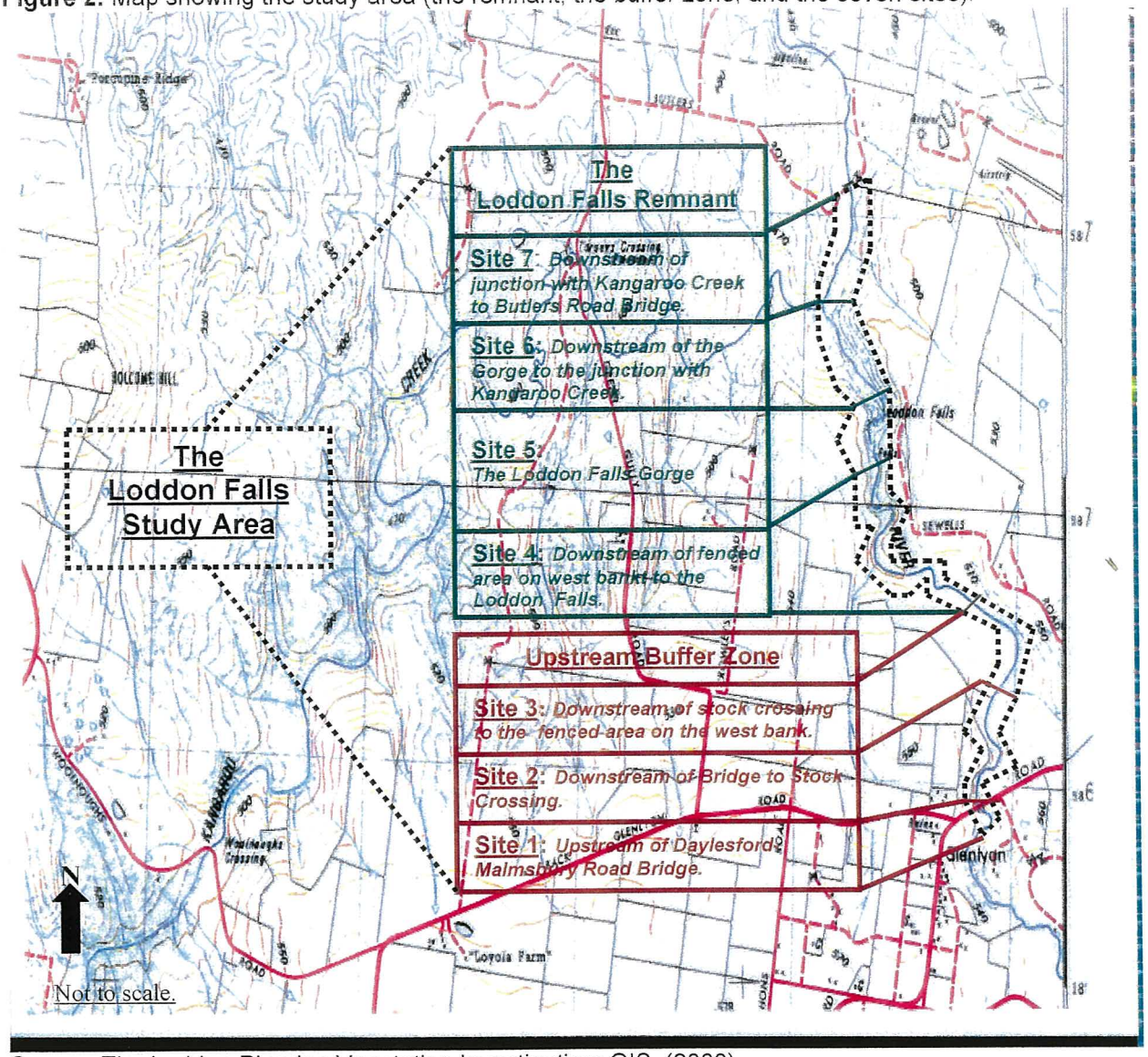
The Loddon Falls is located on the upper reaches of the Loddon River near Daylesford approximately 2 kilometers north of Glenlyon. The Loddon Falls remnant is located on public land managed by Parks Victoria. The adjacent land is predominantly used for sheep and cattle grazing. Access to the site is via Sewells Road that services the adjacent grazing property and culminates in a dead end isolating the site from extensive public traffic (refer to Figure 2).

The geological significance of Loddon Falls is derived from the volcanic lava flows that created the gorge. As the volcanic lava cooled and solidified shrinkage occurred that resulted in basalt columns being formed similar to the well-known Organ Pipes located in the Organ Pipes National Park. The columns are unstable making the site unsafe for tourists. The gorge is approximately 50 metres wide and 30 metres deep, stock are not found in the gorge because the adjacent landholders fence above the gorge to prevent stock loss.

The Loddon Falls remnant is located within the gorge and extends for approximately 1.5 kilometers as shown in Figure 2. For the purposes of managing weeds it is necessary to extend the study area further upstream to combat the spread of invasive weeds flowing downstream (Buffer Zone shown in Figure 2). Therefore, the Loddon Falls study area runs for approximately 2.5 kilometers along the Loddon River from just upstream of the Daylesford-Malmsbury Road Crossing (1.5 kilometer upstream of the falls) down to the Butlers Road Bridge (1 kilometer downstream of the Falls).

The study area was traversed by foot and was divided into seven sites deemed suitable by biogeographical and man made features. These sites are shown in Figure 2. The Loddon Falls remnant that is the focus of this report is located in Sites 4, 5, 6 and 7. Sites 1, 2 and 3 form the Buffer Zone. The observations during field assessment are documented for each of these sites in the following section of this report. This provides a clear understanding of the site conditions throughout the study area and provides a sound basis for the identification of the values, threats, and management issues. The site assessment is a snapshot in time of the conditions within the study area that provides a reference for monitoring changes.

Figure 2: Map showing the study area (the remnant, the buffer zone, and the seven sites).



Source: The Loddon Riparian Vegetation Investigation: GIS, (2000).

2.2 SITE ASSESSMENT

2.2.1 Site 1: Upstream Of The Daylesford-Malmsbury Road Bridge

Site Description

Site 1 is located adjacent to the town of Glenlyon and is bordered by Loddon Drive (Gravel Road), the fencing of adjacent properties, and the Daylesford-Malmsbury Road Bridge. The site is heavily influenced by the disturbance of the bridge. The river is very narrow at this point (2 metres) and is bordered by steep slopes with sparse natives established in the overstorey (plus 2 Radiata Pine) and a dense infestation of Broom in the understorey (over 20 metres wide). Two mature Hawthorn trees are located near the edge of the river close to the bridge. Little regeneration of natives is evident. Blackberry is present along the roadside managed by the council and in adjacent land. There is no evidence of weed control.

Table 1: Site 1 Plant List

Botanical Name	**Common Name**
Natives:	
Eucalyptus viminalis	Manna Gum
Acacia dealbata	Silver Wattle
Acacia melanoxylon	Blackwood
Pteridium esculentum	Austral Bracken
Ozothamnus rosmarinifolia	Rosemary Everlasting
Weeds:	
Cytisus scoparius	Broom
Rubus fruticosus	Blackberry
Ulex europaeus	Gorse
Crataegus monogyna	Hawthorn
Rosa rubiginosa	Sweet Briar
Lonicera japonica	Japanese Honey suckle
Pinus radiata	Radiata Pine

Plate 1: View looking west down into Site 1 from Loddon Drive. Broom dominates the understorey.

2.2.2 Site 2: Downstream Of Daylesford-Malmsbury Road Bridge To Stock Crossing On West Bank

Site Description

Downstream of the bridge the conditions change significantly due to grazing pressure from sheep. The width of vegetation narrows to 3-4 metres where the river remains 2 metres wide. A very sparse overstorey of Manna Gums is present with Water Ribbons located instream. The bank vegetation is dominated by a thick stand of Blackberry along the west bank and a thick stand of Gorse on the east bank. Very little Broom is present in comparison to Site 1. A small number of young Hawthorns are found established on small rocky outcrops located instream.

As the river widens (to approx. 4-5 metres) and the slope and height of the bank increases, large rocky outcrops provide the conditions for River Bottle Brush and Blackwood to persist on islands within the river. Rushes are also evident along the creek line with Kangaroo Grass and Tussock

Grass present higher on the bank. Very few large trees are located along this section of the river. Gorse and Blackberry are rife on both the grazed east bank and the fenced west bank, thistles are also common along the upper section of the bank. There is some evidence of the Gorse being sprayed and burnt in patches along both banks. As the slope of the bank flattens out a stock crossing can be found where there is a break in the fencing along the west bank. Stock tracks are evident along the length of the river on the east bank.

Table 2: Site 2 Plant List

Botanical Name	**Common Name**
Natives:	
Eucalyptus viminalis	Manna Gum
Acacia dealbata	Silver Wattle
Acacia melanoxylon	Blackwood
Triglochin procerum	Water ribbons
Bursaria spinosa	Sweet Bursaria
Callistemon sieberi	River Bottlebrush
Pteridium esculentum	Austral Bracken
Themeda triandra	Kangaroo grass
Poa spp	Tussock Grass
Carex spp	Sedge
Juncus spp	Rush
Weeds:	
Cytisus scoparius	Broom
Crataegus monogyna	Hawthorn
Rubus fruticosus	Blackberry
Ulex europaeus	Gorse
Rosa rubiginosa	Sweet Briar
Silybum marianum	Variegated Thistle

2.2.3 Site 3: Downstream Of Stock Crossing To Fenced Area On West Bank.

Site Description

Along this section of the river the bank height is approximately ½ a metre and the width is approximately 2.5 metres. Mature Manna Gums and large Blackwoods form an overstorey that is patchy but relatively dense compared to Site 2. River Bottlebrush, Rushes and Tussock Grasses are found along the edge of the river. The fencing along the west bank is much further back from the river in this area and there is evidence of sheep grazing up to the river on both sides. Gorse has taken over as the dominant middlestorey species with stands being over a metre thick and 1.5 metres high. Blackberry is found intertwined amongst the Gorse.

As the river bends to the west 200 metres north of the stock crossing an abundance of Water Ribbons are found instream. At this point the river runs adjacent to a piece of remnant vegetation located on the steep hillside on the east side of the river. Very large Blackwood and Manna Gums typify the overstorey vegetation with large River Bottlebrush and Sweet Bursaria in the middlestorey lining the creek. Rushes also line the river and Water Ribbon is common instream. Weeds are also prevalent, Common Elders are present along the east bank and a very thick stand of Gorse (3 metres wide and 2 metres high) is located along the west bank. A Black Wallaby (*Wallabia bicolor*) was seen in the stand of remnant vegetation on the east bank and birds were heard inhabiting the thick stands of Gorse on the west bank.

Table 3: Site 3 Plant List

Botanical Name	Common Name
Natives:	
Eucalyptus viminalis	Manna Gum
Acacia melanoxylon	Blackwood
Triglochin procerum	Water Ribbons
Bursaria spinosa	Sweet Bursaria
Callistemon sieberi	River Bottlebrush
Pteridium esculentum	Austral Bracken
Themeda triandra	Kangaroo grass
Juncus spp	Rush
Weeds:	
Cytisus scoparius	Broom
Rubus fruticosus	Blackberry
Ulex europaeus	Gorse
Sambucus nigra	Common Elder
Crataegus monogyna	Hawthorn

2.2.4 Site 4: Downstream Of Fenced Area On West Bank To The Loddon Falls.

Site Description

Fencing located on the west bank located approximately 10 metres from the rivers edge indicates that a different management regime is being used at this site. Gorse has been controlled allowing Tussock Grasses and Rushes to flourish, particularly on the west bank. The width of the river is approximately 2 metres wide along this section. Large Rosemary Everlasting, River Bottlebrush, and Blackwood line the river with occasional Manna Gum (shown in Plate 2). A large individual Swamp Gum and an individual Tree Violet are also present. Three mature Weeping Willows are situated near the pump house on the east bank. Hawthorns and a few Common Elders are also found along this section of the river.

As the river widens and begins to descend into the gorge the rocky banks become much higher and steeper. Fencing is present along both banks to prevent stock loss in the gorge. One large Pussy Willow is located down at the rivers edge. Patches of Gorse and larger clumps of Blackberry are present low on the bank (shown in Plate 3). Large numbers of Bursaria, Tree Violet and Correa are located on the upper section of the bank. Blackwood, Silver Wattle, and Callistemon are found near the bottom of the bank. A few large Manna Gums are found higher on the bank.

Plate 2: Conditions in Site 4 upstream of the gorge looking upstream (south-west) from Sewells Road. Gorse can be seen in flower lying adjacent to fencing located on the west bank.

Plate 3: Conditions in Site 4 within the gorge looking upstream. Note the Blackberry infesting the bank and spreading up the adjacent steep slopes.

Table 4: Site 4 Plant List

Botanical Name	**Common Name**
Natives:	
Eucalyptus viminalis	Manna Gum
Acacia melanoxylon	Blackwood
Triglochin procerum	Water ribbons
Bursaria spinosa	Sweet Bursaria
Callistemon sieberi	River Bottlebrush
Ozothamnus rosmarinifolia	Rosemary Everlasting
Eucalyptus ovata	Swamp Gum
Hymenanthera dentata	Tree Violet
Acacia dealbata	Silver Wattle
Pteridium esculentum	Austral Bracken
Correa glabra	Rock Correa
Poa spp	Tussock Grass
Cyperus spp	Sedge
Juncus spp	Rush
Phragmites australis	Common Reed
Weeds:	
Salix babylonica	Weeping Willow
Salix cinerea	Pussy Willow
Rubus fruticosus	Blackberry
Sambucus nigra	Common Elder
Ulex europaeus	Gorse
Crataegus monogyna	Hawthorn

2.2.5 Site 5: The Loddon Falls Gorge.

Site Description

The river drops 20-30 metres into a narrow gorge approximately 50 metres wide. Basalt rock columns are a unique feature of the site. Blackberry infests the gorge and six Crack Willows are established with three being mature specimens. The Crack Willows are congregated around the large water hole at the base of the Loddon Falls. Four mature Common Elders are also present scattered across the base of the gorge and Blackberry is prevalent in the understorey vegetation. Gorse is present in small numbers. Large numbers of Blackwood, River Bottlebrush, and Tree Violet are also present in the Gorge, however no very large native trees are found until the gorge begins to recede.

Table 5: Site 5 Plant List

Botanical Name	**Common Name**
Natives:	
Acacia melanoxylon	Blackwood
Callistemon sieberi	River Bottlebrush
Hymenanthera dentata	Tree Violet
Pteridium esculentum	Austral Bracken
Leptospermum lanigerum	Wooly Tea Tree
Weeds:	
Salix fragilis	Crack Willow
Sambucus nigra	Common Elder
Ulex europaeus	Gorse
Rosa rubiginosa	Sweet Briar
Rubus fruticosus	Blackberry

Plate 4: The Loddon Falls are located in Site 5. The basalt rock colums that form the gorge are a unique feature. Large deciduous Crack Willows can be clearly seen.

Plate 5: Within the gorge there is an abundance of weeds and indigenous vegetation. Deciduous Common Elders can be seen clearly.

2.2.6 Site 6: Downstream Of The Loddon Falls Gorge To The Junction With Kangaroo Creek.

Site Description

This site displays a startling example of indigenous vegetation. A moderately sparse canopy of very large Manna Gums towers above steep sloping banks covered by a very dense blanket of Tussock Grasses and Austral Bracken. Large Blackwood, River Bottlebrush, and Tree Violet line the river, and Water Ribbons are located instream. This area displays rock spoil indicating a past history of gold mining in the area. Relatively small patches of Blackberry are found on the flatter sections close to the river. One large Crack Willow and one mature Common Elder are situated on the west bank of the river. A number of Black Wallabies (*Wallabia bicolor*) inhabit this site and many rabbits were observed in the paddock adjacent to the river on the west bank.

Table 6: Site 6 Plant List

Botanical Name	**Common Name**
Natives:	
Acacia melanoxylon	Blackwood
Callistemon sieberi	River Bottlebrush
Hymenanthera dentata	Tree Violet
Eucalyptus viminalis	Manna Gums
Triglochin procerum	Water Ribbon
Exocarpos cupressiformis	Cherry Ballart
Pteridium esculentum	Austral Bracken
Poa spp	Tussock Grass
Juncus spp	Rush
Weeds:	
Salix fragilis	Crack Willow
Sambucus nigra	Common Elder
Rubus fruticosus	Blackberry

Plate 6: View of Site 6 the most intact section of the Loddon Falls remnant. The shot is taken from the top of the gorge in Site 5 on the east side of the river looking north. The tall Manna Gums can be seen towering over Tussock Grasses on the rocky slopes. →

← Plate 7: This shot is taken from the top of the slopes in Site 6 on the east side of the river. The shot shows that the slopes are fairly steep but flatten out at the bottom near the river.

2.2.7 Site 7: Downstream Of The Junction With Kangaroo Creek To The Butlers Road Bridge.

Site Description

This site is also very picturesque displaying a moderately sparse canopy of very large Manna Gums that tower above steep sloping banks that are covered by a very dense blanket of Tussock Grasses and Austral Bracken. Silver Wattles, Large Backwoods and River Bottlebrush surround the large water hole. However, a number of Crack Willows are present near the rivers point of entry to the waterhole and the number increases near the point of exit from the waterhole. Approximately 32 mature Crack Willows are located in the next two hundred-metre section of the river at this site. Blackberry infests the bank after the river exits the water hole. Gorse is also present in small patches. A number of Black Wallabies (*Wallabia bicolor*) inhabit this site and many rabbits were observed. A large stand of bushland is located on the west side of the river.

Table 7: Site 7 Plant List

Botanical Name	**Common Name**
Natives:	
Acacia melanoxylon	Blackwood
Acacia dealbata	Silver Wattle
Callistemon sieberi	River Bottlebrush
Hymenanthera dentata	Tree Violet
Eucalyptus viminalis	Manna Gums
Triglochin procerum	Water Ribbon
Pteridium esculentum	Austral Bracken
Poa spp	Tussock Grass
Juncus spp	Rush
Weeds:	
Salix fragilis	Crack Willow
Ulex europaeus	Gorse
Rubus fruticosus	Blackberry

Plate 8: This shot is taken from the bottom of the sloping bank in Site 7 on the east side of the river. Manna Gums, Silver Wattles and Tussock Grasses can be seen growing on the flats adjacent to the river. Deciduous Willows can be seen lining the river in the background. A dense stand of bushland can be seen behind the Willows on the west side of the river.

Plate 9: Over 30 Crack Willows are found instream in Site 7. Blackberry is also abundant along the river bank severely detracting from the natural values of this site.

2.3 VALUES AND THREATS

2.3.1 Values

The values of the indigenous vegetation within the Loddon Falls remnant are the following (adapted from Bennet et al, 1998):

- Wildlife corridor (and potential link between State Forests);
- Ecological (energy input to the river and increased water quality);
- Riparian environment (biodiversity and habitat value);
- Stream morphology (erosion control); and
- Rare example of indigenous riparian vegetation.

The Loddon Falls remnant (Sites 4,5,6 and 7) is a rare example of established riparian vegetation that provides habitat for a significant number of native animals. It has the potential to be strengthened via the implementation of a long term management plan aimed at removing weeds to incrementally improve the conditions for the growth and regeneration of indigenous vegetation. This would ensure the remnants survival, improvement, and expansion that could one day see this fragment provide a valuable link between the two State Forests located upstream and downstream of the site. This link would provide a corridor for wildlife and ensure plant community regeneration downstream by providing a source of seed from indigenous vegetation.

The native vegetation present in the least degraded section of the Loddon Falls remnant (Sites 6 & 7) is typified by a Manna Gum (*Eucalyptus viminalis*) and Blackwood (*Acacia melanoxylon*) overstorey with River Bottlebrush (*Callistemon sieberi*) and Tree Violet (*Hymenanthera dentata*) in the middle storey and Tussock Grass (Poa spp), Rushes (Juncus spp) and Austral Bracken (*Pteridium esculentum*) present in the understorey with Water Ribbon (*Triglochin Procerum*) found instream.

Nineteen different indigenous species of flora were identified in the study area (listed in Table 8). The flora of the study area is dominated by these nineteen species, however, many more species would be identified with a more detailed botanical survey undertaken at a more favorable time of

the year for identification. Table 8 also shows the location of native vegetation by site. The most diversity was found in Site 4. This was a result of Site 4 encompassing both conditions above the gorge and conditions as the river entered the gorge. An individual Swamp Gum was only found in this site before the river entered the gorge and Rock Correa was also found only in Site 4 high on the steep rocky banks of the gorge. Manna Gum, Blackwood and Austral Bracken were present in all sites within the study area.

Table 8: List of native species identified in the study area

Botanical Name	Common Name	Site Location
Overstorey		
Eucalyptus viminalis	Manna Gums	1, 2, 3, 4, 5, 6, 7
Eucalyptus ovata	Swamp Gum	4
Acacia melanoxylon	Blackwood	1, 2, 3, 4, 5, 6, 7
Middle storey		
Acacia dealbata	Silver Wattle	1, 2, 4, 7
Bursaria spinosa	Sweet Bursaria	2, 3, 4
Callistemon sieberi	River Bottlebrush	2, 3, 4, 5, 6, 7
Correa glabra	Rock Correa	4
Exocarpos cupressiformis	Cherry Ballart	6
Hymenanthera dentata	Tree Violet	4, 5, 6, 7
Leptospermum lanigerum	Wooly Tea Tree	5
Ozothamnus rosmarinifolia	Rosemary Everlasting	1, 4
Understorey		
Carex spp	Sedge	2
Cyperus spp	Sedge	4
Juncus spp	Rush	2, 3, 4, 6, 7
Phragmites australis	Common Reed	4
Poa spp	Tussock Grass	2, 4, 6, 7
Pteridium esculentum	Austral Bracken	1, 2, 3, 4, 5, 6, 7
Themeda triandra	Kangaroo grass	3
Instream		
Triglochin procerum	Water Ribbon	2, 3, 4, 6, 7

Site 6 displays a rare example of intact riparian vegetation (including a few introduced species) with a moderately sparse canopy of very large Manna Gums towering above a very dense blanket of Poa grasses and Austral Bracken with large Blackwood, River Bottlebrush and Tree Violets lining the River. The prolific numbers of Black Wallabies (*Wallabia bicolor*), observed while visiting this site, indicates the high habitat value. A range of bird species were also observed inhabiting hollows of large eucalypts.

Sites 6 and 7 have the lowest diversity of weeds (3 species were observed), however, Site 7 had 32 Crack Willows, some Gorse and a solid infestation of Blackberry. In contrast Site 6 only had one Crack Willow, one Common Elder and only sparse clumps of Blackberry. The conditions displayed in Site 6 should be protected, enhanced, and expanded into Site 7 via management actions being undertaken. Sites 4 & 5 have a greater abundance of weeds but also display a significant amount of indigenous vegetation that should be protected and enhanced.

2.3.2 Threats

The two major threats to the values of the Loddon Falls remnant are:

- increasing abundance of weeds; and
- reduced regeneration of indigenous vegetation as a result of competition with weeds and grazing by rabbits and sheep.

The most significant threat to the values of the Loddon Falls remnant is the spread of woody weeds (Listed in Table 9).

Table 9: List of Woody Weeds Identified in the Study Area, Associated Threats and the Threat Rating.

Botanical Name	Common Name	Location: (Site Numbers)	Site Abundance: (Low, Medium & High)	Dispersal: (Means and Vector)	Limit to Distribution	Management Requirements: (One-off solution or Ongoing action)	Threat Rating: (Very Low, Low, Moderate, High & Very High)
Overstorey							
Salix fragilis	Crack Willow	5,6 & 7	5: Low 6: Low 7: High	Vegetative/Water	Riparian Zone	One-off solution	Medium/High
Salix babylonica	Weeping Willow	4	4: Low	Vegetative/Water	Riparian Zone	One-off solution	Low
Salix cinerea	Pussy Willow	4	4: Low	Vegetative/Water	Riparian Zone	One-off solution	Low
Pinus radiata	Radiata Pine	1	1: Low	Seed/Water&Wind	None	One-off solution	Very Low
Understorey							
Rubus fruticosus	Blackberry	1,2,3,4,5,6 & 7	1: Medium 2: High 3: Medium 4: Medium 5: High 6: Low 7: Medium/High	Seed/ Water Bird (internal) Foxes	None	Ongoing action	Very High
Ulex europaeus	Gorse	2,3,4,5 & 7	2: High 3: High 4: Medium 5: Low 7: Low	Seed/ Water Bird (internal) Explosive Pod	None	Ongoing action	High
Sambucus nigra	Common Elder	3,4,5 & 6	3: Low 4: Low 5: Low 6: Low	Seed/ Water Bird (internal)	Riparian Zone	One-off solution	Moderate
Crataegus monogyna	Hawthorn	1,2,3 & 4	1: Low 2: Low 3: Low 4: Low	Seed/ Water Bird (internal)	Riparian Zone	One-off solution	Moderate
Cytisus scoparius	Broom	1,2 & 3	1: High 2: Low 3: Low	Seed/ Water Explosive Pod	None	Ongoing action	Moderate
Rosa rubiginosa	Sweet Briar	1,2 & 5	1: Low 2: Low 5: Low	Seed/ Water Bird (internal)	None	One-off solution	Low

Pasture grasses are significant weeds in the sites above the remnant (Sites 1,2 and 3), where grazing has been able to encroach on the bank, but are not significant within the remnant. The 11 species of woody weeds observed, including the threat classifications are listed in Table 9.

Each of the weeds listed in Table 9 can adversely affect the riparian environment within the Loddon Falls remnant. For example as stated by Ladson *et al* (1997) the riparian environment can be adversely affected if weeds replace indigenous riparian species by:

- reduced biodiversity;
- reduced available habitat and food supply for indigenous flora; and
- reduced feeding and breeding opportunities for indigenous fauna.

The threat classifications of the weeds shown in Table 9 was determined by considering the abundance, the prevalence throughout the study area, the means of dispersal, the limits to distribution and the management requirements. Blackberry was the only weed to be found abundantly in all seven sites of the study area and poses the highest level immediate threat to the indigenous vegetation within the remnant. Gorse was found in five of the seven sites (absent in Sites 1 and 6, abundant in Sites 2,3 & 4, sparse in Sites 5 & 7). Although Gorse is only found in sparse patches within the Loddon Falls remnant it is abundant upstream and is steadily invading the site making it a high level threat.

Crack Willow was found in three sites (5,6 & 7) and abundant in one (Site 7). The abundance in Site 7 and its ability to reproduce by vegetative means make this species a moderate to high level threat to the values of the remnant (note: it would be considered a higher threat if management was not a one off procedure involving a drill and fill technique rather then spraying which is ongoing). Hawthorn was found in four sites and Common Elder and Sweet Briar were found in three sites but none of them were very abundant in any one site making them only a moderate threat. Broom was only found in two sites but was abundant in Site 1, therefore it is also only a moderate threat. The Weeping and Pussy Willows are found only in Site 4 in small numbers. As a result they are regarded as a low-level threat.

Within the Loddon Falls remnant itself (Sites 4,5,6 & 7) three weeds dominate, these are Crack Willow, Common Elder, and Blackberry. Over three quarters of the Crack Willows, observed in the Loddon Falls remnant are concentrated within a two hundred meter section in Site 7 severely affecting the riparian environment at this site. Blackberry has flourished in the damp, well shaded conditions within the gorge (Site 4 and 5) dominating the understorey, while Crack Willows have established around the edge of the main water hole immediately below the falls. Gorse is emerging as a greater threat presently infesting Site 4 and steadily spreading downstream.

Another threat to the riparian environment of the Loddon Falls Remnant is the impact of rabbits and sheep on the regeneration of indigenous vegetation. The fresh new growth of saplings is highly palatable and these animals will selectively eat it first before eating less attractive plant material resulting in very little regeneration of indigenous vegetation being observed in the study area. Some indigenous species may already be removed from the site due to persistant rabbit grazing.

Reduced regeneration of indigenous vegetation is also related to the extent of the weed problem that can have a two-fold impact. Weeds restrain regeneration of indigenous vegetation by direct competition for resources and also provide a harbor for vermin such as rabbits. Clumps of Blackberry located in land adjacent to Site 6 harbor a significant population of rabbits that would be grazing on any indigenous saplings that emerge within the remnant. As a result, regeneration of indigenous vegetation is reduced and as the presently existing vegetation steadily ages, the lack of regeneration will result in the loss of the environmental values associated with this remnant of indigenous vegetation.

If these threats are not managed this site will become infested by a small number of highly competitive weed species providing habitat for large numbers of rabbits. As a result it is clear that the threat of increasing weed abundance and reduced regeneration of indigenous vegetation

needs to be managed to ensure that the values displayed by this remnant of riparian vegetation are protected and enhanced.

2.4 MANAGEMENT ISSUES

To develop a management plan that will successfully increase the regeneration of indigenous vegetation and ensure that the values of this fragment of remnant riparian vegetation are protected and enhanced requires careful consideration of relevant management issues. These issues include the following:

- management constraints;
- biology, ecology and population dynamics of weeds and animals;
- methods of weed control; and
- methods of regeneration management.

2.4.1 Management Constraints

There are three primary factors that constrain the design and implementation of a management plan for the Loddon Falls remnant. They are:

- economic constraints;
- level of management effectiveness; and
- environmental conditions.

Other factors that influence the design and implementation of a management plan for the Loddon Falls remnant are species specific and will be discussed under separate headings in this report.

Economic constraints are determined by the budget allocated to implementation of management actions over time. The funds allocated restrict the extent of weed and vermin control that can be undertaken each year. Considering that there is a limited supply of funds available it is doubtful that the problems can all be managed effectively within a short timeframe even if it was biologically feasible.

Consistency and persistence over a period of years is required to protect and enhance this valuable remnant. Therefore criteria need to be used to prioritise the direction of funds towards the most appropriate actions in areas where the most valuable impact can be made.

The effectiveness and viability of management can help prioritise where to allocate funds. For example, willows can be very effectively controlled, via the injection of poison, throughout the study area due to the ease and efficiency of this technique. Therefore, the availability of effective and viable management may prioritise the control of willows.

However, it must be remembered that the aim is to enhance regeneration of indigenous vegetation not simply remove weeds. As a result it is crucial that environmental characteristics, such as the following, should also be considered along with effectiveness to prioritise where to direct management funds:

- the abundance and location of weed infestation;
- the abundance and location of indigenous flora;
- feeding and breeding opportunities for indigenous fauna;
- feeding and breeding opportunities for introduced fauna; and
- topography and soil properties.

The geological significance of the basalt columns that define the gorge in Sites 4 and 5 has a high aesthetic value. However, due to the columns instability and the restricted access to the site extensive control of weeds, particularly Blackberry, in these sites is very difficult. Therefore, the geological value and the high abundance of weeds act as significant constraints against management of vegetation within the gorge.

2.4.2 Biology, Ecology And Population Dynamics Of Weeds And Animals

The control of weeds must be done with careful consideration of the biology, ecology and also the population dynamics of the individual weed species. In particular the following needs to be appreciated:

- the role of weeds in providing habitat/and or food for indigenous fauna species;
- the role of weeds in providing habitat and/or food for vermin and stock;
- the role of weeds in providing erosion control;
- the weeds reproduction method and the length of survival in the soil of the seed bank; and
- removal succession.

Removal succession involves an appreciation of what species will regenerate once a particular weed is removed. For example the shade provided by Willows prevents the growth of many weeds below them. Upon removal of willows other weeds may simply takeover by outcompeting the regeneration of indigenous vegetation. Therefore, the control of Willows should be undertaken in such a way as to foster the regeneration of indigenous vegetation rather than other weed species.

To manage grazing and browsing on regeneration of indigenous vegetation the biology, ecology and population dynamics of the animals that are most abundant need to be considered. In particular the following needs to be considered:

- abundance;
- location; and
- feeding habits.

2.4.3 Methods Of Weed and Regeneration Management

Weed Management is focused on reducing the abundance and spread of introduced vegetation. Regeneration Management is focused on the control of grazing and browsing on regeneration of vegetation within the study area. It is not realistic to completely eradicate all the weeds and rabbits or desirable to exclude sheep and wallabies from the entire study area. The methods selected for control of weeds and rabbits and the exclusion of sheep must be aimed primarily at protecting and enhancing the indigenous vegetation within the remnant and not at complete eradication.

The chosen methods must be:

- effective (i.e. protect and enhance regeneration of indigenous vegetation within the remnant);
- viable (in terms of cost and environmental impact);
- feasible (in terms of topography, soil properties and landholders needs)
- strategic (in consideration of biology, ecology and population dynamics of weeds);
- integrated with other forms of management;
- monitored for effectiveness and suitability; and
- consistent and persistent over the long term.

3 THE LODDON FALLS VEGETATION MANAGEMENT PLAN

3.1 APPROACH

The primary aim of this vegetation management plan is to assist natural regeneration of indigenous riparian vegetation in order to protect and enhance the values of the Loddon Falls remnant. The aim is not to completely eradicate weeds or predation of regenerating indigenous vegetation. The approach required to achieve the primary aim is integrated restoration management involving the following actions:

- weed management;
- regeneration management; and
- regular monitoring and ongoing maintenance.

It should be noted that broad scale revegetation is not included due to the steep rocky conditions of the site making planting very difficult. Assisted natural regeneration of indigenous species is more likely to obtain the desired results with less expenditure of resources. Revegetation may be used in association with weed management in areas where large-scale weed removal is required and planting is feasible (ie. on the fertile flood plains and river flats in Sites 1,2,6 & 7).

For integrated restoration management to be successful it has to be applied:

- strategically;
- persistently; and
- consistently.

The structure of this management plan is divided into seven sections:

- division of responsibilities;
- integrated restoration management principles;
- weed management;
- regeneration management;
- the recommended management actions; and
- the recommendations over time.

3.2 DIVISION OF RESPONSIBILITIES

The division of responsibilities defines who is in charge of doing what, where. There are three major stakeholders who will be responsible for management;

- The North Central Catchment Management Authority (NCCMA);
- Parks Victoria; and
- Adjacent landholders

The process of developing effective management requires the adjacent landholders and the river managers (the NCCMA and Parks Victoria) to form a partnership agreement that determines how both parties should work together to achieve the same ends.

The Partnership Agreement is essential because it is the means by which river managers and landholders can attempt to pre-empt the potential conflicts that will arise in the management of ongoing impacts on streamside vegetation (Thexton, 1995). It gives both parties a degree of confidence that both will look after the interests of the other. For example, the landholder will attempt to control vermin and manage stock on adjacent farming land, and the river manager will attempt to keep weeds out of the streamside vegetation (Thexton, 1995).

The NCCMA will coordinate management with the other stakeholders, ensuring an integrated program. Management responsibilities for the riparian zone (bed and bank) lie with the NCCMA, the publicly owned steep slopes (within the remnant) with Parks Victoria and the grazing land with the private landholders. The NCCMA and Parks Victoria will work closely with adjacent landholders to provide extension on vermin control, and stock and weed management.

3.3 INTEGRATED RESTORATION MANAGEMENT PRINCIPLES

The aim of integrated restoration management (as adapted from Buchanan, 1989) is to:

- assist in the restoration of a disturbed and diminished natural ecosystem;
- establish partnership agreements between stakeholders;
- undertake weed control and regeneration management to facilitate natural regeneration of indigenous vegetation within the Loddon Falls remnant (Site 4, 5, 6 & 7);
- ensure that the removal of one weed does not lead to its replacement by another;
- ensure that regeneration management enhances natural regeneration of indigenous vegetation and not weed regeneration; and
- to use techniques that reinforce each other to protect and enhance the regeneration of indigenous vegetation within the Loddon Falls remnant (integrate weed and regeneration management).

Integrated weed management aims to:

- effectively contain the spread of weeds;
- manage the environment to prevent the introduction of new weeds;
- rehabilitate the disturbed ecosystem as far as possible by promoting conditions for regeneration of indigenous vegetation (assisted regeneration);
- remove weeds in consideration of habitat value for indigenous fauna;
- remove harbor for rabbits; and
- undertake primary weed clearance, secondary treatment, and maintain weed control.

Integrated regeneration management aims to:

- Reduce the rabbit population within the remnant;
- Reduce the impact of Wallaby browsing within the remnant;
- Exclude stock from the remnant; and
- Utilise stock grazing upstream (Sites 1,2 & 3) to reduce the spread of weeds downstream into the remnant.

Regeneration management and weed management must be integrated. For example, to provide enhanced regeneration of indigenous vegetation in Site 6 the rabbits need to be controlled prior to weed removal. Weeds in turn should be removed to allow regeneration of indigenous vegetation and to reduce harbor available for rabbits. Conversely, grazing by stock should be utilised in Sites 2 & 3 to reduce regeneration of weeds that could spread into the remnant.

The Loddon Falls Management Plan recognises the Bradley method (Buchanan, 1989), which states:

- Work from minimally disturbed sites in towards the most weed-infested areas;
- Minimise disturbance to the soil; and
- Allow the rate of native plant regeneration to dictate the rate of weed removal.

As discussed earlier there are three primary factors that constrain the design and implementation of a management plan for the Loddon Falls remnant, namely:

- the economic constraints;
- the level of management effectiveness; and
- the environmental conditions.

The Bradley method is focused on disturbance levels associated with the environmental conditions. The Loddon Falls remnant is disturbed by weeds, vermin and by natural processes (e.g. floods) and it is also depleted in extent and is most likely depleted in terms of indigenous diversity. It is therefore, highly disturbed as a whole making disturbance levels inadequate as a sole determinant for setting management priorities. The economic constraints, the topography, and the level of management effectiveness all need to be carefully considered in this case, not just the disturbance levels associated with weed abundance. For example the topographical conditions, that restrict access, also influence the setting of management priorities.

Management should be aimed initially at areas where the environment is least disturbed and the geography is most conducive to the implementation of management actions that will efficiently and effectively enhance regeneration of indigenous vegetation.

For example, Site 6 displays good conditions with a dominance of indigenous vegetation that is threatened by the spread of presently sparse clumps of Blackberry harboring rabbits. Site 6 is also fairly flat on the west side of the river making access for efficient herbicide application convenient. Therefore, Site 6 is highly conducive to efficient and effective management of Blackberry.

In contrast Site 5 has a very heavy infestation of Blackberry and is located within the gorge entwined in a matrix of species (indigenous and introduced) making the implementation of management that will enhance regeneration of indigenous vegetation more difficult. As a result control of Blackberry would be undertaken in Site 6 before it would be attempted in Site 5.

The recommendations for management in this report are adaptive low level management actions to be conducted over a long time period rather than an intense project orientated plan. This plan relies on the promotion of regeneration for indigenous species but has the capacity to be adapted based on observations to include planting in locations where regeneration fails. Initial management actions should be conducted over a period of 3-4 years. Consistent and persistent monitoring and maintenance over many years is required to effectively adapt and implement management actions to protect and enhance the values of the Loddon Falls remnant in the long-term.

In summary the Loddon Falls Management Plan will follow these principles:

- Protect and enhance the remnant (Sites 4, 5, 6 & 7);
- Contain weeds in the Buffer Zone (Sites 1,2 & 3);
- Establish partnership agreements between stakeholders;
- Work from minimally disturbed sites in towards the most weed-infested areas;
- Work from areas where management effectiveness is most efficient towards areas where management effectiveness is least efficient.
- Minimise disturbance to the soil;
- Use revegetation as a tool in weed control rather then just a desired end point;
- Ensure strategic integration of weed management and regeneration management;
- Maintenance should be implemented consistently and persistently over the long term; and
- Monitoring of the effectiveness of management actions should be undertaken regularly and changes to the plan should be made accordingly.

3.4 WEED MANAGEMENT

From site assessments the following woody weeds are classified as threats (detailed in Table 9) to the values of the Loddon Falls remnant (Note: the two mature Radiata Pines located in Site 1 are considered a very low threat to the remnant and do not require management);

Overstorey:

- Crack Willow (*Salix fragilis*)
- Pussy Willow (*Salix cinerea*)
- Weeping Willow (*Salix babylonica*)

Middlestorey:

- Common Elder (*Sambucus nigra*)
- Hawthorn (*Crataegus monogyna*)
- Gorse (*Ulex europaeus*)
- Broom (*Cytisus scoparius*)
- Blackberry (*Rubus fruticosus*)
- Sweet Briar (*Rosa rubiginosa*)

The woody weeds identified in the study area threaten the riparian environment of the Loddon Falls remnant by:

- reducing diversity;
- reducing available habitat and food supply for indigenous flora; and
- reducing feeding and breeding opportunities for indigenous fauna (Ladson et al, 1997).

Species specific sections (located in Appendix 1) outline for each of these species the following;

- distribution of the weed in the study area;
- classification of the threat posed by the weed;
- description of the floristic characteristics;
- means of dispersal;
- means of control; and
- general comments on the biology, ecology, and population dynamics of the weeds relating to management.

It should be noted that the focus of weed management is directed toward woody weeds and not pasture grasses. However, on well-watered sites such as the flats in Site 7 grasses are powerful competitors that can prevent regeneration. Management regimes would be required to deal with the threat posed by grasses such as Canary Grass (*Phalaris paradoxa*), Paspalum (*Paspalum dilatatum*), and Chilean Spear Grass (*Nassella hyalina*).

The close proximity to houses and the township of Glenlyon exposes this site to bird spread garden weeds such as English Ivy (Hedera helix) and Firethorn (Pyracantha angustifolia) and highly mobile grass species such as those listed above. The abiltiy to recognise and manage these and a diversity of other weeds in the early stages of introduction and establishment requires consistent monitoring and ongoing maintenance.

3.4.1 Methods Of Weed Control

The methods selected for control must be:

- effective (i.e. protect and enhance regeneration of indigenous vegetation within the remnant);
- viable (in terms of cost and environmental impact);
- feasible (in terms of topography, soil properties and landholders needs);
- strategic (in consideration of biology, ecology and population dynamics of weeds);
- integrated with regeneration management;
- monitored for effectiveness; and
- followed by consistent and persistent maintenance over the long term.

There are six methods of weed control that are suggested for primary control. Where a range of methods can be used selection is dependent on the location, practicality, the mix of vegetation and the proximity to vegetation and the waterway. The six methods are listed below accompanied by the controlling agent and the weeds that they control. The final decision on which method will be used will be made in the field but a description is provided here for where they are best suited.

1: High Volume Spraying (Chemicals: Garlon 600 and Roundup Biactive)

- Blackberry (*Rubus fruticosus*)
- Gorse (*Ulex europaeus*)
- Broom (*Cytisus scoparius*)

This method should be used in areas of very high weed infestation where there is little native vegetation. Garlon 600 should not be used unless Roundup Biactive is proven ineffective. This method is delivered by vehicle (4WD tractor or 4WD motorbike), therefore, is only suitable in accessible areas.

High volume spraying is suitable for use in the buffer zone (particularly Sites 1 & 2).

2: Low Volume Knapsack Spraying (Chemicals: Garlon 600 and Roundup Biactive)
- Blackberry (*Rubus fruticosus*)
- Gorse (*Ulex europaeus*)

This method should be used in areas where there is a low weed infestation and where there is a mix of indigenous vegetation. This method is more target specific allowing the use of Garlon 600 in areas greater then 10 meters from the waterway. This method is delivered by knapsack, which allows access to steep rocky areas such as the gorge.

Low volume knapsack spraying is suitable for use in the remnant (Sites 4, 5, 6 & 7).

3: Drill and Fill (Chemical: Roundup Biactive)
- Crack Willow (*Salix fragilis*)
- Common Elder (*Sambucus nigra*)
- Weeping Willow (*Salix babylonica*)
- Pussy Willow (*Salix cinerea*)

This method should be used on large trees that cannot be controlled efficiently by spraying. It can be used to selectively kill limbs allowing light penetration. This method is target specific allowing it to be used amongst native vegetation and near the waterway. This method is delivered via a syringe into a hole or cut that penetrates the cambium layer but is not too deep.

This method is suitable for use within the remnant and is efficient enough to allow large numbers of trees to be controlled quickly.

4: Cut and Paint Stump (Chemical: Garlon 600)
- Blackberry (*Rubus fruticosus*)
- Gorse (*Ulex europaeus*)
- Crack Willow Saplings (*Salix fragilis*)
- Common Elder Saplings (*Sambucus nigra*)
- Rose Briar (*Rosa rubiginosa*)
- Hawthorn (*Crataegus monogyna*)
- Broom (*Cytisus scoparius*)
- Weeping Willow Saplings (*Salix babylonica*)

This method should be used on regrowth and isolated shrubs. This method is target specific allowing it to be used amongst native vegetation and near the waterway. This method requires the stem of the plant to be cut-off completely and the chemical to be applied minutes after to ensure control.

Therefore, this method is particularly suitable for control of shrubs and saplings (up to 1 metre) within the remnant and upstream in the buffer zone.

5: Biological Control (Spider Mite: *Tetranychus lintearius Dufour*)
- Gorse (*Ulex europaeus*)

This method is very effective when integrated with other forms of control. The spider mites can be obtained from the Department of Natural Resources and Environment and could be bred by biology students attending local schools.

The spider mite should be released into the site once chemical control has been undertaken and regrowth is emerging.

6: Grazing (Sheep)
- Gorse (*Ulex europaeus*)
- Broom (*Cytisus scoparius*)

Sheep are a very effective means of weed control, however, they also eat native vegetation and degrade the waterway. Stock can also be lost by injuring themselves in the riparian zone.

Therefore, stock should be excluded from the remnant and used strategically upstream to contain the spread of weeds.

Secondary methods of control are also suggested for areas where there are insufficient indigenous propagules present in the soil to promote natural regeneration. Secondary methods include:

- Revegetation (using pre grown seedlings grown from indigenous seed); and
- Mulching (to suppress weeds and hold moisture for emerging indigenous plants).

3.4.2 Weed Management Principles

The following is a list of important points relating to weed management in the study area;

- Control of weeds within the remnant (Sites 4, 5, 6 & 7) is the priority;
- Containment of weeds rather then control is the aim in the buffer zone (Sites 1, 2 & 3);
- Establishment of partnership agreements between stakeholders is crucial;
- Assessment of the vegetation along Kangaroo Creek is required to protect the remnant from further weed invasion;
- Work from minimally disturbed sites in towards the most weed-infested areas;
- Work from areas where management effectiveness is most efficient towards areas where management effectiveness is least efficient;
- Undertake primary weed clearance, secondary treatment and maintenance weeding;
- Undertake regular monitoring;
- Works should minimise disturbance to the soil;
- Use revegetation as a tool in weed control rather then just a desired end point;
- Grazing can only be utilised to control weeds in the buffer zone;
- The species specific sections located in Appendix 1 provide comprehensive information that should be read carefully before undertaking any control actions;
- Waterway contamination is to be avoided at all times;
- Chemicals should be sprayed away from the waterway, not towards it;
- Spray drift and soil saturation should be minimised;
- Target specific methods of application are preferred;
- Roundup Biactive is the only chemical to be sprayed near the waterway;
- Garlon 600 may only be sprayed a distance greater than 10 meters away from the waterway and actions must be taken to prevent soil saturation and spray drift to ensure that no contamination occurs;
- Chemicals should be used in accordance with the label specifications;
- Chemical herbicides should only be applied by licensed and skilled personnel who are also skilled in plant identification at all stages of growth; and
- The Department of Natural Resources and Environment should be contacted to initiate the biological control of the Gorse Spider Mite program.

The following list ranks the weed management actions in order of priority and indicates the order in which the sites should be attended. The list indicates what control should be done first (1) and what should be done last (19) including the location and the methods in order of priority.

- Note 1: This list is in order of priority according to threat, indicating where to direct available funds. However, it is not fixed. Conditions (weather and topography), convenience (location and control method duplication) may alter the order of works (e.g. Step 1, 2 & 3 may be undertaken concurrently because the same methods can be used in the same areas, all cut and paint control procedures may be undertaken in Site 7 and Site 6 prior to Willow injection,

or windy conditions may prevent spraying but allow other methods to be undertaken first contrary to this list).

- Note 2: Monitoring of control effectiveness and new and emerging weeds is a critical aspect of weed management. This will allow management to be undertaken to ensure that weeds are controlled.
- Note3: Grazing of Broom and Gorse regrowth by sheep is discussed in Section 3.5.2 of this report.

3.4.3 Weed Management Priority Recommendations

1. Establish partnership agreements with stakeholders and provide extension where necessary.
2. Undertake Vegetation assessment along Kangaroo Creek (1 km upstream).
3. Cut and Paint Blackberry (Site 6).
4. Spray Blackberry, Low Volume (Site 7, Site 5, Site 4).
5. Cut and Paint Gorse & Spray Gorse, Low Volume (Site 7, Site 5, Site 4).
6. Reduce Willow coverage by injection of limbs to encourage native regeneration in Site 5 & 7 Note: Revegetation using indigenous seed may be required under Willows in Sites 5 & 7.
7. Injection of Crack Willow trunk to provide complete control once native regeneration is established (Site 6, Site 5, Site 7).
8. Cut and Paint Crack Willow saplings (Site 6, Site 5, Site 7).
9. Injection of Common Elder (Site 6, Site 5, Site 4, Site 3).
10. Cut and Paint Common Elder saplings (Site 6, Site 5, Site 4, Site 3).
11. Spray Blackberry, (Low Volume: Site 3, High Volume: Site 1& Site 2).
12. Spray Gorse (Low Volume: Site 3, High Volume: Site 2).
13. Release Gorse Spider Mite into Study Area.
14. Cut and Paint Briar Rose (Site 5, Site 2, Site 1).
15. Cut and Paint Hawthorn (Site 4, Site 3, Site 2, Site 1).
16. Cut and Paint Broom (Site 2).
17. Spray Broom (High Volume: Site 1).
18. Injection of Weeping Willow (Site 4).
19. Injection of Pussy Willow (Site 4).

- Ongoing monitoring (every 6 months) and maintenance over the long term.

Table 10 summarises the information contained in Appendix 1. This table provides a concise overview of which weeds need to be controlled in order of threat, where they need to be controlled first and what techniques should be used in a given situation. The techniques being used are also listed accompanied by the weeds they will target.

The chemical herbicides and associated directions for use (shown in Table 10 and Appendix 1) are drawn from the Australian Weed Control Handbook (Parsons, 1992).

Table 10: Weed Control Specifications

Weed	Threat	Target Locations	Control Details	Control Comments
Blackberry : (*Rubus fruticosus*)	Very High	Sites 6, 7, 5, 4, 3, 2 & 1.	Technique: High Volume /Low Volume Spraying. Chemical: Glyphosate (Roundup Biactive: 150-200mL/15L water) Technique: High Volume /Low Volume Spraying. Chemical: Triclopyr (Garlon 600:25mL/15L water) Technique: Cut & Paint Stump. Chemical: Garlon 600: 1L/30L diesel distillate solution.	Present in every site. Remove from least abundant areas to most abundant. Priority is given to Site 6 because it has the lowest numbers (cut and paint). High volume spraying in Site 1, 2 & 3. Low volume spraying in Sites 4, 5 & 7. Respraying, mulching or revegetation may be required in some areas where weeds re-emerge to combat regrowth.
Gorse: (*Ulex europaeus*)	High	Sites: 7, 5, 4, 3 & 2.	Technique: High Volume /Low Volume Spraying. Chemical: Glyphosate (Roundup Biactive: 150-200mL/15L water) Technique: High Volume /Low Volume Spraying. Chemical: Triclopyr (Garlon 600: 25-50mL/15L water) Technique: Cut & Paint Stump. Chemical: Garlon 600: 1L/30L diesel distillate solution. Biological Control with the Spider Mite: *Tetranychus lintearius Dufour.*	Abundance is low in Sites 4, 5 & 7. Control is of high priority within the remnant while abundance is still low. Use the cut and paint technique within the remnant where bushes are smaller and isolated. Use high volume spraying in Sites 2 & 3 to control the large stands of gorse. Allow grazing after spraying in Sites 2 & 3 to control seedlings. Release mite after physical control. Encourage local schools to breed the spider mite.

Table 10: Cont'd

Weed	Threat	Target Locations	Control Details	Control Comments
Crack Willow: (*Salix fragilis*)	Moderate/ High	Sites: 6, 5 & 7.	Trees: Technique: Drill and Fill. Chemical: Chemical: apply Roundup Biactive (0-25 cm basal diameter: undiluted 1 ml/cut and for 25-60 cm basal diameter: undiluted 2 ml/cut). Regrowth: Technique: Cut and paint stump Chemical: Roundup Biactive (0-10 cm basal diameter 1:15 roundup to water and 0-30 cm basal diameter 1:1 roundup to water).	High infestation in Site 7 will require gradual control to allow regeneration or revegetation concurrent to control. Individual limbs will need to be injected and killed to allow light penetration. Germination should be monitored. Some planting may also be undertaken to ensure weeds do not succeed removal. Blackberry will need to be controlled concurrently.
Common Elder (*Sambucus nigra*)	Moderate	Sites: 6, 5, 4 & 3.	Trees: Technique: Drill and Fill. Chemical: Chemical: apply Roundup Biactive (0-25 cm basal diameter: undiluted 1 ml/cut and for 25-60 cm basal diameter: undiluted 2 ml/cut). Regrowth: Technique: Cut and paint stump. Chemical: Roundup Biactive (0-10 cm basal diameter 1:15 roundup to water and 0-30 cm basal diameter 1:1 roundup to water).	Sambucus can be removed with ease from Sites 3 and 6. The gorge conditions in Sites 4 and 5 make control harder. However, the small numbers and the techniques being used make control feasible.
Hawthorn (*Crataegus monogyna*)	Moderate	Sites: 4, 3, 2 & 1.	Technique: Cut and paint stump. Chemical: Garlon 600: 1L/30L diesel	Control of individuals in Sites 3 & 4 will prevent further spread into the remnant.
Broom (*Cytisus scoparius*)	Moderate/ Low	Site 3, 2 & 1.	Technique: High Volume Knapsack Spraying. Chemical: Garlon 600: 25mL /15L of water Technique: Cut and paint stump. Chemical: Garlon 600: 1L/48L diesel Technique: Sheep Grazing	Highly invasive weed that has a high potential to spread. Grazing in Sites 2 & 3 are presently controlling this spread. Grazing is a cheap way to control Broom within the study area. Therefore, direct control of the infestation in Site 1 is a low priority unless grazing is removed from Sites 2 & 3.

Table 10: Cont'd

Weed	Threat	Target Locations	Control Details	Control Comments
Briar Rose (*Rosa rubiginosa*)	Low	Sites: 5, 2 & 1.	Technique: Cut and paint stump. Chemical: Garlon 600: 1L/30L diesel distillate solution.	Should be controlled in Site 5 while there are only very few present. Control of this species is a low priority.
Weeping Willow (*Salix babylonica*)	Low	Site 4	Trees: Technique: Drill and Fill. Chemical: Chemical: apply Roundup Biactive (0-25 cm basal diameter: undiluted 1 ml/cut and for 25-60 cm basal diameter: undiluted 2 ml/cut). Regrowth: Technique: Cut and paint stump Chemical: Roundup Biactive (0-10 cm basal diameter 1:15 roundup to water and 0-30 cm basal diameter 1:1 roundup to water).	Removal of the three individual trees will prevent any spread into the remnant. Due to the small number and the location this could be achieved with little effort. Only a few seedlings would require subsequent treatment (cut and paint).
Pussy Willow (*Salix cinerea*)	Low	Site 4	Trees: Technique: Drill and Fill. Chemical: Chemical: apply Roundup Biactive (0-25 cm basal diameter: undiluted 1 ml/cut and for 25-60 cm basal diameter: undiluted 2 ml/cut). Regrowth: Technique: Cut and paint stump Chemical: Roundup Biactive (0-10 cm basal diameter 1:15 roundup to water and 0-30 cm basal diameter 1:1 roundup to water).	The individual Pussy Willow located within the Gorge in Site 4 is not easy to access. However, since there is only one individual the threat could be eradicated with little expenditure of resources.

3.5 REGENERATION MANAGEMENT

From site assessment it is evident that there is very little regeneration of indigenous vegetation. Even in the sites with few weeds (e.g. Site 6) very few seedlings of indigenous tree and shrub species were observed. This indicates that weeds are out competing indigenous vegetation in many areas and that very few indigenous tree and shrub species are able to regenerate due to grazing and browsing by animals present in the study area. As a result direct regeneration management is required.

Regeneration management is focused on the control of grazing and browsing on regeneration of vegetation within the study area and is integrated with weed management. The methods selected for regeneration management are aimed primarily at protecting and enhancing the regeneration of indigenous vegetation within the Loddon Falls remnant.

The extent of grazing on vegetation by vermin, native fauna and stock correlates to the abundance of the animals present and the palatability of new growth. The new growth on emerging seedlings is particularly palatable to sheep and rabbits (Bennett et al, 1998). Rabbits were observed in large numbers in Sites 6 & 7 while sheep were grazing along the banks in Sites 2 & 3. Therefore, it is reasonable to assume that within these respective sites, stock and rabbits are reducing regeneration of indigenous and also exotic vegetation. Wallabies are browsers that prefer coarse plant material, as a result saplings rather then seedlings are the focus of their attention. Therefore, browsing by wallabies may also be preventing regeneration of indigenous vegetation. This impact also needs to be considered.

It is not realistic to completely eradicate rabbits, or desirable to exclude sheep and wallabies from the entire study area. Four forms of management are required;

- Reduce the rabbit population within the remnant;
- Reduce the impact of Wallaby browsing within the remnant;
- Exclude stock from the remnant; and
- Utilise stock grazing upstream (Sites 1,2 & 3) to reduce the spread of weeds downstream into the remnant.

It is important to note that Wallaby and rabbit management is focused within the remnant (Sites 4,5,6 & 7) while stock management is required over the entire study area.

The chosen management actions must be:

- effective (i.e. protect and enhance regeneration of indigenous vegetation within the remnant);
- viable (in terms of cost and environmental impact);
- feasible (in terms of topography, geology and land holder needs)
- integrated with weed management;
- consistent and persistent over the long term; and
- monitored for effectiveness and suitability.

3.5.1 Rabbit Control

Aim

Reduce the rabbit population within the Loddon Falls remnant to increase regeneration of indigenous vegetation.

Status and Impact

The European Wild Rabbit (*Oryctolagus cuniculus*) is declared as an established pest animal under the Catchment and Land Protection Act 1994.

As stated by Bloomfield (1999) "Rabbits are the filter that all plants must pass to reach maturity". Therefore, rabbits can significantly alter the botanical composition of natural areas by selective

feeding. Rabbits selectively feed on certain species of plants at critical stages of development such as seeding and seedling establishment (Bloomfield, 1999). This may result in the local extinction of particular native species and proliferation of noxious or unpalatable weed species (e.g. Blackberry).

Rabbit impact on native flora can also seriously disadvantage native fauna. Within the remnant rabbits are in direct competition with native wildlife for food and habitat requirements. In Australia, rabbits have been blamed for a major role in the disappearance of the Greater Bilby (*Macrotis lagotis*) and the Pig-footed Bandicoot (*Chaeropus ecaudatus*), and for putting many other species under threat (Bloomfield, 1999).

Burrowing and grazing undertaken by rabbits can also result in significant soil erosion, this is of less concern within the Loddon Falls remnant due to the rocky conditions of the substrate making burrowing difficult.

Abundance and Location

Large numbers of rabbits were observed in Sites 6 & 7. Large numbers of rabbits were also observed in the paddock adjacent to Site 6 on the west side of the river. Large amounts of rabbit droppings were observed throughout the study area.

Warrens and Harbor

Gorse and Blackberry provide suitable harbor for rabbits throughout the study area. Blackberry is the primary harbor within the remnant and in the paddock adjacent to Site 6 on the west side of the river. Indigenous vegetation such as River Bottlebrush and Tussock Grasses also provide suitable harbor for rabbits within the remnant. The rocky substrate within the remnant makes extensive burrowing difficult, however, rabbits have created warrens within the riparian zone and in adjacent paddocks.

Feeding Habit

Rabbits graze more closely than domestic stock feeding on seeds and seedlings, disturbing the structure of the top soil making it prone to erosion (Bloomfield,1999).

Breeding

As stated by Bloomfield (1999) "a single pair of rabbits can increase in 18 months to 184 individuals". Individual females can produce up to five or six litters each year with an average of five kittens in each litter (Bloomfield,1999).

Control Methods

There are a number of options available for rabbit control. As previously stated the chosen method or methods must be:

- effective (i.e. protect and enhance regeneration of indigenous vegetation within the remnant);
- viable (in terms of cost and environmental impact);
- feasible (in terms of topography, geology and land holder needs)
- integrated with weed management;
- monitored for effectiveness and suitability; and
- consistent and persistent over the long term.

Appendix 2 lists the possible methods for control, their positives and negatives, and whether they are suitable for use within the study area.

Integrated Rabbit Control

As stated by Bloomfield (1999) "two or more control measures used together ensures a longer term effect on rabbit numbers and is better value for money than one method used alone".

As shown in Appendix 2 the methods selected for rabbit control in the Loddon Falls remnant are as follows:

- Poison Trails on adjacent land: 1080 carrots;
- Bait Stations within the remnant: 1080 carrots;
- Shooting; and
- Harbor destruction integrated with weed management.

Control Details

1. Poisoning

1080 (sodium monofluoroacetate) is a lethal poison registered to control vertebrate pest species. For rabbit poisoning, 1080 is applied to carrot or oats and can be laid in a trail or strategically placed in a bait station to ensure that only rabbits eat it.

As stated by Bloomfield (1999), the best results in poisoning are in late summer/early Autumn period because:

- myxomatosis, RCD and natural causes have reduced rabbit numbers
- feed is at a minimum and rabbits are foraging for food
- rabbit population is substantially adult, young rabbits are old enough to emerge from the burrow (21-25 days); and
- breeding is usually over and so rabbits range over greater distances.

(a): Poison Trails on adjacent land

Landholder extension is critical to successful control of rabbit numbers in adjacent land. Integrated rabbit control should be suggested for the whole property. Funds should be provided for poison trails on areas adjacent to the remnant particularly the paddock adjacent to Site 6 on the west side of the river.

(b): Bait Stations within the remnant

Bait stations are cages constructed of steel which have a point of access that a rabbit can just fit through. These stations prevent wallabies or birds from eating the poison. Arboreal mammals do not eat 1080 so their ability to access the station is of no concern. The target specific quality of these bait stations makes them suitable for use within the remnant.

Five of these stations should be placed in both Site 6 and Site 7 (total 10) where the highest numbers of rabbits were observed. Three stations should be placed in both Site 4 and Site 5 (total 6). All sixteen stations need to be regularly monitored to replace the bait, to identify the rate of poison uptake, to evaluate effectiveness and to ensure that no native animals are eating the poison.

2. Shooting

Shooting by a licensed professional should be carried out within the remnant once rabbit numbers have been significantly reduced. Shooting should be integrated with monitoring to assess the numbers of rabbits over time. Once rabbit numbers are low shooting of any stragglers or new settlers will help keep the numbers within the remnant very low.

3. Harbor destruction integrated with weed management

Harbor destruction is incorporated with weed management. As a result, the aim is not to remove rabbit harbor, it is to allow regeneration of indigenous vegetation. Therefore, harbor destruction will be restricted to weeds such as Blackberry and Gorse and will be undertaken at a rate determined by regeneration of native species. In Site 6 the relatively isolated clumps of Blackberry will be removed after the initiation of Bait stations in the site to reduce rabbit numbers. Upstream Gorse will be controlled removing harbor for rabbits in tandem with poison trails set out in adjacent farmland. Refer to weed management of Blackberry and Gorse for details on methods for harbor destruction.

Recommended Management Actions

1. Landholder extension on integrated rabbit control;
2. Lay Poison trails in adjacent land (1080 carrots);
3. Place Bait Stations strategically within the remnant (1080 carrots);
4. Remove Harbor (Integrated with weed management);
5. Shoot rabbits (Integrated with monitoring); and
6. Conduct Regular monitoring (replace poison, identify rate of poison uptake, conduct spotlight transects and identify any non-target kills).

The following is a list of important points relating to rabbit control that should be noted;

- It is aimed primarily at the remnant (Sites 4, 5, 6 & 7);
- Bait Stations are used within the remnant;
- Poison Trails are only used on adjacent land outside the remnant;
- Rabbit control is conducted prior to weed control; and
- A licensed professional must conduct rabbit control.

3.5.2 Stock Management

Aim

The aim is to exclude stock from the remnant (Sites 4, 5,6 & 7) and utilise stock grazing upstream (Sites 1,2 & 3) to reduce the spread of weeds downstream into the remnant.

Status and Impact

Grazing of sheep and small numbers of cattle is undertaken on the land surrounding the study area. Only a section of Site 7 adjoins bushland on the west side of the river and a small section of Site 3 on the east side of the river. Stock is excluded by fencing from most of the remnant due to the steep banks. However, areas of Site 4 are not fenced on the east side of the river.

Upstream of the remnant the banks are not as steep making stock loss less likely. Therefore, fencing is patchy on the west side of the river in Sites 2 and 3 (located only in areas where the bank is steep) and non-existent on the east side. Stock is excluded from Site 1 by fencing.

Unfortunately stock prefers the conditions within the riparian zone and, if not managed, will spend much of their time along the riverbank. Uncontrolled stock access to riparian vegetation can have the following impacts (Buchanan, 1989):

- Erosion;
- Loss of species;
- Soil compaction; and
- Weed invasion.

In areas where restoration is needed to overcome problems created by uncontrolled stock on riparian land, removing or controlling stock access during the period of restoration is the first and most important step in management. Fencing is the simplest way to achieve this.

Integrated Stock Management

To fulfill the aims of stock management two separate approaches are required for the remnant and the upstream areas. Within the remnant (Sites 4,5,6 & 7) stock should be excluded to prevent grazing of native regeneration, spread of seeds from weeds and stock loss. Upstream of the remnant (Sites 1,2 & 3) stock grazing should be integrated with weed management to contain Broom, Gorse and any other weeds that threaten to spread into the remnant.

It should be noted that although controlled grazing within the upstream sites will also hinder regeneration of native species, and that this is not desirable, that the priority of stock management is to protect and enhance regeneration of indigenous vegetation within the Loddon Falls remnant.

There are two factors associated with stock that require management:
- Fencing; and
- Grazing Pressure.

Fencing and Grazing Pressure

The riparian zone within the entire study area should be fenced to prevent the damage that is caused by stock to both the riparian vegetation and the water quality of the Loddon River. This is an expensive task that is made more difficult by the rocky conditions of the substrate. Therefore, the area where fencing is a priority needs to be established. As previously stated stock should be and virtually are excluded from the entire remnant. The few hundred meters in Site 4 where fencing is absent should be fenced immediately.

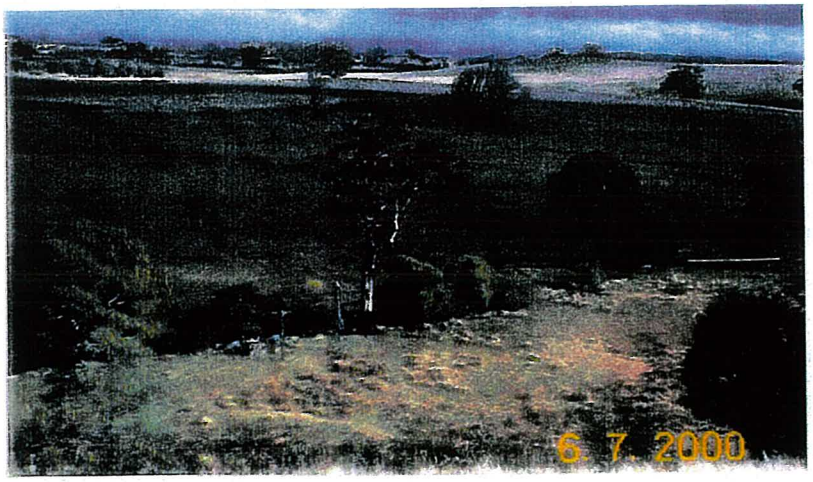


Plate 10: This shot is taken from Sewells Road looking west. It shows the section of Site 4 where fencing is absent on the east side of the river.

Upstream of the remnant in Sites 1,2 & 3 fencing should also be implemented to manage stock access and grazing pressure. However, fencing is not a priority in these areas because of the following environmental and land management issues:
- high weed infestation;
- grazing is presently reducing weed spread;
- not very steep (little stock loss); and
- sparsely fenced at present (large amount of fencing required).

In areas where weed management is undertaken fencing is required to control stock access and grazing pressure. This would allow stock access to be managed strategically to aim grazing

pressure at weed regeneration. Stock grazing pressure can control the spread of Gorse and Broom. Stock is presently restricting the spread of Broom from Site 1 by grazing on seedlings in Site 2. Stock should be directed into Site 1 after chemical control to reduce the major infestation of Broom. Fencing should be implemented in Site 2 so that stock can be contained if Broom seedlings are seen to be proliferating and establishing.

Grazing at present is not restricting spread of Gorse. Gorse requires weed management to remove the large stands that infest the banks in Sites 2 & 3. Subsequent to management Sites 2 & 3 should be fenced to allow strategic stock access that can effectively control the Gorse regrowth and allow regeneration of native species.

Recommended Management Actions

1. Fence Remnant (Site 4);
2. Retain grazing in Sites 2 & 3;
3. Once Gorse is controlled fence and allow strategic grazing in Sites 2 & 3; and
4. Once Broom is controlled allow strategic grazing in Site 1.

The following is a list of important points relating to stock management that should be noted;

- Stock should be excluded from the remnant;
- Stock should be integrated with weed management in the buffer zone; and
- Fencing should be practical (perhaps electric due to the rocky substrate) and allow stock strategic access in the buffer zone when required.

3.5.3 Wallaby Management

Aim

Reduce the impact of Wallaby browsing on regeneration within the remnant.

Status and Impact of Browsing

The Black or Swamp Wallaby (*Wallabia bicolor*) is commonly found along the east coast of Australia and is the sole living member of the genus Wallabia (Strahan, 1983). A number of Black Wallabies inhabit the Loddon Falls remnant and were seen congregating in small groups. As stated by Strahan (1983) "although solitary the Black Wallaby may aggregate when feeding". This suggests that these wallabies are feeding on vegetation within the remnant and are undoubtedly contributing to the lack of regeneration of indigenous tree species.

Preference is shown for the coarse browse supplied by shrubs and bushes rather than grass (Strahan, 1983). In Victoria the Swamp Wallaby eats a wide range of native and exotic vegetation including Pine tree seedlings (Strahan, 1983). Therefore, although wallabies will eat seedlings within the remnant they prefer the coarse browse provided by juvenile saplings. As a result, between rabbits grazing seed and seedlings, and wallabies browsing seedlings and saplings, very few indigenous tree species are able to survive and mature.

Habitat

The Black Wallaby lives in thick undergrowth in forests and woodlands. Areas of dense grass or ferns, sometimes in wet spots on hillsides in open eucalypt forest, provide daytime shelter from which it emerges to feed at night (Strahan, 1983). This description matches the conditions found in Sites 6 & 7 where the greatest number of Black Wallabies were observed during the day.

Abundance and Location

On the field visit to the Loddon Falls study area during the day, five individual Black Wallabies were observed. Three were seen together at one time within Site 6 & 7. Two were also seen together in the hillside remnant located upstream of the remnant adjacent to Site 3.

Breeding

Breeding occurs throughout the year. After a gestation of 33-38 days, a single young is born that stays in the pouch for 8-9 months (Strahan, 1983).

Control Methods

As previously stated the chosen method or methods must be:

- effective (i.e. protect and enhance regeneration of indigenous vegetation within the remnant);
- viable (in terms of cost and environmental impact);
- feasible (in terms of topography, geology and land holder needs)
- integrated with weed management;
- monitored for effectiveness and suitability; and
- consistent and persistent over the long term.

Options include:

- Tree Protectors
- Chemical Repellant and
- Redirection of funds to Rabbit Control.

Tree Protectors and chemical repellant directly control Wallaby browsing. The redirection of funds to rabbit control is an indirect approach that aims to reduce the impact of Wallaby browsing by removing more rabbits and allowing more regeneration of indigenous vegetation.

Appendix 3 lists the possible methods for reducing the impact of Wallaby browsing, their positives and negatives and comments on whether they are suitable for use in this case.

Recommended Management Actions

It is clear that due to the conditions of this site, particularly the rocky substrate and the unique environmental values, that direct control of Wallaby browsing is not appropriate. Therefore the indirect approach of increased rabbit control is suitable to ensure that regeneration is increased sufficiently to cope with the impact of native animals such as the Black Wallaby. This indirect approach will encourage more native animals, that are a valuable component of the remnant, to inhabit the site by making more resources available.

3.6 RECOMMENDATIONS

The following recommendations are based on;

- The principles of integrated restoration management;
- The proposed weed management actions; and
- The proposed regeneration management actions.

The recommended actions are listed under the following three headings;

- Protection and Enhancement of the Loddon Falls Remnant (Sites 4, 5, 6 & 7);
- Control and Containment of Weeds upstream of the Loddon Falls Remnant (Sites 1, 2 & 3); and
- Regular Monitoring and Ongoing Maintenance.

The actions recommended for the protection and enhancement of the Loddon Falls remnant are the priority and should start as soon as possible. Control and containment of weeds upstream of the remnant should be implemented once actions recommended for the protection and enhancement of the remnant are adequately completed (particularly the first 13 actions). Although funds should initially be aimed directly at the remnant subsequent control and containment of weeds upstream is critical to prevent weeds re-establishing within the remnant.

The following lists rank the weed management actions in order of priority and indicate the order in which the sites should be attended. These actions are shown diagrammatically in Figure 3. The timing (year and season), labor and cost estimates for these actions are outlined in Table 11 (refer Section 3.7).

3.6.1 Protection and Enhancement of the Loddon Falls Remnant (Sites 4, 5, 6 & 7)

To protect the values of Sites 6 & 7 it is crucial that weeds located in areas immediately upstream of the junction with the Loddon River along Kangaroo Creek are also assessed and managed. Crack Willow may be spreading vegetatively along Kangaroo Creek into the remnant. This action should be taken prior to undertaking any direct management within the remnant.

The next four actions are aimed at managing regeneration by excluding stock and reducing rabbit numbers. These actions are undertaken before managing the weeds to give any regeneration of indigenous vegetation a better chance of surviving.

The following actions should begin in Spring 2000 and be completed by Autumn 2002.

1. Vegetation Assessment of Kangaroo Creek
2. Landholder extension for rabbit control and stock exclusion
3. Fence Remnant (Site 4);
4. Lay Poison trails in adjacent land (1080 carrots) (Site 6, Site 7, Site 5, Site 4);
5. Place Bait Stations within the remnant (1080 carrots) (Site 6, Site 7, Site 5, Site 4);
6. Cut and Paint Blackberry (Site 6);
7. Spray Blackberry: Low Volume (Site 7, Site 5, Site 4);
8. Cut and Paint Gorse (Site 7, Site 5, Low Volume Spray in Site 4);
9. Reduce Willow coverage by injection of limbs to encourage native regeneration in Site 5 & 7: Note Revegetation using indigenous seed may be required under Willows in Sites 5 & 7;
10. Injection of Crack Willow trunk to provide complete control once native regeneration is established (Site 6, Site 5, Site 7).
11. Cut and Paint Crack Willow saplings (Site 6, Site 5, Site 7);
12. Inject Common Elder (Site 6, Site 5, Site 4);
13. Cut and Paint Common Elder saplings (Site 6, Site 5, Site 4);
14. Cut and Paint Briar Rose (Site 5);
15. Cut and Paint Hawthorn (Site 4);
16. Inject Weeping Willow (Site 4);and;
17. Inject Pussy Willow (Site 4).

3.6.2 Control and Contain Weeds upstream of the Loddon Falls Remnant (Sites 1, 2 & 3)

Landholder extension is critical in control and containment of weeds upstream of the Loddon Falls Remnant. Due to the abundance of weeds upstream rabbits and sheep do not need to be managed prior to weed control. Instead they can be used to graze regrowth of weeds during the control period. Once control has been adequately achieved rabbits should be controlled and fencing implemented to allow strategic grazing in order to promote the regeneration of indigenous vegetation.

It is estimated that the following actions should begin in January 2002 and be completed by Autumn 2003.

1. Landholder extension for rabbit control and stock exclusion;
2. Allow continued grazing in Sites 2 & 3;
3. Spray Blackberry (Low Volume: Site 3, High Volume : Site 2, Site 1);
4. Spray Gorse High Volume (Site 3, Site 2);
5. Release Gorse Spider Mite into Study Area;
6. Inject Common Elder (Site 3);
7. Cut and Paint Common Elder saplings (Site 3);
8. Cut and Paint Briar Rose (Site 2, Site 1);
9. Cut and Paint Hawthorn (Site 3, Site 2, Site 1);
10. Cut and Paint Broom (Site 2);
11. Once weeds are controlled fence Sites 2 & 3 and allow strategic grazing to contain weeds;
12. Lay Poison trails in adjacent land to control rabbits;
13. Spray Broom (Site 1); and
14. Allow strategic grazing in Site 1

3.6.3 Regular Monitoring and Ongoing Maintenance

Regular monitoring is required during the implementation of the recommended management actions to ensure effectiveness and to allow restructuring if required. This process is called adaptive management. Although it is feasible that the actions recommended above could protect and enhance the remnant, weeds will continue to emerge from the soil seed bank and rabbits will continue to breed within the study area requiring ongoing maintenance.

Therefore, the actions recommended above are just the beginning. Regular monitoring and ongoing maintenance must be undertaken indefinitely in order to direct consistent and persistent management in ways that will best control weeds, rabbits and stock in order to protect and enhance the Loddon Falls Remnant.

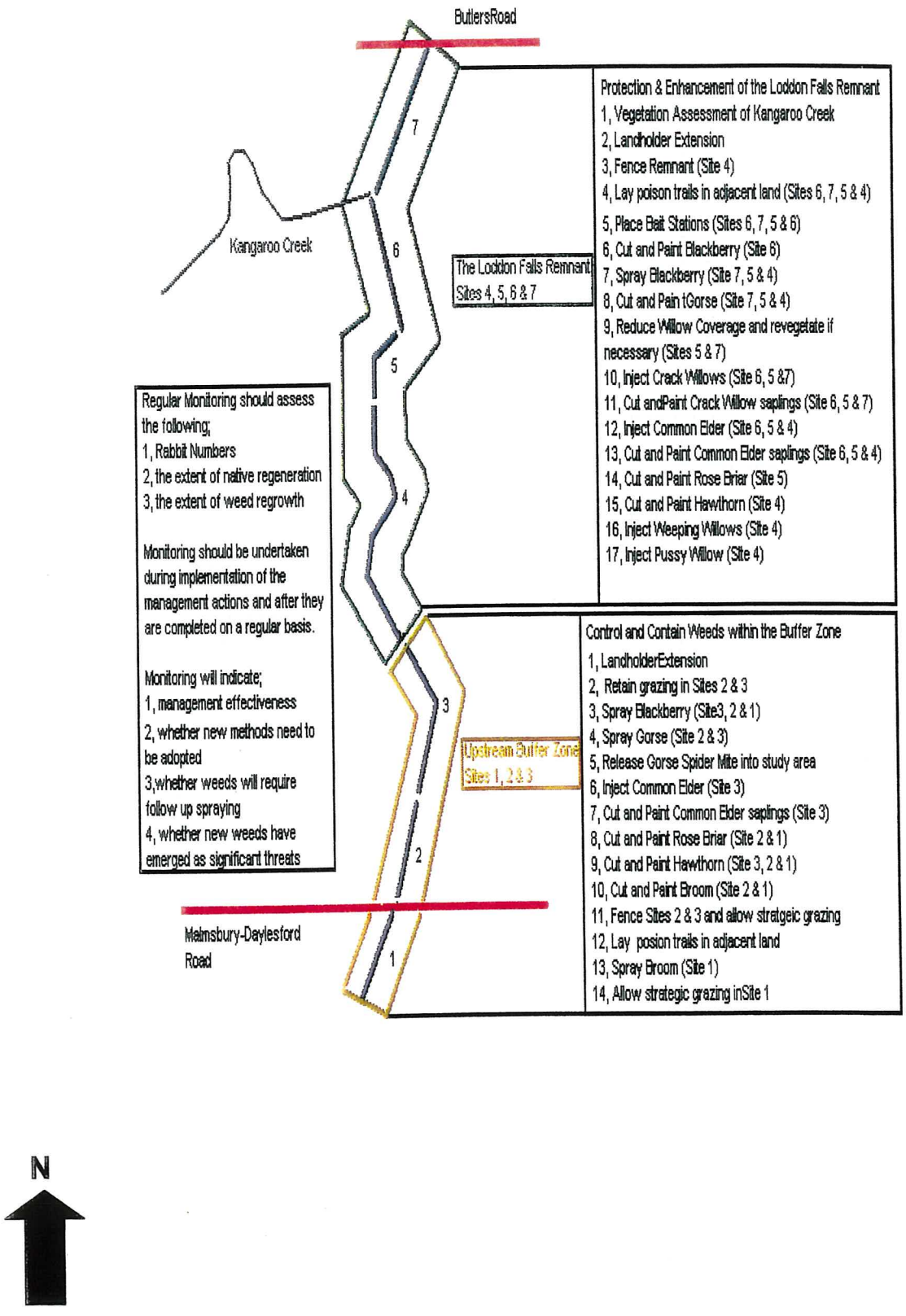
Regular monitoring (every six months after commencement of management) is required to assess the following;

1. rabbit numbers (spotlight transects, rate of poison uptake);
2. the extent of native regeneration (quadrat surveys);
3. the extent of weed regrowth after control (quadrat surveys); and
4. the presence of new and emerging weeds.

This will indicate the following;

- Effectiveness of management actions;
- Whether new methods may need to be adopted (e.g. different herbicide or a different baiting regime);
- Whether weeds will require secondary spraying and ongoing maintenance (e.g.: Blackberry and Gorse); and
- Whether new weeds have emerged as significant threats that require management.

Figure 3: Recommended Management Actions



3.7 RECOMMENDATIONS OVER TIME

Table 11 lists the recommended management actions in order of priority. The table also shows where the actions are directed, when they should be undertaken and how long they will approximately take. This table is subject to change depending on the availability of funds and variation in the associated costs. The number of days work required is an estimation for a one man crew.

Table 11: Recommended actions, locations, timing and number of days work.

Action	Location	Time (Year, and season)	Number of Days Work	Estimated Cost
Protection and Enhancement of the Loddon Falls Remnant	**Sites 4, 5, 6 & 7**	**2000-2002**	**Approximately 35 Days work required.**	**Approximately $18,000 – $23,000. (Dependent on quotes from consultants)**
Vegetation Assessment of Kangaroo Creek	At least 1 kilometer upstream of junction.	2000 Spring	10 Days	$6000
Landholder extension for rabbit control and stock exclusion	All landholders surrounding study area.	2000 Spring	1 Day	$600
Fence Remnant	Site 4	2000 Spring	Consult fencing contractor for site inspection.	Consult fencing contractor for site inspection.
Lay Poison trails in adjacent land (1080 carrots)	Site 6, Site 7, Site 5, Site 4	2000-2001-2002 Summer and Early Autumn	Consult vermin control professionals for site inspection.	Consult vermin control professionals for site inspection.
Place Bait Stations within the remnant (1080 carrots)	Site 6, Site 7, Site 5, Site 4	2000-2001-2002 Summer and Early Autumn		
Cut and Paint Blackberry	Site 6	2000 Summer	1 Day	$500
Cut and Paint Gorse Low Volume Spray of Gorse	Site 7, Site 5, Site 4	2000-2001 Summer 2001 Autumn	3 Days X 2 Years, Note: follow up spraying will probably be required the following year.	$1500 X 2 years
Reduce Willow coverage by injecting limbs to encourage native regeneration.	Sites 5 & 7	2000-2001 Summer	1 Day X 2 Years Note: Revegetation using indigenous seed may be required under Willows.	$500 X 2 years
Low Volume Spray of Blackberry	Site 7, Site 5, Site 4	2001-2002 Early Autumn	5 Days X 2 Years, Note: follow up spraying will probably be required the following year.	$2500 X 2 years
Eliminate Crack Willow	Site 6, Site 5, Site 7	2001 or 2002 Spring early Summer	2 Days, Note: should be undertaken once regeneration has established.	$1000
Cut and Paint Crack Willow saplings	Site 6, Site 5, Site 7	2001 or 2002 Spring early Summer		
Elimination of Common Elder	Site 6, Site 5, Site 4, Site 3	2001 Spring early Summer		

Table 11: Cont'd

Action	Location	Time (Year, and season)	Number of Days Work	
Cut and Paint Common Elder saplings	Site 6, Site 5, Site 4	2001 Spring early Summer		
Cut and Paint Briar Rose	Site 5	2001 Spring early Summer	1 Day	$500
Cut and Paint Hawthorn	Site 4	2001 Spring early Summer		
Injection of Weeping Willow	Site 4	2001 Spring early Summer	½ Day	$250
Injection of Pussy Willow	Site 4	2001 Spring early Summer		
Control and Containment of Weeds upstream of the Loddon Falls Remnant	**Sites 1, 2 & 3**	**2002-2003**	**Approximately 10-15 days work required.**	**Approximately $5000- $10,000 (Dependent on quotes from consultants)**
Landholder extension for rabbit control and stock exclusion	All landholders surrounding study area.	2002 Summer (January)	1 Day	$ 600
Allow grazing	Sites 2 & 3	Ongoing	NA	NA
High Volume Spray of Blackberry Low Volume in Site 3.	Site 3, Site 2, Site 1	2002 Early Autumn	2 Days	$1000
High Volume Spray of Gorse	Site 3, Site 2	2002 Early Autumn	3 Days	$ 1500
Release Gorse Spider Mite into Study Area		2002 Summer (November)	Consult DNRE professionals.	Consult DNRE professionals.
Injection of Common Elder	Site 3	2002 Summer (November)	2 Days	$1000
Cut and Paint Common Elder saplings	Site 3	2002 Summer (November)		
Cut and Paint Briar Rose	Site 2, Site 1	2002 Summer (November)		
Cut and Paint Hawthorn	Site 3, Site 2, Site 1	2002 Summer (November)		
Cut and Paint Broom	Site 2	2002 Summer (November)		
Once weeds are controlled fence and allow strategic grazing to contain weeds.	Sites 2 & 3	2003 Summer (January)	Consult fencing contractor for site inspection.	Consult fencing contractor for site inspection.
Lay Poison trails in adjacent land to control rabbits	Site 3, Site 2, Site 1		Consult vermin control Professionals.	Consult vermin control Professionals.

Table 11: Cont'd

Action	Location	Time (Year, and season)	Number of Days Work	
High Volume Spray of Spray Broom	Site 1	2003 Early Autumn	½ Day	$250
Regular monitoring and ongoing maintenance.	Sites 4, 5, 6 & 7 initially and Sites 1, 2 & 3 subsequent to commencement of management.	2003 onwards (Monitoring every 6 months)	(10 Days a year) 2 days every 6 months for monitoring plus ongoing maintenance as required, approximately 6 days per year.	Approximately$50 00 per year.
Overall Estimates		2000-2003	50 days followed by 10 days/year monitoring and maintenance.	$20 – 33,000 followed by $5000/year.

APPENDIX 1: Weed Control Details And Comments

4.1 Crack Willow *Salix fragilis*.

Origin: Europe and west Asia, Family: Salicaceae

Distribution
This species prefers waterways, ponds, lake-sides and other wet habitats (Roy et al, 1998). It occurs within Sites 5,6 & 7. In Site 5 Crack Willows are congregated around the large water hole at the base of the Loddon Falls. Only one Crack Willow is found on the west bank in Site 6. Approximately 32 mature Crack Willows are located within a two hundred-metre section of the river in Site 7: some were possibly planted.

Threat Classification (Moderate/High)
This species is regarded as a serious weed because the easily broken shoots regrow readily and it has invaded and grown into trees resulting in a widening of the water course in Site 7.

Description
Tree up to 25m high, but sometimes only a shrub. Branches spreading, not drooping. Shoots snap with an audible crack when bent (Roy et al, 1998). Leaves shining on the upper surface, hairless underneath (Roy et al, 1998). A mass of red rootlets forms when roots are in or near the water and leaves often have red galls on them (Roy et al, 1998).

Means of Dispersal
Reproduces exclusively by vegetative means (Roy et al, 1998). Only male catkins are present, the fruit is not formed, as the female plants are rare or absent (Roy et al, 1998). The crack willow is dispersed by easily broken shoots that regrow readily (Roy et al, 1998).

Means of Control
Direct injection of trees and cut and paint stump of regrowth: • Drill and Fill trees: Chemical: apply Roundup Biactive (0-25 cm basal diameter: undiluted 1 ml/cut and for 25-60 cm basal diameter: undiluted 2 ml/cut). On multiple trunk trees ensure each trunk is treated. Drill holes 8-14mm diameter, spaced 50-100 mm apart into the cambium of the lower trunk. The holes should point downward at about 45° to retain herbicide. Treat in spring – summer. Trees die in approximately 2 months (Carr et al. 1994). • Cut and paint stump: Chemical: Roundup Biactive (0-10 cm basal diameter 1:15 roundup to water and 0-30 cm basal diameter 1:1 roundup to water). Dilute roundup with water in the recommended ratio. Cut tree close to ground and immediately wet stump surface. Remove any branches on stump and treat cut surface.

COMMENTS

As stated by Ladson et al (1997) willows can come to dominate the riparian zone because:

- they can spread rapidly by seed or vegetatively (i.e. branches and twigs breaking off and taking root); and
- their dense shade and thick root mat restricts the growth of the understorey.

It is important to consider the influence of willow control strategies on the composition of the vegetation after willows are removed. Willow removal operations could result in a succession by other weeds in the area such as Blackberry. The degree to which succession leads to indigenous

APPENDIX 1 Cont'd

species depends on the potential productivity of the environment, the nature and persistence of alien species, and the availability of propagules of alien and indigenous species (Ladson et al, 1997).

In Site 7 where Crack Willow is abundant instream, complete removal by mechanical excavation would result in the release of large amounts of accumalated sediments and organic matter, followed by the encroachment of Blackberry that already infests the site. A gradual approach over 2-3 years, involving a number of stages is required to prevent these problems from occurring. The stages are listed below;

1. (First year) Drill and fill 50% of the limbs to increase light penetration in order to promote growth of existing seed below the Willows,
2. (First/Second year) Control emerging weeds concurrently
3. (Second Year) If no indigenous vegetation regenerates, revegetate using pre grown seedlings grown from indigenous seed;
4. (Second/Third year) Once indigenous species are established, securing sediment and organic matter, drill nd fill trunks to kill Willows.

4.2 Pussy Willow *Salix cinerea*.

Origin: Europe, west Asia and north Africa, Family: Salicaceae

Distribution
This species prefers swamps, river-banks and other wet habitats. Often forms the dominant vegetation in swampy areas (Roy et al, 1998). It occurs only within Site 4.

Threat Classification(Low)
Within the study area conditions are not swampy and only one individual Pussy Willow was identified, therefore, the threat classification is low.

Description
Shrub or small tree up to 7m high, but often only 1-2m (Roy et al, 1998). Catkins appear in spring, before the leaves (Roy et al, 1998). Leaves shiny on the upper surface, covered with soft grey hairs underneath (Roy et al, 1998).

Means of Dispersal
Reproduces by seed, only one sex is present within the study area limiting dispersal (Ladson et al, 1997). Vegetative recruitment is rare and insignificant (Ladson et al, 1997).

Means of Control
Direct injection of trees: • Drill and Fill trees: Chemical: apply Roundup Biactive (0-25 cm basal diameter: undiluted 1 ml/cut and for 25-60 cm basal diameter: undiluted 2 ml/cut). On multiple trunk trees ensure each trunk is treated. Drill holes 8-14mm diameter, spaced 50-100 mm apart into the cambium of the lower trunk. The holes should point downward at about 45° to retain herbicide. Treat in spring – summer. Trees die in approximately 2 months (Carr et al. 1994).

APPENDIX 1 Cont'd

COMMENTS

As previously stated it is important to consider the influence of willow control strategies on the composition of the vegetation after willows are removed. In Site 4 where the Pussy Willow is located near the base of the gorge removal could allow succession of adjacent River Bottlebrush and/or Blackwood. The threat of this weed is low but due to the isolated occurrence of one tree and the control method being target specific and efficient any threat that is posed could easily be removed. It should be noted that another Pussy Willow could be seen approximately 300m away on an adjoining drainage line not included within the study area. This tree should also be controlled after consultation with the landholder.

4.3 Weeping Willow *Salix babylonica*.

Origin: Europe and west Asia, Family: Salicaceae

Distribution
This species prefers moist sites, along drainage lines and streamsides (Roy et al, 1998). It is sporadic on the margins of water bodies (Roy et al, 1998).

Threat Classification(Low)
This species is classified as a low threat because only three mature specimens were located within Site 4.

Description
Tree up to 20 m high. Branches drooping with green or brownish stems, giving the plant its characteristic weeping form (Roy et al, 1998).

Means of Dispersal
Reproduces exclusively by vegetative means (Roy et al, 1998). Only male catkins are present, the fruit is not formed, as the female plants are rare or absent (Roy et al, 1998). The Weeping Willow is dispersed by easily broken shoots that regrow readily (Roy et al, 1998).

Means of Control
Direct injection of trees and cut/paint stump for regrowth: • Drill and Fill trees: Chemical: apply Roundup Biactive (0-25 cm basal diameter: undiluted 1 ml/cut and for 25-60 cm basal diameter: undiluted 2 ml/cut). On multiple trunk trees ensure each trunk is treated. Drill holes 8-14mm diameter, spaced 50-100 mm apart into the cambium of the lower trunk. The holes should point downward at about 45° to retain herbicide. Treat in spring – summer. Trees die in approximately 2 months (Carr et al. 1994). • Cut and paint stump: Chemical: Roundup Biactive (0-10 cm basal diameter 1:15 roundup to water and 0-30 cm basal diameter 1:1 roundup to water). Dilute roundup with water in the recommended ratio. Cut tree close to ground and immediately wet stump surface. Remove any branches on stump and treat cut surface.

COMMENTS

In Site 4 where the Weeping Willows are located near the pump house removal could allow succession of adjacent River Bottlebrush, Blackwood and Tussock Grass. The threat of this weed is low but because of the isolated occurrence of three mature trees within 30 m of each other and

the control method being target specific and efficient, any threat that is posed could easily be removed. It should be noted that Weeping Willow spreads by vegetative means making it more likely to spread then the Pussy Willow.

APPENDIX 1 Cont'd

4.4 Common Elder *Sambucus nigra*.

Origin: Europe, north Africa and west Asia, Family: Caprifoliaceae

Distribution
This species prefers hedges, cut-over forest, forest margins and waste places (Roy et al, 1998). It is not a common weed along waterways in Victoria. It is found in three sites within the study area (Sites 3,4,5 and 6). It is most abundant within the gorge in Site 5 just below the falls. It is also found in significant numbers in Site 3 on the west bank along the margin of the hillside remnant of vegetation.

Threat Classification (Moderate)
This species is considered a moderate threat because it is found in four of the seven sites within the study area. The presence of this species in Sites 3 and 4, the abundance within the gorge below the falls in Site 5 and the presence of an individual tree in Site 6 suggests a gradual spread downstream. This spread must be prevented to protect the conditions within Sites 6 and 7.

Description
Deciduous shrub or small tree up to 6 m tall, with large, soft, pinnate leaves and white flowers in dense, flat corymbs, followed by shining black berries (Roy et al, 1998).

Means of Dispersal
Ripe berries are eaten by birds that then spread the seed in their droppings (Roy et al, 1998).

Means of Control
Direct injection of trees and cut/paint stump for regrowth: • Drill and Fill trees: Chemical: apply Roundup Biactive (0-25 cm basal diameter: undiluted 1 ml/cut and for 25-60 cm basal diameter: undiluted 2 ml/cut). On multiple trunk trees ensure each trunk is treated. Drill holes 8-14mm diameter, spaced 50-100 mm apart into the cambium of the lower trunk. The holes should point downward at about 45° to retain herbicide. Treat in spring – summer. Trees die in approximately 2 months. • Cut and paint stump: Chemical: Roundup Biactive (0-10 cm basal diameter 1:15 roundup to water and 0-30 cm basal diameter 1:1 roundup to water). Dilute roundup with water in the recommended ratio. Cut tree close to ground and immediately wet stump surface. Remove any branches on stump and treat cut surface.

COMMENTS-

In Site 3 and Site 5 where the majority of Common Elders are located removal could allow succession of adjacent Callistemon, Blackwood and Tree Violet. Blackberry could also succeed removal particularly within the gorge. This would not be desirable, however, the gorge is infested with Blackberry that would be very difficult to eradicate. In contrast, the conditions downstream in Site 6 where only one mature Elder is located at present could be protected by control of Elders upstream. The threat of Common Elders is moderate but due to the control method being target specific and efficient the control of elders should be given priority over other actions, such as Blackberry control within the gorge, because the threat posed could be easily removed.

APPENDIX 1 Cont'd

4.5 Hawthorn *Crataegus monogyna*.

Origin: Europe, Family: Rosaceae

Distribution
Typically found in hedgerows, road-sides and deserted habitations (Roy et al, 1998). Within the study area it occurs in four sites. The majority are in Site 1 and only a small number are located in Sites 2,3 & 4.

Threat Classification (Moderate)
This species is regarded as a moderate threat. Hawthorn is not abundant in the study area and those located within Site 4 were upstream of the gorge. However, this species does appear to be spreading steadily downstream.

Description
Thorny, much-branched, deciduous hedge plant or small tree up to10m tall (Roy et al, 1998). Beautifully covered in sweet scented white or pink flowers in springtime, and later in bright red berries (called haws) (Roy et al, 1998).

Means of Dispersal
Ripe berries are eaten by birds that then spread the seed in their droppings (Roy et al, 1998).

Means of Control
• Cut and paint stump with Garlon 600: 1L/30L diesel distillate solution: Apply to whole stump. This technique can be very useful for small numbers of bushes in restricted areas. Apply when bushes are actively growing.

COMMENTS-

In the sites where Hawthorn is present weeds are the dominant form of vegetation in the middlestorey. As a result removal of Hawthorns will most probably be succeeded by Gorse or Broom. This is not desirable, however, it is important to note that Hawthorn is not yet prolific in the Loddon Falls Remnant. It is, however, present in the upper section of Site 4 and may spread further into the remnant. Therefore the removal of this weed will stop it spreading into the remnant. This is more important then whether weeds succeed it at the site of removal.

4.6 Blackberry *Rubus fruticosus*.

Origin: Europe, Family: Rosaceae

Distribution
This species prefers moist sites, along drainage lines and streamsides (Roy et al, 1998). Blackberry (*Rubus fruticosus*) was the only weed to be found abundantly in all seven sites of the study area. It is most abundant in the gorge (Site 5) and is least abundant in Site 6.

Threat Classification (Very High)
This species is regarded as a very high level threat, invading riparian vegetation and smothering native plants. Blackberry poses the most immediate threat to the indigenous vegetation within the remnant.

APPENDIX 1 Cont'd

Description
Very prickly, scrambling, woody perennial up to 2 m or more tall, bearing, large white or pink flowers followed by black berries (Roy et al, 1998). Extremely variable in leaf shape and plant form (Roy et al, 1998). Leaves are dark green and have a rough texture (Roy et al, 1998).

Means of Dispersal
Ripe berries are eaten by birds and foxes that then spread the seed in their droppings (Panetta et al, 1998). Plants are able to spread by runners with small plants growing from their tips when in contact with the soil (Panetta et al, 1998).

Means of Control
• High Volume or Low Volume Spraying using Roundup Biactive: 150-200mL/15L water. Apply from flowering to leaf fall (January to May). Use the higher rate on old, dense infestations. Plants should not be under stress of high temperature, drought or frost. Complete plant foliage cover is essential. Visible symptoms may not be fully apparent until the next season. • In areas where there is not threat of contaminating the waterway (no less than 10 meters) High Volume or Low Volume Spraying could be done using Garlon 600: 25 mL/15L water. Apply between January and April when the bushes are actively growing to give a better result. Plants should not be under stress of high temperature, drought or frost. One application may be satisfactory but subsequent regrowth and seedlings should be resprayed after hardening off. Thorough coverage is essential. • Cut and paint stump with Garlon 600: 1L/30L diesel distillate solution: Apply to whole stump. This technique can be very useful for small numbers of bushes in restricted areas.

COMMENTS

Blackberry is a widespread weed the highland areas of South-Eastern Australia. It has the potential to colonise all agricultrural land if not controlled.Because of the wide dispersal by birds, it is not feasible to eradicate this species from the study area. However, Blackberries are highly invasive and will smother indigenous vegetation along streams, and also provide harbor for rabbits that eat regenerating indigenous vegetation (Panetta et al, 1998). Therefore, it is crucial that strategic control of Blackberry is undertaken within the remnant. Priority should be given to sites where infestation is low and access is feasible (e.g.: Site 6 & 7). The rocky, shallow soils and grazing by wallabies and rabbits probably limits the occurance of Blackberry in these sites.

Where Blackberry lines the river spraying cannot be conducted without chemicals entering the waterway (it can be reduced by spraying from the waterway towards the bank), therefore, Roundup Biactive must be used. Garlon 600 which is considered a more effective control can only be used in areas greater than 10 meters from the waterway and in a manner that will not result in contamination via spray drift or leaching. Cut and Painting the stump using Garlon 600 can be undertaken in areas where there are isolated stands of Blackberry (e.g. Site 6).

If native birds or animals are using the Blackberry as cover, the control work may need to be implemented in stages or blocks to allow movement of such fauna from the Blackberry cover back to natural cover, or the establishment of alternative cover of indigenous plants (Bruzzesse and Lane, 1996). Members of the public sometimes collect blackberries, therefore, it is recommended that herbicide is not applied to bushes bearing mature fruit (Bruzzesse and Lane, 1996).

Removal of Blackberry in Sites 4, 5, 6 & 7 could be succeeded by invasive pasture grasses, by Gorse or by the re-emergence of Blackberry, depending on what seed is present in the soil.

APPENDIX 1 Cont'd

Natural regeneration is encouraged but revegetation using seedlings grown from indigenous seed could be used in areas where the soil seed bank is infested with weeds (e.g.: Blackwood, Silver Wattle and Manna Gum). Weeds should be suppressed by mulching and saplings protected by fencing or tree guards.

Removal of Blackberry from Sites 4, 5, 6 & 7 may take years, and the threat of re-infestation will always be present, so there is a need for a long-term commitment to ongoing monitoring and maintenance.

4.7 Gorse *Ulex europaeus*.

Origin: Western Europe to Italy, Family: Fabaceae

Distribution
This species prefers river beds, pasture, scrubland, forest margins and wasteland (Roy et al, 1998). Gorse was found in five of the seven sites in the study area (abundant in Sites 2,3 & 4, sparse in Sites 5 & 7 and absent in Sites 1 and 6).

Threat Classification(High)
Although Gorse is only found in sparse patches within the Loddon Falls remnant it is abundant upstream (Sites 2,3 & 4) and is steadily invading the remnant making it a high level threat.

Description
Very spiny, woody perennial shrub up to 3m tall. Gloroius yellow flowers mostly in Autumn, winter and early spring, followed by explosive seed pods (Roy et al, 1998).

Means of Dispersal
Black pods, up to 25 mm long, with soft grey hairs split explosively to disperse the few shiny, smooth round seeds (Roy et al, 1998). Seeds can also be spread by birds, in mud on animals and man and possibly by wind and water (Panetta et al, 1998)

Means of Control
• High Volume or Low Volume Spraying using Roundup Biactive: 150-200mL/15L water. Apply from flowering to leaf fall (January to May). Use the higher rate on old, dense infestations. Plants should not be under stress of high temperature, drought or frost. Complete plant foliage cover is essential. • In areas where there is no threat of contaminating the water way (greater than 10 meters) High Volume or Low Volume Spraying using Garlon 600: 25-50 mL/15L of water. Apply from spring to mid-summer. Use the higher rate on older hard plants. Ad a non-ionic wetting agent at a rate of 125 mL/100L. Do not burn bushes for at least 6 months following treatment. Re-treatment of regrowth may be necessary. • Cut and paint stump with Garlon 600: 1L/30L diesel distillate solution: Apply to whole stump. This technique can be very useful for small numbers of bushes in restricted areas. • Biological Control with the Spider Mite: *Tetranychus lintearius Dufour*. Gorse spider mites have sucking mouthparts that pierce individual cell wall of gorse foliage and extract the cell contents. This causes the foliage to look bleached or brown. Extensive feeding pressure can kill shoots, reduce plant growth and overall plant biomass and abort the production of flowers. (Roberts and Kwong, 1998).

APPENDIX 1 Cont'd

COMMENTS-

Gorse is a widespread weed in the highland areas of South-Eastern Australia. It has the potential to colonise all agricultrural land if not controlled. Gorse numbers within the remnant (Sites 5 & 7) are presently low, cutting and painting the stump with Garlon 600 should control these individual bushes. Priority should be given to sites where infestation is low and access is feasible (e.g. Sites 6 & 7).

Thick stands located in Sites 2,3 & 4 provide harbor for rabbits and if undisturbed will prevent regeneration of native species for at least 25 years (Panetta et al, 1998). These thick stands of Gorse require spraying. Where Gorse lines the river spraying cannot be conducted without chemicals entering the waterway, therefore, Roundup Biactive must be used. Garlon 600 which is considered a more effective control can only be used in areas greater than 10 meters from the waterway and in a manner that will not result in contamination via spray drift or leaching.

If native birds or animals are using the Gorse as cover, the control work may need to be implemented in stages or blocks to allow movement of such fauna from the Gorse cover back to natural cover, or the establishment of alternative cover of indigenous plants (Bruzzesse and Lane, 1996).

Gorse is a prolific seeder with seed surviving in the soil for up to 25 years (Panetta et al, 1998). The largest hurdle to overcome is management of the Gorse seedlings that would continue to emerge for many years after initial application of chemical control. Sheep will graze regenerating seedlings (Panetta et al, 1998). Therefore grazing along with spraying should be used over a period of many years to prevent reinfestation particularly in Sites 2 & 3 to stop the spread of Gorse into Sites 4,5,6 & 7.

Biological control using the spider mite can also help reduce the spread and density of the gorse infestation within the study area. Biological control will not eradicate Gorse, however, if it is integrated with other forms of control such as spraying and grazing it will help achieve the desired level of control(Roberts and Kwong, 1998).

4.8 Briar Rose *Rosa rubiginosa*.

Origin: Europe and north Africa, Family: Rosaceae

Distribution
This species prefers Tussock grassland, riverbeds, flats, terraces and roadsides (Roy et al, 1998). It occurs in three sites within the study area (Sites 1,2 & 5)

Threat Classification (Low)
This species is regarded as a low threat because it is found in very small numbers in only three of the sites within the study area.

Description
Prickly, woody, deciduous perennial shrub up to 3m tall (Roy et al, 1998). Pink rose-like flowers in early summer, followed by bright red rose hips. Leaves divided into five to nine leaflets (Roy et al, 1998).

Means of Dispersal
Roots are often suckering (Roy et al, 1998). Fruit is eaten by birds and dispersed in droppings (Roy et al, 1998).

APPENDIX 1 Cont'd

Means of Control
• Cut and paint stump with Garlon 600: 1L/30L diesel distillate solution: Apply to whole stump. This technique can be very useful for small numbers of bushes in restricted areas. Apply when bushes are actively growing.

COMMENTS

Succession is not a major concern because this species is not found in abundance but rather as isolated individuals within the study area. Succession by weeds is not desirable, however, it is important to note that Rose Briar is not yet abundant in the Loddon Falls Remnant. Therefore the control of this weed will reduce the rate of infestation within the gorge and spreading further downstream into Sites 6 & 7.

Established plants are very competitive, but seedlings are slow growing and many are killed by pasture competition or by grazing (Roy et al, 1998). Therefore, once the mature specimens are controlled allowing grazing of re-emerging seedlings in Sites 2 & 3 will prevent re-infesation.

4.9 Broom Cytisus scoparius.

Origin: Europe, Asia Minor and Russia, Family: Fabaceae

Distribution
This species prefers riverbeds, hedgerows, low fertility hill country, scrubland, coastal and waste places (Roy et al, 1998). Within the study area Broom is presently only found in two sites. It is abundant in Site 1, dominating the middlestorey and sparse in Site 2.

Threat Classification (Moderate/Low)
This species is regarded as a moderate to low threat because the abundance in Site 1 is presently restricted from spreading downstream of Site 2 by grazing pressure from sheep. If grazing was removed Sites 2 & 3 the threat would be moderate.

Description
Erect, much-branched, almost leafless, deciduous woody shrub 1.5-3m tall (Roy et al, 1998). Beautiful golden-yellow flowers in spring, followed by explosive pods (Roy et al, 1998). The leaves which fall easily are trifolate (Roy et al, 1998).

Means of Dispersal
Broom develops two-valved, oblong pods, 3-6 cm long, hairy on margins(Panetta et al,1998). The 3 mm long seeds are dispersed explosively, leaving the empty pods in coils (Panetta et al,1998). Longer distance dispersal may occur by movement of seed internally by animals such as sheep or by flooding which carries the non-buoyant seeds by bedload saltation (Panetta et al,1998).

Means of Control
• High Volume Knapsack Spraying using Garlon 600: 25mL /15L of water. Apply when bushes are actively growing. Avoid spraying when bushes are stressed. Spray to thoroughly wet all foliage, but not to cause run-off. • In areas where Broom is located within 10 meters of the water way Cut Stump Treatment is required using Garlon 600: 1 L/48 L diesel distillate. Apply immediately to freshly cut stump. • Grazing by sheep in Sites 2 & 3 is presently restricting establishment of Broom.

APPENDIX 1 Cont'd

COMMENTS-

As previously stated, it is important to consider the influence of control on the composition of the vegetation after removal. In Site 1 where Broom is abundant, weeds are the dominant form of vegetation in the middlestorey. The size and persistence of Broom in the soil seed bank leads to rapid and substantial regeneration following attempts to control it chemically, mechanically or by fire (Panetta et al, 1998). As a result, control of Broom will most probably be succeeded by Gorse, Blackberry or by Broom itself. This is not desirable, however, it is important to note that Broom is not yet present in the Loddon Falls Remnant or Site 3. As a result the sheep grazing that is presently restricting the spread of Broom to Site 3 should be retained and direct control of Broom in Site 1 should be seen as a low priority.

If spraying is conducted in Site 1 it cannot be allowed within 10 meters of the waterway and must be conducted in a manner that will not result in contamination via spray drift or leaching. Within 10 meters of the waterway the cut stump treatment must be used to prevent contamination. After chemical control is complete stock should be allowed access to Site 1 to graze regrowth. This will contain Broom within Site 1.

APPENDIX 2: Methods Of Rabbit Control

Method	Positives	Negatives	Comments
Fencing	• One-off operation. • Long-term solution. • Allows control to be focused within a restricted area.	• Expensive • Long-term maintenance required. • Construction is difficult in rocky substrate.	To fence the site adequately would require hundreds of meters of fencing to be constructed and maintained. This makes fencing labor intensive and financially expensive. This method is not practical at this site.
Fumigation	• Is aimed at the burrow and has a high level of success.	• High safety hazard. • Fumigation is difficult in rocky substrate.	To fumigate the site adequately all burrows would have to be located. Ripping would have to be undertaken which is not feasible within the remnant. Fumigation is not suitable in rocky terrain and is financially expensive.
Shooting	• Is target specific. • Is relatively cheap.	• Is not a stand-alone solution.	Shooting should be conducted once numbers have already been controlled to try and remove stragglers and new settlers.
Harbor destruction	• Reveals access to burrows. • Removes safe refuge. • Can be integrated with weed management.	• Native vegetation can also provide harbor but cannot be removed.	Blackberry is a major source of harbor for rabbits. Blackberry is the focus of weed control to be undertaken within the remnant. Therefore harbor destruction will be integrated with weed management.
Chemical Repellant	• Deters rabbits from feeding on both seedlings and saplings.	• Expensive • Short term solution. • Requires spraying of individual seedlings and saplings.	This method is labor intensive and financially expensive. This method is not practical at this site.

Appendix 2: Cont'd

Method	Positives	Negatives	Comments
Poison Trails: 1080 carrots	• If used strategically can significantly reduce rabbit numbers. • Suitable for use on adjacent farmland.	• Not Target Specific. • Could be eaten by wildlife, e.g.: wallabies.	Although use of poison trails would not be suitable within the remnant due to the potential impact on wildlife that feed there, it would be suitable in adjacent farm land where rabbits are rife and few wild animals feed.
Bait Stations: 1080 Carrots	• If used strategically can significantly reduce rabbit numbers. • Target specific. • Reusable.	• Requires constant attention to refill bait and ensure that rabbits are the only animals eating it.	Bait stations would allow rabbits access to poison through an entrance that prevents access by wallabies. 1080 carrots should be used because they are not attractive to arboreal mammals such as possums.
Tree Protector	• Prevents rabbits from feeding on saplings.	• Very rocky conditions make fastening difficult. • Protectors need to be removed.	This method is labor intensive and financially expensive. This method is not practical at this site.

APPENDIX 3: Methods To Reduce The Impact Of Wallaby Browsing

Method	Positives	Negatives	Comments
Tree Protectors	• Prevents rabbits and wallabies from feeding on saplings.	• Expensive • Very rocky conditions make fastening difficult. • Protectors need to be removed.	This method is labor intensive and financially expensive. This method is not practical at this site.
Chemical Repellant	• Deters rabbits and wallabies from feeding on both seedlings and saplings.	• Expensive • Short term solution. • Requires spraying of individual seedlings and saplings.	This method is labor intensive and financially expensive. This method is not practical at this site.
Redirection of funds to Rabbit Control	• Reduction of rabbit numbers. • Increased regeneration. • Increased resources available to wallabies.	• Impact of wallabies is not being managed. • Wallaby numbers may increase in the area further reducing regeneration.	Wallabies are a native animal that inhabits this site. By redirecting funds to increase rabbit control regeneration will be increased enough to counter the impact of Wallaby browsing.

APPENDIX 3: Glossary Of Terms

These definitions are quoted from the Australian Natural Heritage Charter (Cairnes, 1996) and *Recher et al* (1986).

Abundance is the number of individuals of a species in a given area.

Biological Control is the use of organisms to control parasites, weeds or other pests, for example, control of rabbits by myxomatosis.

Cambium is a layer of formative cells between the wood and bark in woody plants, from which new wood and bark grow.

Competition: the striving for the use of common resources between or within species; two species are in competition if an increase in the number of one species results in a reduction of the numbers in the second.

Dispersal is the spread of organism to new areas.

Dispersion is the spatial pattern of individuals in a particular poulation.

Diversity is the number of species in a given area. Some measures od diversity alo consider the relative abundance of each species.

Ecology is the study of the ways that organisms interact with each other and with their abiotic environment.

Enhancement means the introduction to a *place* of additional individuals of one or more *organisms*, species or elements of *habitat* or *geodiversity* that naturally exist there.

Fauna means the animals of an area; the number of species of animals in an area , such as in a particular habitat, or island, or country.

Flora means the species of plants of an area.

Habitat means the structural environments where an *organism* lives for all or part of its life.

Indigenous species means a species that occurs at a *place* within its historically known natural range and that forms part of the natural *biological diversity* of a *place*.

Introduced species means a translocated or alien species occurring at a *place* outside its historically known natural range as a result of intentional or accidental dispersal by human activities.

Maintenance means the continuous protective care of the *biological diversity* and *geodiversity* of a place and is to be distinguished from repair. Repair involves restoration and reinstatement.

Monitoring means ongoing review, evaluation, and assessment to detect changes in condition of the natural *integrity* of a *place*, with reference to a baseline condition.

Population Dynamics means the rate of change of the demographic characteristics of a population; sometimes used broadly to mean the study of the changes within populations and the factors that cause the changes.

Propagule is a structure capable of producing a new plant; includes seed, spores, bulbils, etc.

Appendix 3: continued

Protection means taking care of a *place* by *maintenance* and by managing impacts to ensure that *natural significance* is retained.

Regeneration means the recovery of natural integrity following disturbance or degradation.

Restoration means returning existing *habitats* to a known past state or to an approximation of the natural condition by repairing *degradation*, by removing *introduced species*, or by *reinstatement*.

Riparian means of the banks of a river.

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