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KNOX CITY COUNCIL

VEGETATION SURVEY OF LINEAR RESERVES

A management strategy for
Riparian and Flood Plain Vegetation

PREPARED BY

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SEPTEMBER 1997

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First released as a draft in May 1997
Final report completed September 1997

Published by
Knox City Council
Civic Centre
511 Burwood Hwy
Wantirna South, Vic.
Postal address: Private Bag 1, MDC, Wantirna South, Vic. 3152

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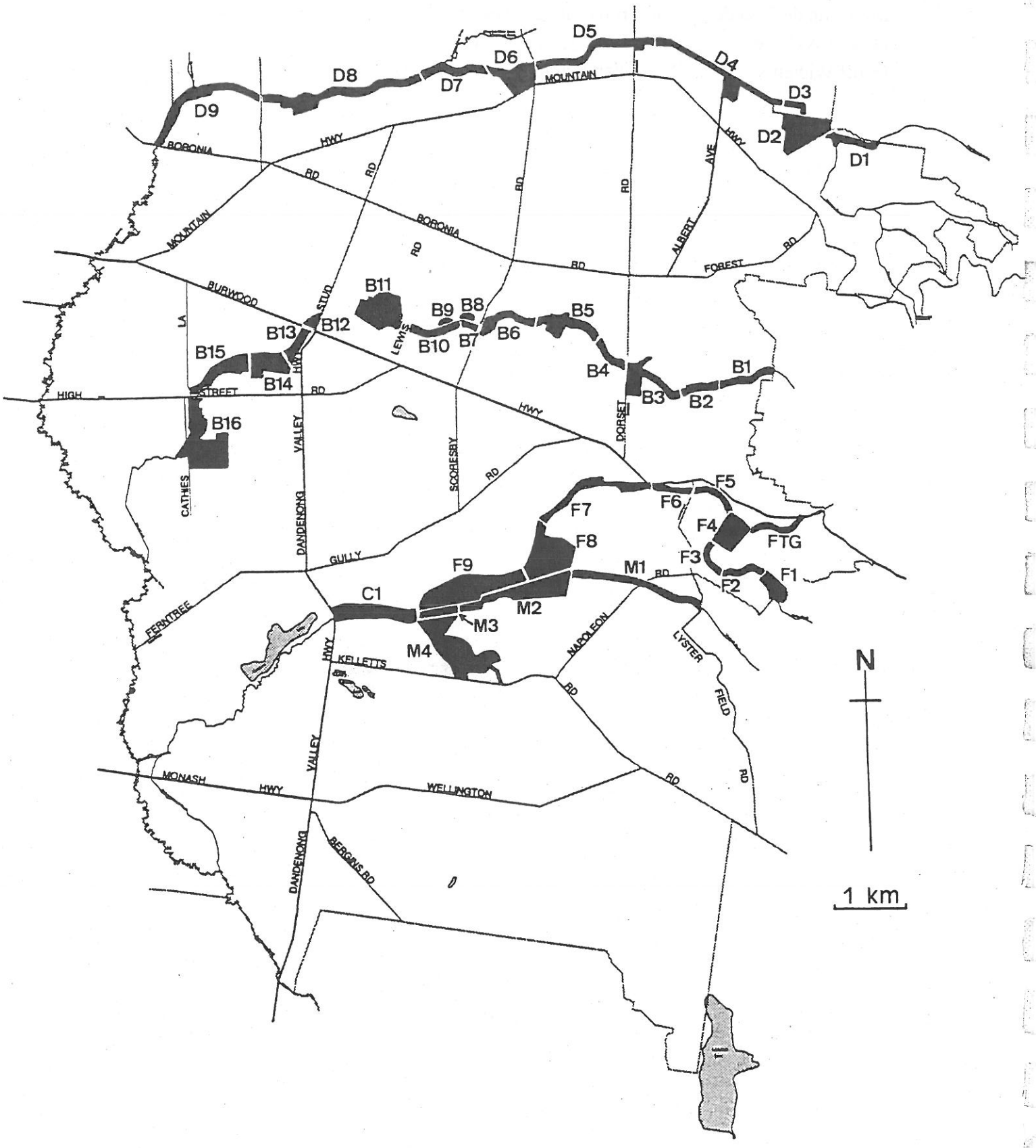
Acknowledgments

Thanks are due to the following people who freely gave their time to assist the authors:

Dr Melody Serena	Australian Platypus Conservancy
Mick van de Vreede	Knox Environment Society
Darren Wallace	Knox Environment Society
Geoff Williams	Australian Platypus Conservancy

Figure 1. Map of the City of Knox, with the forty sections of the study area blacked in. Each section is labelled as in Chapter 7, with an alphabetical prefix to denote the waterway: B=Blind Ck; C=Corhanwarrabul Ck; D=Dandenong Ck; F=Ferny Ck; FTG=Ferntree Gully Ck; and M=Monbulk Ck.



Summary

This report assesses the vegetation of the main waterways of Knox, namely Dandenong Ck, Blind Ck, Ferny Ck, Monbulk Ck, Ferntree Gully Ck and Corhanwarrabul Ck.

A field survey was conducted, leading to the production of eighteen maps which appear at the back of this report (also available at A1 size). The maps show each occurrence of rare plant species, as well as important wildlife habitat and the best opportunities for revegetation.

The maps use colours to denote the fourteen different vegetation types found in the survey, overlaid with hatching to indicate the ecological condition of the vegetation on a scale from A to D (or 'excellent' to 'poor').

Indigenous vegetation covers less than half of the total area covered in the survey, the remainder being mostly weedy pasture and slashed grass. Of the indigenous vegetation, there is more in condition D (poor) than C (fair) and much more in C than B (good). Very little vegetation at all is in condition A (excellent).

Note that this study relates to vegetation and its habitat value. Only very limited conclusions can be drawn from it regarding the status of wildlife in the study area.

Chapter 7 provides descriptions of each of forty separate sections of the waterways. Each description covers issues and recommendations related to the management of that section of waterway.

The main features of the vegetation and wildlife habitat found in each of the forty sections are summarised in a Microsoft Excel spreadsheet. Council plans to incorporate this data into its Geographic Information System.

While some issues are specific to individual sections of the waterways, others apply more generally. Discussion of these issues is provided in Chapters 4 to 6.

The main issues related to protecting and enhancing the waterways for indigenous flora and fauna as well as for humans are, in approximately decreasing order of priority:

- weeds (the most severe of which are listed on p.23)
- conservation of rare plants
- revegetation and regeneration
- slashing
- enhancing fauna habitat
- wetland rehabilitation
- land development
- promoting community respect and participation in waterway management
- grazing
- harm done by visitors (e.g. cubby houses, setting dogs onto birds)
- rubbish dumping
- provision of paths and nature trails
- pest animals
- water pollution.

Chapter 6 provides management guidelines to deal with each of these issues.

Of the large number of recommendations contained in the report, the most important are as follows:

1 Council should liaise with Melbourne Water to develop site-specific management plans for the following sites:

- Gilmour Park in Upper Ferntree Gully (including the Ferny Creek Retarding Basin);
- Liverpool Road Retarding Basin in The Basin;
- Monbulk Creek - Ferny Creek flood plain area between Knoxfield and Ferntree Gully;

and the 1996 management plan for the Timmothy Drive area of Wantirna South should be followed up as recommended by the author of that plan (Donoghue 1996a).

2 Thirteen of the worst weed species (Table 8 on 29) are recommended for priority removal wherever they occur in the study area, and an additional sixteen (Table 9 on 30) are recommended for priority removal from remnant bushland areas. Highest priority should be to contain or eradicate all known occurrences of Square-stem St John's Wort in the district. Blackberry control is the second highest priority.

3 An attempt should be made to establish Friends Groups for specific waterways, wetlands, and fauna species, and to ensure that each group is kept up to date with the activities of the others, particularly with those working on the same waterway.

4 The role of slashing within the linear reserves should immediately be reassessed in light of our comments in Section 6.4 and the site descriptions so it can be used to more positive ecological effect. In particular, efforts need to be made to prevent slasher operators encroaching into remnant bushland. Methods will vary from site to site, and need to be developed in conjunction with operators.

5 All remnants of indigenous vegetation should be permitted to expand naturally where their doing so will not interfere with the functions of the waterway reserves, particularly for flood mitigation.

6 People involved in weed control should maintain an awareness that certain weeds may form part of the habitat for some wildlife where the original natural habitat has been lost. Sometimes it is preferable to control weeds no faster than the rate of provision of alternative habitat. (Refer to Chapter 5).

7 Council should try to increase public awareness of ornamental plants which are environmental weeds and encourage residents to remove these plants from their gardens.

8 Council should raise community awareness of available methods for disposing of or composting prunings and lawn clippings to reduce the amount dumped in linear reserves.

9 Drainage of wetlands within the linear reserves should cease.

10 Council should offer nature walks to local residents.

11 Council should produce a series of brochures on local flora, fauna, environmental weeds, habitat features and other issues related to urban bushland in Knox and the threats it faces, as exemplified in Appendix E.

12 Fox control programs should be implemented where feasible.

13 Council and Melbourne Water should adopt the major, five-year objective of planting enough indigenous trees to provide, at maturity, as close as practicable to an unbroken line of trees along each waterway. Highest priority should be given to trees which will shade the sections of creeks which flow above ground, and to linking major habitat areas.

14 The naturally regenerating area of Llewellyn Reserve, near Coppelia St, Wantirna South, should be inspected by a qualified botanist in or about early November, in the likelihood of finding rare plant species that need careful management.

15 Council and Melbourne Water should initiate a program to monitor, propagate and replant plant species whose numbers in the study area are so low that they are threatened by inbreeding and chance events. (Refer to Section 6.2).

1. Introduction

This study was commissioned by the City of Knox in November 1996 to provide practical advice on the quantification, protection and expansion of the remnant indigenous vegetation along approximately 37 kilometres of waterways, comprising:

- Dandenong Creek from Pavitt Lane, The Basin to Boronia Rd, Wantirna (Melway reference 65 A5 to 63 D5);
- Blind Creek from Himalaya Rd, Ferntree Gully to Jells Park East, Wantirna South (Melway reference 74 E1 to 72 E1);
- Corhanwarrabul Creek from its start to Stud Rd, Knoxfield (Melway Reference 73 C9 to 72 J9), along with the following three tributaries:
- Monbulk Creek downstream from Lysterfield Rd, Ferntree Gully (Melway reference 74 C9 to 73 C9);
- Ferny Creek downstream from New Rd, Upper Ferntree Gully (Melway reference 74 F8 to 73 C9); and
- Ferntree Gully Creek downstream from Burwood Highway, Ferntree Gully (Melway reference 74 H5 to 74D5).

These are shown on Fig.1, p.iv.

The width of the study area's corridors is variable, generally bounded by the edge of public land.

Two areas of special botanical significance along the Blind Creek corridor are the subjects of companion reports with more detailed information:

- the billabong site near Rankin Rd in Ferntree Gully (Melway reference 64 H11) - see *'Management Plan for Blind Creek Billabong, Ferntree Gully'*; and
- the stretch between High Street Rd and Jells Park East, Wantirna South (Melway reference 72 E1 to D3) - see *'Management Plan for Cathies Lane Bushland, Wantirna South'*.

For the present document, the objectives were to:

- make an inventory and quality assessment of existing remnant vegetation and plant species;
- produce explanatory maps showing the different types of vegetation or aquatic habitat and their ecological condition;
- translate the salient features of the inventory into electronic form (a Microsoft Excel spreadsheet) so that it can be accessed via Council's Geographic Information System;
- map and document sites of botanical and zoological significance;
- produce recommendations and guidelines for the maintenance, protection, rehabilitation and expansion of existing remnant vegetation;
- identify and prioritise sites for revegetation, and recommend suitable species;
- identify and discuss threatening processes, weed invasion and other management issues;
- provide guidelines for the improvement of habitat values; and
- identify ways to improve the quality of recreational user experience.

2. Geography of the Study Area

Since this study focuses on waterways, the predominant soil type in the study area is alluvium, i.e. sediment transported by rivers and creeks and deposited in the valley floors. Alluvium typically provides a more fertile growing medium than the soil of surrounding hills from which it derives, which for this study are Upper Devonian volcanics of the Dandenong Ranges and Lower Devonian sedimentary rocks west of the Dandenongs.

Except in one small section of the study area, at the uppermost reaches of Blind Creek, the study area lies in flat to very slightly sloping valleys.

The combination of alluvial soils and poor drainage accounts for the abundance of Swamp Gum (*Eucalyptus ovata*), Swamp Paperbark (*Melaleuca ericifolia*) and Manna Gum (*Eucalyptus viminalis*) in the remaining areas of natural vegetation in the study area.

The climate of the study area is Mediterranean, with annual average rainfall of around 900 mm and summer drought periods in most years. The hottest and coldest months are February and June respectively, with average daily temperature ranges of approximately 13-26 C in February and 6-14 C in June.

A good map of the broad environment types (e.g. aquatic, granitic, heath etc.) is provided by Paget (undated).

3. Survey Methods

3.1 Literature Survey

The bibliography (p.104) lists the main existing reports that were studied to provide background information for this study.

Several management plans or other reports contain information about natural vegetation in the City of Knox, including those concerning Dandenong Ranges National Park, Koolunga Reserve, Wicks Reserve, Lakewood Estate, Manson Reserve and the Timmothy Drive area of Blind Creek. The last two of these are within the area of the present report, as is the forthcoming report on Gilmour Park in Upper Ferntree Gully.

The best overview of plant species found in Knox up to the 1980s is provided by *'Knox's Indigenous Plants Suitable for Cultivation'* (Paget, undated). This document does not seem to have been rendered obsolete by any more recent publication.

Even when taken collectively, the reports above do not provide a complete inventory of the plant species or vegetation communities present in Knox. This is because they either do not cover enough of the bushland in Knox or else they describe the vegetation incompletely.

As a consequence, there is not yet a sufficient basis to determine the rarity of plant species within Knox. For example, our survey found large numbers of some species that had apparently not been previously recorded in the municipality.

On geographic scales larger than Knox, the rarity of plant species was determined by reference to:

- the definitive work, *'Flora of Victoria'* volumes 2 &3 (Walsh & Entwisle 1994,1996);
- *'Flora of Melbourne'* (SGAP 1993);
- *'Sites of Biological Significance in Maroondah'* (Lorimer *et al.* 1997), and
- computer records and collections of pressed specimens at the National Herbarium of Victoria.

3.2 Aerial Photograph Interpretation

Aerial photographs dated March 1996 were used to assist the mapping of areas of vegetation. Immediately prior to the present study, Qasco Pty Ltd extracted from the photographs boundaries between patches of vegetation with different height, colour or other features. These patches were digitised and inserted into Knox City Council's Geographic Information System.

The Geographic Information System was then used to generate eighteen base maps of A1 size for the present study, marked with Qasco's patches of differentiated vegetation. Field work then further refined the mapped patches of vegetation and determined the type and ecological condition of vegetation in (and within) each patch.

3.3 Field Work and Data Management

Field surveys on foot were conducted along the 37 km of waterways between January and April 1997.

The eighteen base maps were taken into the field and marked with different colours for areas of distinct habitat types, and hatching to indicate vegetation quality (using the A-D scale described in Section 6.5). Refined versions of the marked maps are a major output from this project. An A3-sized set, photo-reduced from the original A1 set, appears at the back of this report.

The waterways were divided into sections typically a few hundred metres long. Within each section, a separate list of plant species was compiled for each vegetation type. This gave rise to more than four thousand records of plants in well over one hundred separate lists. The same sections are used in Chapter 7 to describe conditions along the waterways.

A concerted effort was made to detect all indigenous species of fern and flowering plant within each section of waterway. Weeds were also recorded: sometimes all species, but just the main ones in particularly weedy vegetation.

The locations of significant plant species were marked on the maps, and a summary of the size of their populations was recorded.

Management issues, threatening processes, notable weed infestations, revegetation opportunities, significant fauna habitat and incidental fauna sightings were recorded on data sheets and/or field maps.

Opportunities for improved facilities such as paths, interpretive trails and signs were also noted.

All of the plant records were entered into a computer data base compatible with that of the Dept of Natural Resources & Environment, which facilitates analysis and presentation of the data. Examples of the output from the data base are Appendices A and B, which summarise the occurrence of plant species in each section and vegetation community of the study area.

Quadrats

In most respects, the vegetation is best characterised by the lists of plant species that are present in each vegetation type within each section of waterway. Most studies like this cannot compile full lists from the whole study area because of the budget and the size of the area to be covered, so it is common for them to rely on investigation of a selection of small plots called quadrats. Within each quadrat, the investigator writes down a rough estimate of the abundance of each plant species present.

If quadrats are sufficiently numerous and carefully chosen, they contain the vast majority of the plant species present in the whole study area.

In this study, we have been more thorough and examined the whole study area in detail. However, there is still some benefit in sampling quadrats, because quadrat data can be compared directly with thousands of other Victorian quadrats whose data is stored on computer.

For this purpose, we have surveyed at least one quadrat in each type of vegetation. The quadrats were chosen to exemplify each vegetation type in the best ecological condition to be found in the study area.

To conform with the Victorian Dept of Conservation & Natural Resources, the abundance of plants was recorded using the following modified Braun-Blanquet scale (Gullan 1978):

+ Rare (i.e. possibly a chance recording), with less than 5% projected foliage cover;
1 Less rare, still less than 5% projected foliage cover;
2 5-25% projected foliage cover;
3 25-50% projected foliage cover;
4 50-75% projected foliage cover;
5 over 75% projected foliage cover.

Lists of the data collected from the quadrats appears in Appendix D.

3.4 Limitation

The timing of this study, which necessitated a summer field survey, would have limited the range of both indigenous and exotic plant species found, particularly since the summer of 1996-97 was one of the driest on record. Many herbaceous species such as orchids and annuals have no living parts above ground during summer.

4. Vegetation Survey Results

4.1 Habitat Types

A major outcome of this project is that the areas occupied by each of fourteen habitat types have been determined and mapped in colour. A3-sized copies of the series of eighteen maps appears at the back of this report. The original A1 maps are Knox City Council's series A1-97/3420.

Two of the habitat types recognised here are aquatic (flowing and still) and can be distinguished without reference to vegetation. The others are usually distinguishable from the plant species alone, particularly the dominant species and those that show up in Appendix A as being very much associated with one or two particular habitat types. (The latter are often called 'differential species').

The fourteen habitat types recognised here are listed in Table 1 and illustrated in Figure 2 to Figure 11.

Table 1. Habitat types recognised in this study.

1. Perennial stream: Provides specialised habitat required by some aquatic life such as migratory fishes and platypus. For our plant species lists, we include true aquatic species as well as fringing plants whose root systems are periodically inundated.
2. Perennial wetland: As above, but for dams and billabongs with still water. Some examples dry up in drier summers. Often includes many of the flora and fauna typical of the previous habitat type, such as eels, Water Plantain and pondweeds.
3. Seasonal wetland: Covered with water in winter, then drying out in summer. Typically contains Slender Knotweed (*Persicaria decipiens*), rushes (*Juncus* spp.) and club-rushes (*Isolepis* spp.), and often with Water Plantain (*Alisma plantago-aquatica*) and *Carex* species. Cumbungi (*Typha* spp.) often dominates when it is present.
4. Phragmites wet grassland: Dominated by Common Reed (*Phragmites australis*). This is usually a sub-case of seasonal wetland, but it occasionally occurs where inundation is rare. This habitat type is separated from the former one because of its consistent overwhelming dominance by Common Reed and its ability to regenerate vigorously when slashing is relieved from it.
5. Swamp scrub, dominated by Swamp Paperbark (*Melaleuca ericifolia*). This type grows in association with any of habitat types 6-10, and it often (perhaps always, in Knox) results from natural regeneration after clearing. This habitat type is distinguished by the dense canopy of Swamp Paperbarks, not by the presence or abundance of particular species.
6. Riparian forest beside perennial streams. ('Riparian' means on the banks of streams). Includes Manna Gum (except where these have all been removed), often mixed with Swamp Gum, Messmate Stringybark, Narrow-leafed Peppermint or Silver-leafed

Stringybark, and sometimes with Yellow Box, Bundy or Red Stringybark. This includes the 'Messmate Subriparian Forest' of Lorimer *et al.* (1997), which cannot be distinguished in the modified environments of Knox's waterways. Manna Gum is the best character species because all others are frequently present in other habitat types. In more intact environments than Knox's creek corridors, this habitat type is characterised by abundant Victorian Christmas Bush (*Prostanthera lasianthos*), Prickly Currant-bush (*Coprosma quadrifida*) and Purple-sheathed Tussock-grass (*Poa ensiformis*).

7. Swamp Gum forest or woodland: Occurring on poorly drained alluvium, usually with Swamp Paperbarks present. Swamp Gum is typically the only eucalypt present, but intergradation occurs with habitat types 6 and 10.
8. Wattle scrub: dominated by Black Wattle or Blackwood, resulting from clearing of any of the habitat types 6, 7, 9 or 10. Some occurrences mapped by us may not be natural but the result of old plantings where only wattles have survived.
9. Red Gum woodland: now reduced to a few remnant trees at one site in Knox, so its original composition has to be inferred from elsewhere (e.g. Springvale and Dandenong).
10. Silver-leafed Stringybark & Swamp Gum forest: on poorly drained soils of flats and lower slopes, often with Narrow-leafed Peppermint. Swamp Gums are usually only present as outliers from adjacent areas of habitat type 7, and are absent from larger stands of this habitat type, so Lorimer *et al.* (1997) call this 'Silver-leafed Stringybark forest'. Intergrades with the following habitat type at the edge of alluvial deposits.
11. Messmate & Silver-leafed Stringybark forest: characterised by Silver-leafed Stringybarks sharing dominance with Messmate Stringybark and Narrow-leafed Peppermint, from lower slopes to less exposed high ground in undulating terrain. Distinguish from the previous habitat type by the presence of Messmate stringybarks and the absence of water-loving species such as Centella (*Centella cordifolia*) and sedges in the genus *Carex*. This habitat type sometimes intergrades with the following habitat type at the drier end of its ecological tolerance.
12. Bundy-Messmate-Peppermint forest: characterised by a canopy of Bundy, Messmate Stringybark, Narrow-leafed Peppermint and (usually) Red Stringybark, sometimes with Yellow Box on deeper soil. Occurs on slopes and hills.
13. Yellow Box & Bundy forest: on hills with deeper soils, sometimes with Narrow-leafed Peppermint present. Well represented outside the study area beside Glenfern Rd beyond the eastern end of Napoleon Rd, Upper Ferntree Gully (Melway reference 74E8).
14. Messmate damp forest: dominated by Messmate Stringybark, often with lesser numbers of Narrow-leafed Peppermint or Swamp Gum. The understorey contains abundant ferns. Restricted within the study area to Liverpool Road Retarding Basin; better represented in the Dandenong Ranges, where Mountain Grey Gum is a common constituent.

The table in Appendix A indicates the indigenous plant species found in each habitat type within each of the three waterway systems of the study area. It shows that certain habitat types are associated predominantly with particular catchments. Most markedly, habitat types 10 and 13 stand out as being represented far better in the Blind Creek corridor than in other corridors.

Figure 4. Habitat type 4, Phragmites wet grassland. The foreground shows regrowth of *Phragmites australis* after slashing. There is swamp scrub (habitat type 5) in the background.

Figure 5. Habitat type 6, riparian forest with Manna Gum. Immediately east of Liverpool Rd.

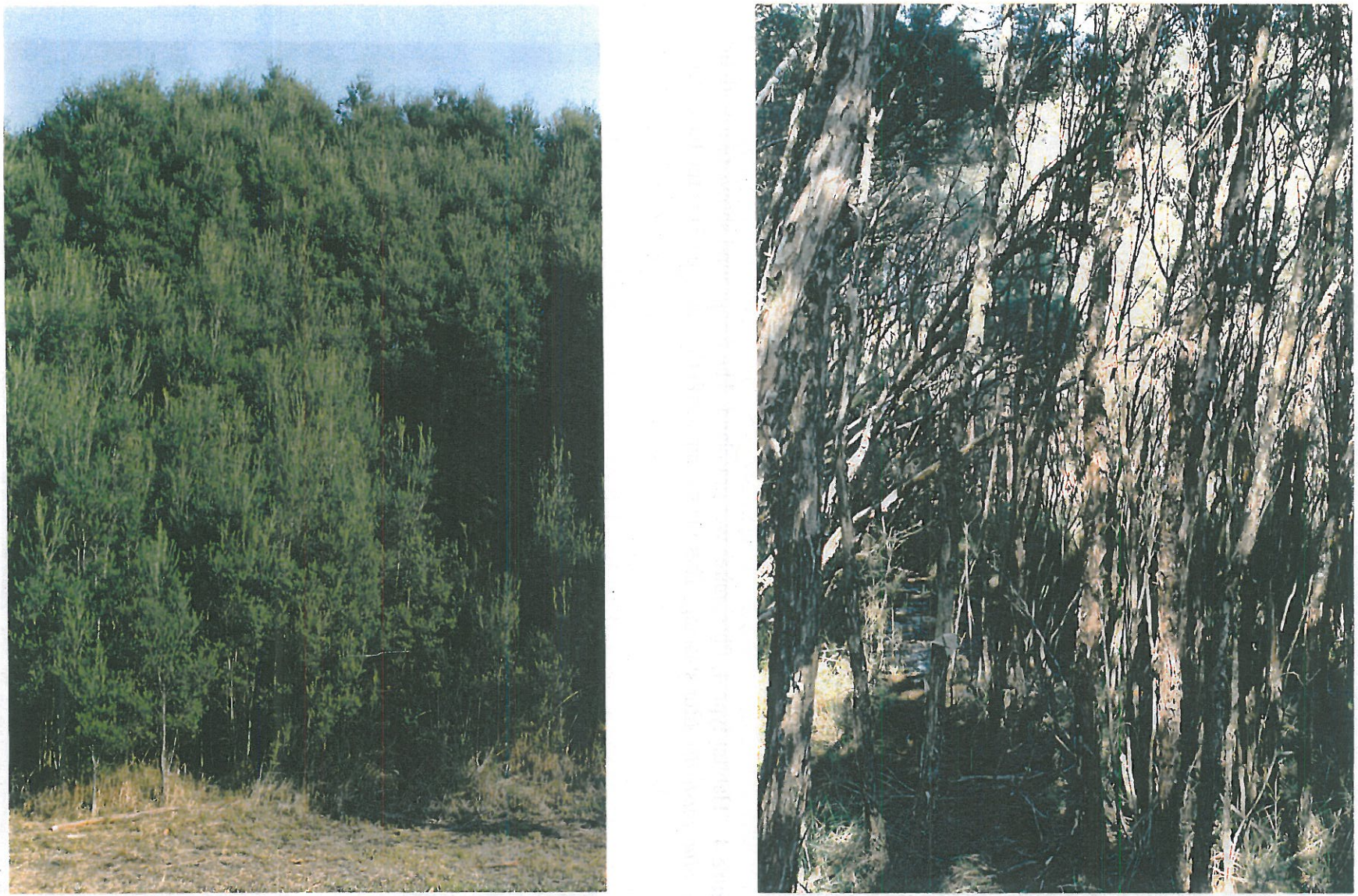


Figure 6. Habitat type 5, Swamp Scrub at Liverpool Road Retarding Basin.
Left: external view, with younger growth at the edge where slashing has ceased. Right: inside the same scrub - densely shaded and wet.

Figure 7. Habitat type 7, Swamp Gum forest. Lewis Park.

Figure 8. Habitat type 8, wattle scrub (in the middle distance) at Liverpool Road Retarding Basin. This stand is dominated by Blackwood trees; Some other occurrences are dominated by Black Wattles.

Figure 9. Habitat type 10, Silver-leafed Stringybark & Swamp Gum forest. A stand without Swamp Gum near Timmothy Dr, Wantirna South.

Figure 10. Habitat type 12, Bundy-Messmate-Peppermint forest. Liverpool Rd Retarding Basin, on the east-facing slope above the lake.

Figure 11. Habitat type 14, Messmate damp forest. Liverpool Road Retarding Basin. Note the characteristic ferny understorey.

4.2 Vegetation Condition

The series of maps at the end of this report not only show the different habitat types by colour, but also indicate the ecological condition of vegetation. Four different ratings of ecological condition are denoted by different styles of hatching.

Rating system

The four ratings of ecological condition are designated A to D, or equivalently, 'excellent', 'good', 'fair' and 'poor', respectively. They are determined by consideration of biodiversity rather than the more commonly used criteria of weed abundance, for the following reasons:

Human modification of a natural environment generally causes a reduction in biodiversity (i.e. species and genetic variability) and a shift from native to introduced species. Plants are very good indicators of this process; indigenous plants tend to be replaced by weeds, and the total number of plant species declines.

This process goes through several stages. First, a few indigenous plant species that are sensitive to disturbance disappear, while most other species survive and reproduce. With greater disturbance, the number of lost indigenous species increases and some of the remaining ones struggle to reproduce, typically because their seedlings are out-competed by weeds.

A stage may then arise where half or more of the indigenous species die out, leaving only hardy species that can survive against weed invasion and loss of native pollinators and insect eaters. If earthworks or similar activities are conducted, only the hardiest plants are likely to survive (such as isolated remnant trees in gardens), and these generally gradually decline because they cannot reproduce effectively (e.g. tree seedlings being mowed).

Because maintenance of biodiversity is such an important issue nationally and locally, Lorimer *et al* (1997) introduced a 'biodiversity condition' scale from A to D based on the position of vegetation in the stages of degradation just described. The ratings were designed to be easily determined in the field, using criteria based on two factors:

- the number of indigenous plant species remaining compared with expectations of a pristine site of the same size and habitat type; and
- the ability of the indigenous species present to survive and reproduce.

These ratings form the basis for the present study, except that we have made the criteria for rating C slightly more lenient. This is partly to conform more closely to the scheme used by the National Trust of NSW (Buchanan 1989), and partly to give greater recognition to the very common cases in our study area where only hardy plants remain but with sufficient abundance to be important to native fauna.

The revised rating criteria used here are described in Table 2.

The awkward case of an isolated indigenous tree with few if any indigenous plants beneath is categorised here as rating D.

In marginal cases, attention is focused on the plant species that are expected to play the most important ecological role, such as the naturally dominant species in the overstorey and understorey. If the loss of biodiversity is particularly evident among the most ecologically important species, the lower ranking is assigned.

Because the rating scheme is based on the plants present, it cannot be applied in this study to aquatic environments except in the few cases where there is abundant aquatic vegetation.

We believe that, while this rating scheme is based solely on plants, it is a reasonable indicator of fauna habitat and overall biodiversity.

We also believe that the scheme is a good workable indicator of the value of a site for conservation of biodiversity. Note that it differs from indicators of vegetation 'quality' published elsewhere, for the important reason that we do not downgrade a site solely for the presence of weeds.

Table 2. Rating scheme for ecological condition of vegetation.

Rating A: Contains almost all of the indigenous plant species that one could expect to occur in that type of vegetation (taking into account the size of the site); at least 80% of plant species able to reproduce adequately to maintain their numbers.

Rating B: Contains at least half of the indigenous plant species that could be expected, but not reaching rating A due to species loss or reproductive failure. Better management and some revegetation can usually raise the rating to A.

Rating C: Not meeting Rating B, but either containing at least 20% of the indigenous plant species that could be expected, or else satisfying both the following conditions:

(a) the indigenous plants dominate (i.e. they intercept more direct sunlight than non-indigenous plants); and

(b) native wildlife is likely to make regular and substantial use of the vegetation.

Most of the indigenous plants present are likely to be able to reproduce successfully.

Rating D: Contains less than half of the indigenous plant species that could be expected, frequently less than 20%; reproduction of most of the indigenous plants usually seriously impeded. These sites usually have value only for landscape purposes and hardier wildlife.

For example, some sites (particularly wetlands) have relatively high numbers of weeds in a stable coexistence with high numbers of indigenous species. The biodiversity condition rating may be 'B' in such a case, despite the weediness, because the indigenous plants are secure. A typical 'vegetation quality' indicator would rate such a site as being of poor quality because of the significant proportion of weeds.

Findings

Analysis of the maps at the end of this report shows that the majority of the land within the waterway corridors contains negligible indigenous vegetation (e.g. slashed floodways). Of the remaining area, there is more in condition D than C and much more in C than B.

Very little habitat at all is in condition A. It is confined to Liverpool Road Retarding Basin in The Basin, and a wetland at Manson Reserve, Wantirna. (The latter is only tentatively given rating A because the season in which the survey was conducted made assessment difficult).

4.3 Inventory of Plant Species

The 210 indigenous species and subspecies found in the survey are tabulated in Appendix A, including their scientific and common names, their conservation status and their presence or absence within each catchment and each type of habitat.

A total of 163 indigenous species and subspecies was detected along the Blind Creek corridor, compared with 162 along Dandenong Creek, and 79 along Corhanwarrabul Creek and its tributaries.

It is expected that about twenty or so additional indigenous plant species would have gone undetected because of the season in which the survey had to be undertaken.

A few species were found only beside the Norvel Rd quarry in Ferntree Gully, before it was established that this site was not intended to be within the study area. The species in question included two regionally significant ones: Golden Spray (*Viminaria juncea*) and Tadgell's Bluebell (*Wahlenbergia multicaulis*). We have found no prior records of the bluebell in Knox. Both of these species were bulldozed within weeks of their discovery, but are still listed in Appendix A.

The 135 naturalised plant species found in the survey are tabulated in Appendix B. Almost all of these are environmental weeds (i.e. well established and likely to be having a detrimental effect on indigenous flora or fauna).

It is likely that more naturalised species went undetected than indigenous species, because of the high proportion of annuals in the former category and because the field surveys focused on recording indigenous species and dominant weeds rather than less important naturalised plants.

4.4 Significant Plant Species

Seventy-two indigenous plant species are regarded in this study as worthy of having each plant or colony marked on the maps because they are uncommon, threatened or suspected to be so throughout Knox (excluding the Dandenong Ranges National Park). This includes some species that have moderate numbers in the study area, but which are believed to be practically absent everywhere else in Knox.

Species that are scarce in the study area but not so elsewhere in Knox (e.g. Red Stringybark or Short-hair Plume-grass) are not highlighted here.

The significant species are divided into two tables below. The list in Table 3 contains mostly species which were rigorously determined by Lorimer *et al.* (1997) to be significant at the regional level or above (where the region corresponds to the coverage of the standard text, *'Flora of Melbourne'*). Several species not present in Maroondah (and hence not listed by Lorimer *et al.*) have been added, based on identical criteria to Lorimer *et al.*

Table 4 includes species rare in Knox but not throughout the region. Because of the paucity of information about the distribution, abundance and security of plant species in Knox, the list in Table 4 has weaker foundation than Table 3. In addition to the information sources cited in Section 3.1, we relied in part on our own experience and that of local naturalist, Mr Darren Wallace.

As far as possible, each occurrence of species in Tables 3 and 4 has been marked on the relevant maps at the end of this report and listed in the section-by-section descriptions of the waterway reserves in Chapter 7.

Table 3. Plant species that are at least regionally significant

Acacia leprosa Dandenong Range variant (Cinnamon Wattle)
Amyema quandang (Grey Mistletoe)
Austrofestuca hookeriana (Hooker Fescue)
Azolla pinnata (Ferny Azolla)
Baumea acuta (Pale Twig-rush)
Baumea rubiginosa (Soft Twig-rush)
Baumea tetragona (Square Twig-rush)
Blechnum minus (Soft Water-fern)
Bolboschœnus medianus (Marsh Club-rush)
Calystegia marginata (Forest Bindweed)
Carex fascicularis (Tassel Sedge)
Carex gaudichaudiana (Fen Sedge)
Centipeda minima (Spreading Sneezeweed)
Cynoglossum latifolium (Forest Hound's-tongue)
?Cyperus gunnii (Flecked Flat-sedge) - identity unconfirmed
Danthonia duttoniana (Brown-back Wallaby-grass)
Eucalyptus yarraensis (Yarra Gum) - unconfirmed
Goodenia elongata (Lanky Goodenia)
Gratiola pubescens (Glandular Brooklime)
Juncus australis (Austral Rush)
Juncus vaginatus (Clustered Rush)
Lepidosperma filiforme (Common Rapier-sedge)
Lepidosperma gunnii (Slender Sword-sedge)
Lycopus australis (Australian Gipsywort)
Myriophyllum simulans/variifolium (a milfoil)
Persicaria prætermissa (Spotted Knotweed)
Persicaria subsessilis (Hairy Knotweed)
Potamogeton crispus (Curly Pondweed)
Ranunculus ?inundatus (a buttercup - exact identity unconfirmed)
Schoenus tesquorum (Soft Bog-rush)
Spiranthes sinensis (Ladies' Tresses)
Spirodela punctata (Thin Duckweed)
Thelymitra holmesii (Slender Blue Swamp Sun-orchid)
Villarsia reniformis (Running Marsh-flower)
Viminaria juncea (Golden Spray)
Wahlenbergia multicaulis (Tadgell's Bluebell)
Wolffia australiana (Tiny Duckweed)

Table 4. Plant species that are significant within Knox

Allocasuarina littoralis (Black Sheoke)
Alternanthera denticulata (Lesser Joyweed)
Blechnum cartilagineum (Gristle Fern)
Centrolepis strigosa (Hairy Centrolepis)
Crassula helmsii (Swamp Crassula)
Danthonia geniculata (Kneed Wallaby-grass)
Eleocharis acuta (Common Spike-rush)
Eleocharis sphacelata (Tall Spike-rush)
Empodisma minus (Spreading Rope-rush)
Eucalyptus camaldulensis (River Red Gum)
Exocarpos strictus (Pale-fruit Ballart)
Gahnia sieberiana (Red-fruit Saw-sedge)
Gonocarpus micranthus (Creeping Raspwort)
Goodenia humilis (Swamp Goodenia)
Gynatrix pulchella (Hemp Bush)
Hakea nodosa (Yellow Hakea)
Histiopteris incisa (Bat's Wing Fern)
Hypolepis ?rugosula (a ground-fern - exact identity unconfirmed)
Hypoxis hygrometrica (Golden Weather-glass)
Imperata cylindrica (Blady Grass)
Lemna disperma (Common Duckweed)
Leptospermum lanigerum (Woolly Tea-tree)
Muellerina eucalyptoides (Creeping Mistletoe)
Olearia ramulosa (Twiggy Daisy-bush)
Poa labillardierei (Common Tussock-grass)
Polystichum proliferum (Mother Shield-fern)
Pomaderris aspera (Hazel Pomaderris)
Pomaderris racemosa (Cluster Pomaderris)
Prostanthera lasianthos (Victorian Christmas-bush)
Rapanea howittiana (Muttonwood)
Thelionema cæspitosum (Tufted Blue-lily)
Triglochin procerum (Water-ribbons)
Triglochin striatum (Streaked Arrow-grass)
Typha domingensis (Cumbungi)
Veronica gracilis (Slender Speedwell)

One species which may superficially appear to warrant inclusion in the tables above is *Persicaria lapathifolia*, which had rarely if ever been recorded in Knox prior to this study. It grows in

heavily modified conditions in Knox and it is not certain whether it is native to Knox or to Victoria generally. It is recognised internationally as a weed of wet places, and in Knox it may be more a weed than a natural component of indigenous vegetation. It is therefore omitted from the tables above.

The locations of all species of Tables 3 & 4 are marked on the maps at the end of this report. The scientific names of species of Table 3 are written in bold italics on the maps, while those of Table 4 are in italics but not bold.

Note that a significant species does not automatically confer significance on every site where it occurs. If a site containing a significant species does not provide viable habitat for the species, the presence of the species may count for little. For example, the Dandenong Range variant of the Cinnamon Wattle is of high Regional or State significance, but the several specimens found in this study add almost nothing to the stock of that species and their presence is of only local interest.

Figure 12 shows the orchid known as Ladies' Tresses (*Spiranthes sinensis*). It is extremely rare in Knox and rare throughout the Melbourne region, but scattered across Australia and eastern Asia.

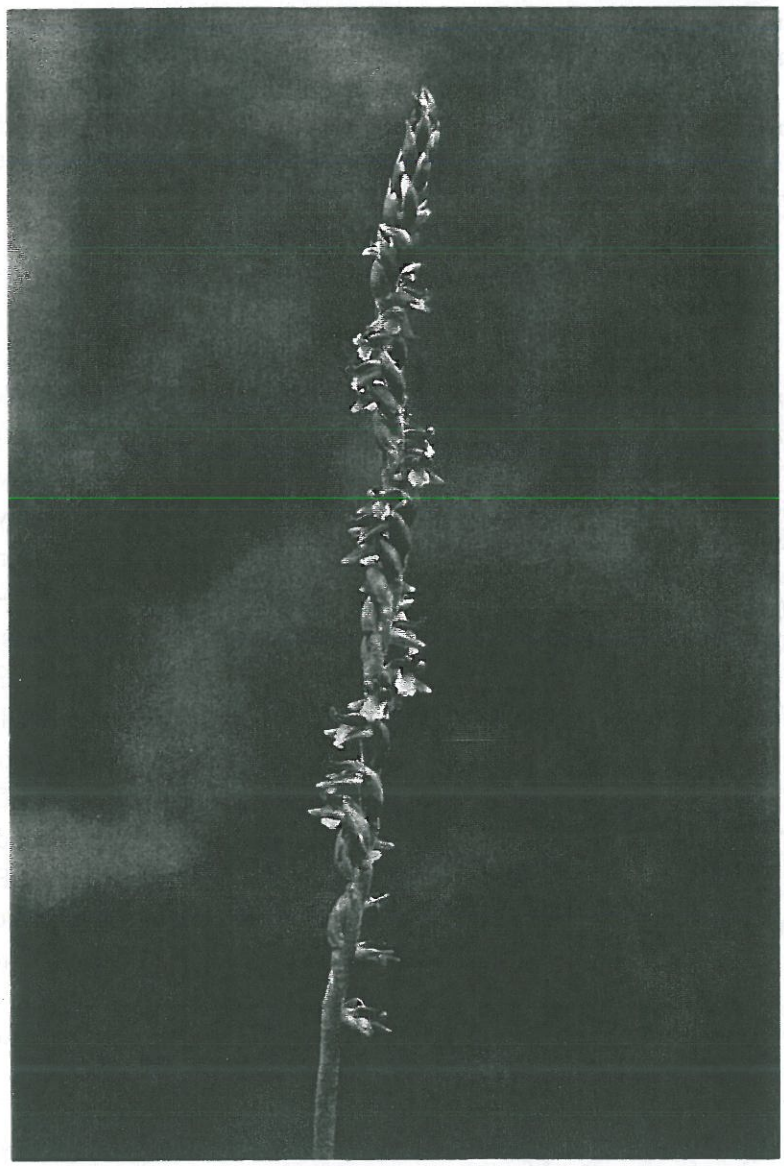


Figure 12. Ladies' Tresses (*Spiranthes sinensis*)

4.5 Dominant Weeds

Appendix B lists all the weeds found during the survey.

Just a small proportion of the weed species represent by far the majority of the environmental threat by weeds. Table 5 provides the authors' assessment of the weeds presenting the greatest harm or threat:

Table 5. Subjective assessment of the worst weeds in the study area.

Most serious weeds

Agrostis capillaris (Brown-top Bent)
Anthoxanthum odoratum (Sweet Vernal-grass)
Callitriche stagnalis (Water Starwort)
Calystegia silvatica (Greater Bindweed)
Cortaderia selloana (Pampas Grass)
Cotoneaster glaucophyllus (Cotoneaster)
Crataegus monogyna (Hawthorn)
Dactylis glomerata (Cocksfoot)
Ehrharta erecta (Panic Veldt Grass)
Galium aparine (Cleavers)
Holcus lanatus (Yorkshire Fog)
Hypericum tetrapterum (Square-stem St John's Wort)
Juncus articulatus (Jointed Rush)
Lonicera japonica (Japanese Honeysuckle)
Paspalum distichum (Water Couch)
Pennisetum clandestinum (Kikuyu)
Phalaris aquatica (Toowoomba Canary-grass)
Pittosporum undulatum (Sweet Pittosporum)
Ranunculus repens (Creeping Buttercup)
Rubus discolor (Blackberry)
Salix fragilis (Crack Willow)
Salix × *rubens* (White Crack Willow)
Tradescantia albiflora (Wandering Jew)

Serious weeds

Cotoneaster pannosus (Cotoneaster)
Cynodon dactylon (Couch)
Cyperus eragrostis (Drain Flat-sedge)
Erica lusitanica (Spanish Heath)
Fraxinus angustifolia (Desert Ash)
Hedera helix (Ivy)
Lotus suaveolens (Hairy Bird's-foot Trefoil)
Mentha spicata (Spearmint)
Paspalum dilatatum (Paspalum)
Rumex crispus (Curled Dock)
Ulex europæus (Furze or Gorse)
Vulpia bromoides (Squirrel-tail Fescue)
Watsonia meriana (Bulbil Watsonia)

Some of the species above are serious in only one or two habitat types; e.g. Jointed Rush (*Juncus articulatus*) is a weed solely of wetlands. Others, such as Cocksfoot and Blackberry, are very widespread. The distribution of the species is indicated in Appendix B.

Particular attention is drawn to Square-stem St John's Wort (*Hypericum tetrapterum*). The first record of this weed in the region was by Dr Lorimer just a few years ago, just over Knox's border with Maroondah City Council. It has since spread and proliferated very rapidly, but is still sufficiently localised that there is some hope of containment or eradication. It is regulated at one of the highest levels under the *Catchment and Land Protection Act 1994*.

It is therefore recommended that a program be established by the Councils of Knox and Maroondah, Melbourne Water and the Dept of Natural Resources & Environment to contain or eradicate all known occurrences of Square-stem St John's Wort in the district.

4.6 Spreadsheet Representation of the Vegetation Data

The spreadsheet which accompanies this report contains a record for each habitat type within each of the sections of creek corridor described in Chapter 7. Each record contains the following information:

- an identifier for the section of waterway;
- the number of the habitat type to which the record applies;
- the condition or conditions of vegetation present, using the A-D scale of Section 4.2;
- a subjective assessment of the degree of cover of indigenous plants within the areas described;
- a list of significant species found;
- a list of character species for that habitat type at that location;
- a description of any important wildlife habitat features observed; and
- the percentage of plant species found that are not indigenous.

It is intended that this information will be inserted into the 'Significant Vegetation' layer of Council's Geographic Information System. Clicking a mouse on a polygon representing one of the sections of creek corridor will allow you to summon the above information about each habitat type within that polygon.

4.7 Sites of Botanical Significance

The survey detected the sites of particular botanical significance summarised in Table 6.

Table 6. Sites of botanical significance

Title	Melway Reference	Most significant attributes
Gilmour Park, Upper Ferntree Gully	74 F8	Good wetland habitat with majestic Manna Gums.
Monbulk Ck /Ferny Ck flood plain, Rowville - Knoxfield	73 C9	Wetlands with good biodiversity and several regionally significant plant species.
River Red Gums, Karoo Rd, Rowville	73 D9	The last remnants in Knox of Red Gum woodland, formerly covering large expanses from here southward.
Yellow Box trees, Dorset Rd, Boronia	65 A12	A group of very old, large trees, of a species which has been decimated elsewhere along the waterways.
Blind Creek Billabong, Ferntree Gully	64 H11	Seven regionally significant plant species; around 100 indigenous plant species in total.
Timmothy Dr / Blind Ck Bushland	63 G12	Two regionally significant plant species; substantial areas of bushland with good biodiversity; unusual form of *Eucalyptus cephalocarpa*.
Cathies Lane Bushland, Wantirna South	72 E2-3	Six or seven regionally significant plant species; around eighty indigenous plant species in total.
Llewellyn Reserve North-east, Wantirna South	72 E-F 2	Vegetation with very good biodiversity regenerating after fire; many significant plants - possibly many more to be found when regeneration is more advanced.
Liverpool Road Retarding Basin, The Basin	65 G4	Many regionally significant plant species; substantial areas of bushland with very good or excellent biodiversity.
De Felice development site, Bayswater (in Maroondah)	64 K1	Many regionally significant plant species; one of the best wetlands in the region.
Wetlands east of University Rd	64 B3	Many significant plant species; augments significant bushland to the north.
Manson Reserve, Wantirna	63 J3	Many significant plant species; wetlands in very good ecological condition; augments significant bushland to the north.
Winton Wetlands, Wantirna	63 E3	Many significant plant species; wetlands in very good ecological condition.

5. Fauna

This project did not include a fauna survey, but it did include the identification of important wildlife habitat and opportunities to protect and improve it.

The fauna noted during the field work were mainly birds, butterflies, frogs and introduced mammals. A list of fauna seen during the study appears in Appendix C.

Consistent with Lorimer *et al.* (1997) and Bedggood *et al.* (1997), we regard nearly all indigenous bird species recorded in the study area as being biologically significant at the municipal level (i.e. within the context of the City of Knox). The exceptions are a few hardy, urbanised species such as Australian Magpie, Little Raven and Red Wattlebird.

We also regard every indigenous mammal species recorded as being biologically significant at the municipal level, with the exceptions of the Common Brushtail Possum and Common Ringtail Possum, which are extremely adaptable to the urban environment.

Sites of particularly significant observations of fauna or wildlife habitat are marked on the maps at the end of this report and listed in the section-by-section descriptions of the waterway corridors in Chapter 7.

Some native fauna were observed making use of introduced vegetation for habitat; e.g. wrens using blackberries for foraging, shelter and nesting. Brown Goshawk, Black-shouldered Kite and Nankeen Kestrel were observed in areas of predominantly introduced vegetation, presumably hunting prey such as mice, rabbits and introduced birds. Introduced flora and fauna are therefore acting partly as substitutes for the preferable indigenous species which they have replaced.

It is therefore important that programs to remove pest plants and animals are done with consideration for indigenous flora and fauna that may be reliant on them.

5.1 Sites of Zoological Significance

The survey detected the sites of particular zoological significance summarised in Table 7.

Table 7. Sites of zoological significance

Title	Melway Reference	Most significant attributes
Gilmour Park, Upper Ferntree Gully	74 F8	Known Platypus habitat; wetland frequented by water birds
Monbulk Ck, upper reaches (to Blackwood Park Rd)	74 A8	Known Platypus habitat.
Monbulk Ck / Ferny Ck flood plain, Rowville - Knoxfield	73 C9	Good wetland habitat; good numbers of locally or regionally uncommon birds of open country including Golden-headed Cisticolas and Brown Goshawks.
Blind Creek Billabong, Ferntree Gully	64 H11	Good forest habitat; mature trees with potential nesting and roosting hollows.
Cathies Lane Bushland, Wantirna South	72 E2-3	High diversity of nomadic birds (presumably coming from nearby Jells Park).
Liverpool Road Retarding Basin, The Basin	65 G4	Excellent forest and wetland habitat; excellent occurrence of water birds.
De Felice development site, Bayswater (in Maroondah)	64 K1	Good numbers of locally uncommon birds of open country including Golden-headed Cisticolas and Dusky Woodswallows.
Wetlands east of University Rd, Bayswater	64 B3	Good wetland habitat.
Manson Reserve, Wantirna	63 J3	Good wetland habitat.
Winton Wetlands, Wantirna	63 E3	Good wetland habitat.

6. Management Guidelines

This section provides background information and advice on how to manage land in the study area to meet the following ...

objectives:

- to protect and enhance indigenous flora and vegetation communities;
- to prevent further degradation of remnant vegetation and result in natural regeneration of bushland;
- to control and contain the spread of weeds;
- to improve wildlife habitat and enhance values of bushland areas as wildlife refuge;
- to improve the overall recreation experience for users of the land through enhancement of landscape values, screening visual intrusion of adjacent properties and suggestions for location of interpretative trails;
- to recommend areas and plant species for revegetation;
- to achieve the above objectives without compromising the flow characteristics of the waterways for flood mitigation.

Threatening processes ...

which the guidelines must address are, in approximately decreasing order of importance:

- weed invasion;
- inbreeding and critical diminution of populations of significant plant species;
- land development (particularly a proposed golf course on the border of Knoxfield and Ferntree Gully);
- fragmentation of the tree canopy;
- slashing of remnant natural vegetation;
- harm done by visitors (e.g. cubby houses, setting dogs onto birds)
- predation of wildlife and other environmental harm done by cats, foxes and dogs;
- clearance of vegetation to increase flow capacity during flood;
- grazing; and
- dumping of garden refuse and other rubbish.

The highest management priority is weed control, which is the subject of the following section of this chapter. Other categories of management actions are discussed is the subsequent sections, in approximately decreasing order of priority.

6.1 Weeds

An inventory of weed species is presented in Appendix B. The authors' qualitative assessment of weeds that are serious or very serious is given in Table 5 on p.23.

The control of weeds should be focused on species whose severity and ease of control is greatest. Some should be treated fairly uniformly throughout the waterways, while others only need attention in bushland areas.

We recommend that the weeds listed in Table 8 be destroyed wherever they occur along the waterways.

Table 8. Weeds recommended for removal wherever they occur along the waterways.

WEED NAME AND TYPE	TIMING
Vines	
Rubus discolor (Blackberry)	Highest priority. Spray as much as possible every summer. Combine with Honeysuckle control.
Lonicera japonica (Japanese Honeysuckle)	Not urgent. Spray bushland infestations in conjunction with the blackberry control program.
Woody weeds	
Cotoneaster glaucophyllus (Cotoneaster) *Cotoneaster pannosus* (Cotoneaster) *Crataegus monogyna* (Hawthorn) *Fraxinus angustifolia* (Desert Ash) *Pittosporum undulatum* (Sweet Pittosporum) *Salix fragilis* (Crack Willow) *Salix* × *rubens* (White Crack Willow) *Ulex europaeus* (Furze or Gorse)	Not urgent. Aim for progressive removal over several years. (This applies to all woody weeds in this table).
Herbs	
Cortaderia selloana (Pampas Grass)	Urgent. Aim to poison every plant within 2 years.
Hypericum tetrapterum (Square-stem St John's Wort)	Very urgent. Aim for total eradication in 1-2 years, with follow-up annually thereafter.
Watsonia meriana (Bulbil Watsonia)	Urgent. Aim to treat all small infestations of bush-land within one year, larger bushland infestations within 3 yrs, and non-bushland infestations in 5 yrs.

Where possible, owners of land adjacent to the waterways should be encouraged to cooperate by removing from their land any of the weeds in Table 8. This would be best done by pamphlet delivery to letterboxes, coinciding with control work on the adjacent public land.

Some of the remaining weeds that are deemed to be serious or very serious are so difficult to control that they only warrant effort in new infestations or particularly significant bushland areas.

Leaving aside these and the species already covered in Table 8, Table 9 lists the species which are recommended for highest priority in bushland areas.

Table 9. High-priority weeds recommended for removal only in bushland areas.

WEED NAME AND TYPE	CONTROL APPROACH
Woody weeds	
Erica lusitanica (Spanish Heath)	Manual removal, preferably July-August.
Grasses & their relatives	
Agrostis capillaris (Brown-top Bent) *Paspalum dilatatum* (Paspalum)	Where slashing can be done without detriment to indigenous vegetation, do so at New Year and at intervals through Jan-Mar depending on growth. Hand-weeding is best in spring to early summer. Paspalum can be spot-sprayed.
Anthoxanthum odoratum (Sweet Vernal-grass) *Dactylis glomerata* (Cocksfoot) *Holcus lanatus* (Yorkshire Fog) *Phalaris aquatica* (Toowoomba Canary-grass)	Where slashing can be done without detriment to indigenous vegetation, do so in early November and at intervals through Nov-Dec depending on growth. Hand-weeding is best in winter or spring.
Juncus articulatus (Jointed Rush) *Paspalum distichum* (Water Couch)	Hand-weed, preferably from September to December.
Cynodon dactylon (Couch)	Spray with a grass-specific herbicide according to label instructions.
Pennisetum clandestinum (Kikuyu)	Spray with herbicide in warmer months.
Creepers & Climbers	
Calystegia silvatica (Greater Bindweed)	Unknown.
Galium aparine (Cleavers)	Where possible to spray, do so in August.
Ranunculus repens (Creeping Buttercup)	Spray when the ground is at its driest. In frog habitat, use herbicide with low frog toxicity.
Tradescantia albiflora (Wandering Jew)	Manual removal, any season.
Forbs	
Lotus suaveolens (Hairy Bird's-foot Trefoil)	Where spraying can be done without detriment to indigenous vegetation, do so prior to seed-set (preferably around November). Hand-weeding is best in spring to early summer.
Mentha spicata (Spearmint)	As for *Ranunculus repens*.

The urgency and importance of control of weeds in Table 9 varies from place to place depending on the extent of the infestation and the significance of the vegetation affected. Highest priority should be given to the 'sites of significance' listed in Table 6 on p.25.

Note that where herbicide is indicated as an option above, it should not be used in very wet sites because of the sensitivity of aquatic environments and frogs.

Herbicides used in wetlands should ideally be registered for aquatic use (which includes a special formulation of glyphosate). They should be applied by qualified people in the driest practicable conditions. Check for frog calls (day or night) to detect breeding season, and avoid spraying then.

Herbicides not registered for aquatic use should not be used in wetlands while they contain water or are heavily populated by frogs.

The following subsections provide additional weed control guidelines concerning specific weeds or types of control.

Blackberry

Our survey saw plenty of evidence of good results from skilful spraying of blackberries in the study area. However, the rate of killing may be barely matching the rate of spread. There is great need for maintaining or increasing efforts to control this weed, and this should be a major component of Council's strategy for its waterways.

Highest priority for blackberry control should be areas where existing indigenous vegetation is in greatest decline from the weed's presence. Areas with more established infestations, where a stable state has arisen and only hardy indigenous plants remain (or none at all), should be given lower priority than other infestations unless they threaten nearby areas.

If blackberries are to be sprayed with a herbicide which is also suitable for Japanese Honeysuckle (as has occurred in the past), both weeds should be sprayed at the same time where they occur together or in close proximity.

As previously stated, some birds (e.g. wrens) have resorted to using blackberries where the natural habitat has been destroyed. It is also thought that Platypus have a distinct preference for overhanging vegetation at burrow sites, and sometimes blackberries are all that is left. Where this has happened, blackberry control should ideally be accompanied by planting of alternative habitat, such as Prickly Currant-bush (*Coprosma quadrifida*) and Sweet Bursaria (*Bursaria spinosa*).

Woody Weeds

Woody weeds such as willows, Desert Ash, Hawthorn and Box Elder are very prominent along all of the waterways surveyed. Their replacement with indigenous trees, where the drainage function of the creeks will not be impaired, would be most desirable from the perspective of landscape, habitat and hydraulics. Given the extent of the task, it would need to be staged over a number of years. The control methods proposed in '*Willow Control Procedure*' of Melbourne Water's Waterways and Drainage department should be successful for Desert Ash and Box Elder as well as willows.

Introduced Grasses

Careful timing of slashing can be used to keep exotic grasses in check, provided there are no indigenous shrubs which might be adversely affected.

Most areas with no indigenous shrubs or wildflowers should be slashed in early November, or the first opportunity in spring when a tractor can enter without risk of bogging (whichever comes later). This will deprive Yorkshire Fog, Cocksfoot and several other serious grass weeds of their seed crop. Slashing should then continue at a rate dependent on the rate of growth, until the ground becomes too wet in autumn or winter.

Heavy infestations of Brown-top Bent Grass (*Agrostis capillaris*) that threaten indigenous vegetation should be slashed very early in January to reduce seed production.

Grassy areas which must be slashed despite the presence of wildflowers should be slashed straight after species such as Milkmaids (*Burchardia umbellata*) and Chocolate Lilies (*Arthropodium strictum*) have set seed, normally around late December.

Revegetation Plots

Revegetation plantings are generally protected against weeds by mulch. However without attention, Couch and annual weeds (e.g. *Lotus suaveolens*) can invade in the spring and summer following the planting. These need to be destroyed manually or by the methods in Table 9.

Follow-up

When one species of weed is removed, it is often replaced by another weed. For example, blackberry removal is often followed by proliferation of annual weeds such as thistles, fleabanes and Ox-tongue. Weed control work should therefore always be planned with an allowance for follow-up.

Where weeds such as blackberries are to be destroyed with no indigenous plants to take over from them, slashing, revegetation and repeat spraying are all options for follow-up work.

6.2 Rare Plant Conservation

Many of the significant plant species in the study area are present in extremely small numbers, sometimes as a single individual. This renders them at serious risk from inbreeding and chance events (e.g. fire or inadvertent damage).

The only long-term prospects for survival of such species are with horticultural intervention to bolster population sizes and bring in broader genetic diversity from nearby sites with the same habitat types. This is also true of some other Council reserves.

We therefore propose the objective of increasing the numbers of individuals of rare plant species in the more intact parts of the study area, and avoiding inbreeding of critically small populations by translocation of progeny from one section of the creek system to another.

This objective should be supported by a program of population monitoring, plant breeding and re-introductions, overseen by a committee which might comprise representation from Council, Melbourne Water and Knox Environment Society.

Every effort should be made to exchange plant material only within each habitat type, or between similar habitat types.

The most important species for the breeding program are:

Allocasuarina littoralis
Austrofestuca hookeriana
Baumea species
Carex gaudichaudiana
Centipeda minima
Crassula helmsii
Cynoglossum latifolium
Danthonia duttoniana
Eucalyptus camaldulensis
Eucalyptus yarraensis (if its presence in Knox is confirmed)
Gratiola pubescens
Juncus vaginatus
Lycopus australis
Myriophyllum simulans/variifolium
Ranunculus ?inundatus (from Winton Wetlands)
Rapanea howittiana
Schoenus tesquorum
Thelionema caespitosum
Villarsia reniformis
Viminaria juncea
Wahlenbergia multicaulis

6.3 Revegetation and Regeneration

Restoring the Tree Corridor

Vegetation along waterways is extremely important in providing habitat corridors for animals to live and for migratory and nomadic species to move from one patch of habitat to another.

The effectiveness of a wildlife corridor depends greatly on the continuity of its vegetation. For aquatic fauna, it is also important to have a more or less continuous canopy over a creek to regulate water temperature and provide input of organic material.

Recent revegetation works have helped to fill gaps in the corridors of Knox's waterways. However, some large gaps remain, and many sections of creek are left unshaded.

To maximise the habitat and landscape value of the creek corridors, a central plank of the management strategy of Council and Melbourne Water for waterways should be:

> *to adopt the major, five-year objective of planting enough indigenous trees to provide, at maturity, as close as practicable to an unbroken line of trees along each waterway. Highest priority should be given to trees which will shade the sections of creeks which flow above ground, and to linking major habitat areas.*

Some of the existing gaps cannot be filled by adding mulched revegetation plots, because of flood control restrictions (see *'Maintaining drainage function'* below). The cost of such plots may also be too great to fill all the gaps in the recommended time. Where these problems are encountered, it should be possible to resolve them by planting carefully positioned, individual trees with weed mats and tree guards.

In some places the vegetation corridor is dominated by large woody weeds such as willows (*Salix* spp.) and Desert Ash (*Fraxinus angustifolia*). These introduced species are recommended for complete removal in Table 8. As they are removed, they need to be replaced with indigenous species (either through regeneration or revegetation) to restore corridor continuity.

Natural Regeneration

In addition to planting, there are many opportunities to allow existing vegetation to increase naturally, either by seed or vegetatively. Where this can be done, it offers the cheapest way of vegetating the area and providing species that are undoubtedly suited for the site. (Some species used in plantings turn out not to be so well chosen).

Two methods for natural regeneration are recommended here. The first is to relieve slashing as described in Section 6.4.

The second is to fence around suitable trees so that their progeny will not be killed by slashing or grazing. The fence around such a seed tree should typically be about 1-1½ tree-heights from the trunk.

A special case of natural regeneration occurs next to Coppelia St, Wantirna South, in Llewellyn Reserve. This area was burnt, probably around summer 1995-6. Natural regeneration is vigorous and includes several significant plant species. It is our expectation that several more significant plant species may appear late in 1997, and Council should ensure that the area is monitored in early November (when sun-orchids will probably be detected).

It is quite possible that the burnt area may regenerate to become one of the most botanically significant sites in the study area.

Species selection

The species we recommend as suitable for use in revegetation plantings are marked in bold in Appendix A. We recommend that these species be planted only within or near areas of the habitat types where the species have been observed (as indicated in the columns of the table in Appendix A).

Plants should all be propagated from local stock.

In addition to species highlighted in Appendix A for general revegetation, others may be propagated and planted under the conservation program recommended in Section 6.2.

One species of note is the Red-fruit Saw-sedge (*Gahnia sieberiana*). It is the critical food plant for the Sword-grass Brown Butterfly, a species in decline. Knox Environment Society already has a program to encourage planting it, supported by Council and Melbourne Water. The Society's guidelines recommend planting groups of saw-sedges at intervals of 200 m or less.

Maintaining Drainage Function

The capacity of waterways to carry flood water must not be compromised by revegetation works, and this limits the sorts of plants which may be planted along floodways. Swamp Paperbark (*Melaleuca ericifolia*) and tea-trees are examples of plants which, in dense stands, can create drag in flood flow and thereby exacerbate flooding.

Low-growing species which bend over in floods, such as Tall Sedge (*Carex appressa*), Purple-sheath Tussock-grass (*Poa ensiformis*) and Hop Goodenia (*Goodenia ovata*), are more acceptable and can be planted at high densities.

Sparse plantings of smooth-barked eucalypts such as Manna Gum (*Eucalyptus viminalis*) and Swamp Gum (*E. ovata*) are acceptable on some sites. These will be necessary in order to meet the recommended objective of providing continuous corridors of tree canopy along the waterways.

The centres of floodways are more sensitive than their margins to flow obstruction by inappropriate plantings. Mown sites directly over underground barrel drains are generally seen as unsuitable for revegetation, particularly near inlets and outlets and at critical flood points. Nevertheless, in some circumstances surrounding vegetation such as Common Reed (*Phragmites australis*) may be allowed to spread onto floodways above barrel drains.

Decisions relating to regeneration or revegetation on floodways need to be made on a site by site basis in consultation with the Environmental Planning Section of Melbourne Water. Melbourne Water's *Revegetation Strategy & Guidelines* covering floodway sites are expected to be released around the time the present report is released.

Planting method

The present practice of planting mixed trees and understorey plants in mulched beds should continue.

No planting should be done beyond the capacity of staff to keep weeds away, because otherwise it is a waste of time, money and propagating material. If residents who participate in a planting see it lost through neglect, they are likely to become disenchanted and not bother to attend another.

There are as many formulae for calculating the numbers of trees, shrubs and ground covers to plant in a given area as there are people organising the plantings. Melbourne Water is presently preparing revegetation guidelines which include this subject, but until then, an interim guide for restricted floodways is 1 tree per 10 m^2, one medium to large shrub per 5 m^2, one small shrub per square metre and up to 5 small herbaceous plants per square metre. Higher densities may be used where a broad flood plain is available.

Planted Environmental Weeds

Some inappropriate species have been used in revegetation works of earlier decades.

One category of inappropriate plants is those now known to spread and displace indigenous flora. This includes Willow Hakea (*Hakea salicifolia*) and Sallow Wattle (*Acacia longifolia*).

Another category is those which hybridise with naturally occurring plants, resulting in the possible swamping of genes which help the naturally occurring plants to survive. This includes non-indigenous species such as Bog Gum (*Eucalyptus kitsoniana*) and Spotted Gum (*E. maculata*), as well as plants whose species is indigenous but that are propagated from parents that are not local.

Removal of these inappropriate plantings is important but not urgent. Because some members of the community may be distressed at seeing established trees and shrubs removed, this should be done progressively, focusing on areas which are overplanted or where the greatest threat is posed.

Most recent plantings have been of indigenous species and probably from locally sourced material, creating no environmental risk.

6.4 Slashing

Most bushland patches in the study area are steadily diminishing in size due to continual encroachment of slashing around their peripheries. This represents an unnecessary decline in natural vegetation.

It is recommended that slasher operators be required not to slash into the margins of bushland.

Some areas that have been slashed in recent years are still capable of recovering if slashing ceases. These areas are marked on the maps at the end of this report and mentioned in the section-by-section descriptions of the waterways in Chapter 7.

Examples of indigenous plants which will regenerate strongly when slashing pressure is relieved are Swamp Paperbark (*Melaleuca ericifolia*) and Common Reed (*Phragmites australis*), both of which provide important habitat for native fauna. Slashed areas with a dense covering of these two species are recommended to be relieved from slashing (perhaps initially at their edges only), subject to the constraints of fire safety, free flow of floodwater and access to tracks and fences.

It may be necessary to delineate regeneration areas using fencing or marking with posts and signs. On some sites (e.g. Lewis Park), young revegetation plots have been mown. More frequent weed control and mulching is evidently required to ensure that the plantings are clearly visible to slasher operators.

Discussion with slasher operators may help to find an innovative method by which they could be made aware of regrowth or revegetation areas in a manner which is effective but minimises visual intrusion.

6.5 Wildlife Habitat

While enormously altered from their pre-European condition, sections of the study area such as the Ferny Creek and Monbulk Creek flood plains mentioned above have retained some fauna habitat values associated with patches of wattle regrowth along streams, and with large blackberry thickets and patches of unmown grass (eg. Toowoomba Canary Grass, *Phalaris aquatica*) on old market garden and grazing sites.

These 'wasteland wildernesses' have good numbers of birds of prey (mainly Brown Goshawks) sheltering and nesting in wattle scrub and hunting for mice and rabbits in the weedy paddocks.

The Golden-headed Cisticola, a small bird generally scarce in the Melbourne area due to urban development, is locally common in these 'weedy wildernesses', in patches of Common Reed (*Phragmites australis*), indigenous rushes (*Juncus* spp.) and exotic grasses. Careful planning and management will be required to improve the indigenous composition of these areas while preserving and, hopefully, increasing the existing habitat values.

Platypus have been found all the way along Monbulk Creek and further downstream along Corhanwarrabul Creek, according to the Australian Platypus Conservancy. Low, overhanging cover is very important in protecting their nesting burrows on creek banks, as well as for contributing organic matter to the creek and reducing water temperature fluctuations that disrupt

aquatic life. This cover is sometimes provided by blackberries where natural vegetation has been lost.

The presence of sites for nesting and roosting (particularly tree hollows) is important. There are still large trees with hollows, but when they die, they are frequently cut down in the belief that they are dangerous. In fact, dead trees may be less likely to fall or drop limbs than living ones because they offer less wind resistance and because dry timber is lighter and (if not rotten) stronger than green timber.

There is one other major way in which to provide good wildlife habitat (along with other benefits), and it is the subject of the following section:

6.6 Wetland Rehabilitation

Wetlands can provide good habitat for wildlife and plants, as well as an attractive landscape and a valuable educational resource.

The maps at the end of this report show that there are many seasonal wetlands within the study area, and some opportunities for creation of more.

Wetlands have a stronger capacity to regenerate than other types of habitat. Even a pond dug from a paddock can readily provide a site for indigenous wetland plants to colonise from seed borne on wind and the feathers and feet of water birds.

An example is a disused horse pond near the northern banks of Dandenong Creek west of Dorset Rd, where several regionally significant plant species volunteered themselves in what is now a rich ecosystem with very few non-indigenous components. Establishment of wetlands can therefore be very successful with limited effort.

In the study area, Winton Wetlands and Manson Reserve provide excellent examples of successful wetland establishment and rehabilitation (see pp.99-101).

Oates (1994) and Romanowski (1992) explain what is involved in the creation of wetlands. Information about weed control in wetlands is much scarcer, so the reader is referred to Section 6.1 above.

Because of the important habitat and landscape values of wetlands, and their relative ease of establishment and maintenance, we recommend that Council and Melbourne Water continue to create new wetlands where opportunities exist for improved water quality and habitat.

Since wetlands can be so successful with fairly limited effort, and because they can be readily enhanced by hand weeding of species such as Jointed Rush (*Juncus articulatus*), they provide a good focus for Friends groups.

6.7 Land Development

The study area is mostly public land, but some of it is being, or planned to be, developed. Adjacent land is also being developed, and this usually causes direct adverse impact inside the study area.

Developments include new subdivisions, conversion to multiple occupancies, and proposals for a golf course and other sporting facilities. Their effects include:

- clearing of vegetation, either for the development or for drainage required by the development;
- death or damage of trees whose roots are cut, often quite some distance from the trunks;
- alteration of soil hydrology and hence decline of vegetation health;
- proliferation of weeds planted in new gardens (e.g. Ivy, Cotoneaster, Wandering Jew);
- increased dumping of rubbish, particularly garden waste;
- loss of wildlife due to presence of pets and increased human and vehicle presence; and
- increased risk of fire-lighting, particularly by children.

Each development needs to be considered on its merits. It is therefore recommended that Council's planners be conscious of the issues above and direct new developments towards minimum adverse impact.

Golf Course and Other Developments, Rowville - Ferntree Gully - Knoxfield

A case of particular currency and importance is the development of the flood plain around the lowest reaches of Monbulk Creek, where proposals exist for a golf course, playing fields and other facilities. The area affected extends north from Kellets Rd to Ferny Ck, involving sections F8, F9, M2, M3 and M4 described in Chapter 7.

This area is largely weedy pasture dotted with blackberry thickets, wattle regrowth patches, reed beds and seasonal wetlands. It superficially appears to have little conservation value. However, there are several regionally significant plant species, and there are good numbers of birds such as Brown Goshawks and Golden-headed Cisticolas which are very uncommon in metropolitan Melbourne.

Any developments in the area should therefore be designed to minimise adverse effects on the significant flora and fauna.

The present study was not intended to survey wildlife, and so we are limited in our ability to make recommendations. A fauna survey is recommended prior to Council approving development plans for this area.

Nevertheless, some general recommendations can be made.

Most of the significant plant species occur in seasonal wetlands and drainage lines. As many as possible of these habitats should be retained. Where destruction cannot be avoided, any significant plants should ideally be transplanted or propagated for introduction to new or retained wetlands.

The features of the existing habitat which make it so good for the significant bird species are the combination of open, grassy expanses with shrubby or reedy patches and occasional trees for perching, roosting or nesting.

Development plans should aim to retain these features. They can even be improved relatively easily by replacing blackberry patches with indigenous shrubs and woody weeds with indigenous trees, and by planting more scattered trees for perching, roosting and nesting.

If a golf course is to be approved by Council, conditions should be applied that require the adoption and implementation of an environmental management plan. These are presently being promoted and researched within the golf course industry. A plan could provide official recognition of the importance of the area for fauna and flora, and prescribe management practices that conserve these values.

6.8 Grazing

Horses and cattle with access to creek banks or adjacent land can cause environmental harm through:

- erosion;
- siltation;
- fouling of water;
- soil compaction and pugging (i.e. the creation of muddy ground full of hoof-prints);
- weed dispersal (through manure and stock feed);
- encouragement of weeds through natural selection of species unpalatable to the animals;
- ringbarking of trees; and
- trampling and grazing of desirable understorey, including plants that are needed to filter excess nutrients (e.g. manure) before they reach the creek.

The upper reaches of Ferny, Monbulk and Dandenong Creeks are particularly affected.

Stock can be provided with alternative watering and do not need creek access. It is recommended that Council and Melbourne Water use their Stream Frontage Management Program or other means to remove existing creek accesses for stock and have the affected areas fenced to allow the banks to recover.

Planting of trees and low plants such as Purple-sheathed Tussock-grass (*Poa ensiformis*) would be highly desirable in conjunction with the fencing.

6.9 Community Involvement

Council cannot maintain the momentum and funding required to complete long-term bushland maintenance, restoration and expansion projects without the interest, support and participation of the community. Therefore, community education and the assistance of Friends Groups deserves substantial commitment, finance and staff time.

Community involvement commences with meeting local people to discuss any proposed change to their open space. The rehabilitation of linear open space corridors is ecologically desirable, and even essential to the continued survival of local flora and fauna, but unless this rationale is accepted by residents using or living near the reserves, the task becomes long and tedious and its chances of success are reduced.

Although not everyone will want to actively participate in planting, weed removal or other physically demanding work, keeping people informed of the goals of neighbourhood conservation programs and the progress being made towards those goals is very important in gaining general acceptance of the works (and the fact that rates money is financing them) and help people feel that they are a part of the activity.

Offering local residents nature walks with a skilled naturalist can help to change the way people think about their local piece of bush. It can engender interest and pride, and make the difference between having a supportive local community and trying to retain local bushland remnants in the face of apathy or even antipathy.

It may also encourage the formation of 'Friends Groups'. Such groups need ongoing Council assistance, but overall they could save money for Council and Melbourne Water. Initially, members will be keen, but most will need basic training and guidance.

Friends Groups need a focus, which could be particular wetlands, or the quality of a stretch of creek, or preservation of fauna species like Swordgrass Brown butterflies, frogs or birds such as rosellas, hawks and Golden-headed Cisticolas.

It must be stressed that not all work is of a strenuous physical nature and that there are tasks within the ability of almost everyone. Watching for fauna (diurnal and nocturnal), keeping records of activities, writing newsletter articles, talking to local groups and schools about the aims and activities involved, or making nest boxes for birds, possums and bats are all valuable contributions.

Community interest and involvement can be promoted by production of brochures about the flora and fauna to be found along the various waterways. Brochures are also useful as responses to requests for information from school students.

A brochure could be produced for each site of significance. There could also be one for wetland flora and fauna, one for birds and their movement along the waterways, and so on.

A set of examples of brochures that may serve as models is presented in Appendix E.

6.10 Visitor Impact

Each year, a substantial area of bushland in the study area is damaged by cubby house construction and use. Fires are often associated, representing a threat to life and property.

Prevention of cubby house construction is intractable. In the usual event that the culprits are not found, the only worthwhile responses known to us are removal of each cubby house as soon as it is found, and a letterbox drop in the neighbourhood advising of the problem.

Walking dogs along shared pathways can have adverse effects if the dogs are unleashed. They may represent a nuisance or a cause of fear or concern to other users. Some owners even encourage their pet to chase water birds, with obvious adverse effects on the wildlife and hence the enjoyment of other people.

Staff working regularly in the waterway reserves should be trained or advised how to approach and deal with someone found at a cubby house, or letting their dog run loose, or similarly causing harm. Emphasis should be placed on imparting a recognition of the area's ecological values.

6.11 Rubbish

The dumping of garden refuse and other rubbish is a problem in numerous locations throughout the study area. Dumping is most common where access is easily gained.

Garden refuse dumping:

- spreads weeds;
- smothers indigenous vegetation;
- adds excess nutrients to the soil (encouraging weed growth); and
- encourages proliferation of bacteria and fungi that are deleterious to indigenous plants.

It is important that Council remove dumped garden refuse and other rubbish because people are less likely to litter or dump rubbish in an attractive area. Rubbish attracts more rubbish.

6.12 Paths and Nature Trails

Paths in the study area have often been located very close to fences even where this is not necessary. In these situations, it is not possible to plant between the path and the fence because of possible fire risk or simply because there is no room. Locating paths close to fences is inadvisable for reasons of visual amenity and because the adjacent fences are prone to become graffiti boards.

It is recommended that paths not be located unnecessarily close to neighbours' fences.

The extent of the path system is mostly adequate; however new paths are recommended along Blind Ck near Timmothy Dr, Wantirna South (see p.86). In addition, an easterly extension of the Dandenong Ck path is becoming increasingly desirable due to rapid population increase east of Colchester Rd.

If track systems are not adequate, people create their own and often cause damage, particularly when these tracks start to hold water forcing walkers to walk beside them.

A number of locations along existing paths are well suited to signs drawing attention to the natural features present. These are shown on the maps at the back of this report.

There are many schools close to linear reserves and the availability of nature trails and accompanying notes could be valuable for science or biology teachers and allow students to gain a

greater appreciation of the Australian bush. Signposting interesting features or places where an insight into natural processes can be gained would improve the quality of user experience for everyone.

One location, Liverpool Road Retarding Basin, is recommended for a new nature trail with signs at several stops. This would be included in the management plan which we recommend for that site (see Section 7.6 and the first recommendation on p.2).

6.13 Pest Animals

Red Foxes were commonly seen or detected by their droppings during the field survey. They are likely to be having a significant effect in killing wildlife. Control programs for foxes can only be conducted by the Dept of Natural Resources & Environment, and this should be encouraged by Council.

Rabbits are likely to form a significant part of the diet of Brown Goshawks in the study area, particularly near the confluence of Monbulk and Ferny Creeks in Ferntree Gully. A reduction in rabbit numbers (e.g. by calicivirus) should be expected to adversely affect the goshawks.

Feral Mallard ducks are found on the lakes at Gilmour Park and Liverpool Road Retarding Basin. They occur with flocks of the indigenous Pacific Black Duck. Interbreeding between feral and indigenous ducks has been observed in the district and the feral ones may also out-compete indigenous ducks for food and other resources. Assistance with removal of feral Mallard ducks from these sites should be sought from the Dept of Natural Resources & Environment.

Common Mynas are likely to be out-competing indigenous birds for scarce nesting hollows. Starlings may be doing the same. The only method of control currently available is the monitoring of tree hollows to determine which species are using them and to continually destroy the nests and eggs of the introduced species.

6.14 Water Pollution

During our flora surveys, the water in the creeks was at times gun-metal grey in colour.

Siltation and excessive nutrient levels are bound to be reducing many stretches of creek to weedy, over-simple ecosystems in which the creek bed is dominated by hardy fauna such as leeches and worms. This renders the environment unfit for higher animals such as molluscs, fish, Water Rats and Platypus. Similar effects are likely in wetlands.

The use of chemicals (including herbicides) near waterways and wetlands must be done with great care.

Other aspects of pollution control are beyond the scope of this report.