

GUIDELINES FOR ASSESSING AND MONITORING SCLEROPHYLL BUSHLAND HEALTH

A Component of the Trust's Manual:
"Aspects of Catchment Health"



GUIDELINES FOR ASSESSING AND MONITORING SCLEROPHYLL BUSHLAND HEALTH, Hawkesbury-Nepean Catchment Management Trust, Windsor, NSW, Australia, 2000.

We are always seeking comments on the usefulness of this guideline for your project. Please write, phone or email any suggestions for improvement. Please do not extract any parts of this document for your own publications without contacting us first.

Please return any comments to:

**CRAM Project
HNCMT
PO Box 556
Windsor NSW 2756**

**Tel: (02) 4577 4243
Fax: (02) 4577 4236
Email: cram@hncmt.nsw.gov.au**

© Copyright Hawkesbury-Nepean Catchment Management Trust, 2000.

Editors: Jamie Molloy, Haydn Washington, 1999. Final editing by Shelley Baldwin, 2000.

Acknowledgments

This project has been funded by the Commonwealth Natural Heritage Trust.



Guideline Summary

Introduction

Describes bushland in the Hawkesbury-Nepean Catchment, and defines the concepts of resilience, remnant vegetation, connecting corridors, and biodiversity – concepts we harness to protect and enhance bushland resources. This section provides an overview of the checklist system used in this guideline, and suggests real ways that community groups can use the information they gain from assessing and monitoring their bushland sites.

Initial Site Assessment

Explains how to draw a map of your site, marking all the apparent problems, and how to complete Checklist 1: Site Description. Tables are provided for referencing vegetation type, geology, subcatchment division, common tree species for your site, and vegetation structure and percentage cover.

Monitoring Checklists

Contains 5 standardized monitoring checklists (2-6) to measure site features, a detailed site traverse, biodiversity, habitat, and disturbances at bushland sites. Provides a quantifiable index used to rate the health of each of these aspects of bushland health. Community groups can keep track of change at their site through repeated assessments – any change in the index number means the site has either degraded or improved!

Overall Assessment /Lessons for Management

Summarizes all the findings from the previous 6 checklists into a single general score (Checklist 7). The section suggests different management actions that can come out of the score results, and then prompts groups to think forward and predict what the health of the their bushland site will be in the future – using a more qualitative assessment focus (Checklist 8).

The Page Numbers

Each section of the CRAM Manual can be identified by its page number, eg:

ACH means Aspects of Catchment Health; BCP = BushCare Project; SBH = Sclerophyll Bushland Health; RBH = RiverBank Health; WM = Weed Mapping.

Symbols used in the Manual

The following symbols identify important sections in the manual. They will help you to navigate through the manual to locate information relevant to you.



Indicates text describing what you will learn in this section. This symbol usually occurs at the beginning of a section/chapter.



Indicates an important passage in the text for special attention



Occurs at the end of a section to summarise the guideline

Contents

Monitoring Sclerophyll Bushland Health	1
Bushland in the Hawkesbury-Nepean Catchment	2
What Community Groups do to Protect Bushland in the H-N Catchment.....	2
Important Concepts to Know – Resilience, Remnant Vegetation, and Biodiversity ...	3
The Sclerophyll Bushland “Rapid Assessment” Checklists.....	5
Important Conditions of Use.....	5
Checklist Indicators and Scoring Systems	6
What the Monitoring Checklist Scoring System Means	6
How You can Use the Checklist Data.....	7
Site Description	8
Drawing a Map and Marking Zones.....	8
The Site Description Checklist.....	9
Checklists for Monitoring Bushland Health	15
Monitoring Checklist 2: Site Features	15
Monitoring Checklist 3: Biodiversity Traverse	17
Monitoring Checklist 4: Biodiversity.....	20
Monitoring Checklist 5: Habitat Features.....	24
Monitoring Checklist 6: Disturbances.....	26
Overall Assessment	29
Monitoring Checklist 7: Summary of Bushland Health	29
Making Predictions: How will the Area be in the Future?	31
PROGNOSIS	31
Checklist 8: Further Assessment (non-scoring).....	32
Lessons for Management	34
References.....	35
Other useful reading	35

Monitoring Sclerophyll Bushland Health



What you will Learn in this Section:

- Keeping native bushland is the best way to maintain biodiversity
- Define important concepts – resilience, biodiversity, remnants, connectivity
- Indicators that measure the health of Sclerophyll bushland – such as Edge to Area ratio of remnant vegetation
- Use the checklists to create an index number to easily compare changes in bushland health over time
- Create a map that becomes a visible spatially organized description of your project site and its issues

Maintaining native habitat is the best way to keep our diversity of animals and plants in the Hawkesbury-Nepean catchment, so we need to continually measure (monitor) the 'health' of bushland in the catchment to make sure our management strategies are working.

The Sclerophyll bushland health checklists have been developed for communities to measure the health of their local native sclerophyll bushland by observing 3 main landscape features:

1. Plants - types, structure, and health
2. Habitat – existing and potential places for animals and plants to live and grow
3. Disturbances that damage habitat health – eg. erosion, pest invasions, pollution, and land clearing

✓ People wanting to use the checklist need only minimum knowledge, experience and training to complete. For example, the ability to see the differences between different plants is required, but the knowledge to identify botanical names is not. Anyone who is interested in learning about their environment and how to collect information about it can use methods in the CRAM Manual!

Bushland in the Hawkesbury-Nepean Catchment

The Hawkesbury-Nepean catchment contains a wealth of bushland, relative to other areas in the Sydney region (Webb & Foley, 1996), with 60% of it being made up of native vegetation. Some of this bushland is in national parks and wilderness areas and is largely undisturbed. However, a large part of it lies outside of reserves on public and privately owned land.

These bushland areas, whether they exist as isolated remnants or areas adjoining larger bushland areas, are under threat from a broad range of pressures exerted through human activity. We need to be able to identify what the threats are, and how much affect they are having on our bushland, in order to protect it from serious degradation. The major threats to bushland stem from land clearing, urban development, stormwater runoff transporting high nutrient levels, inappropriate fire management, weed invasions, and predation or displacement of fauna by introduced animals such as foxes, cats, dogs, rabbits and Indian mynahs.

The local Government Act 1993 requires that bushland be identified as a **community asset**, and the value it brings to the community ranges from ecological significance, aesthetic and recreational features, through to essential enhancement and protection of catchment water quality. According to the principles of ecologically sustainable development (ESD) bushland should be used, conserved and enhanced so that ecological processes on which life depends are maintained, and quality of life for present *and* future generations is increased.

What Community Groups do to Protect Bushland in the H-N Catchment

The work that environmental community groups undertake to rehabilitate and protect bushland is vitally important for overall catchment health. They act as problem identifiers, investigators, communicators, and publicists – all in addition to doing the on-ground tasks of weed and rubbish removal, soil stabilization, plant propagation and replanting! The Hawkesbury-Nepean Catchment Management Trust openly and warmly acknowledges the great work community groups do to help improve the health of our catchment!

The aim of this CRAM manual is to act as a useful tool for community groups to measure changes in bushland sites so they can know if it is declining, stable or improving. It is *not* intended as extra paperwork, but to provide sound and consistent information that community groups can use to improve their project works, their applications for funding, and overall environmental management practices.

✓ ***This guideline describes relevant background information explaining important concepts about what makes bushland valuable to our community, and why we should work to protect it now and in the future.***

Important Concepts to Know – Resilience, Remnant Vegetation, and Biodiversity

It is important to understand that bushland community groups are working with the **resilience** of the bushland landscape to make it healthy and sustainable as an ecosystem. Resilience is the ability of bushland to regenerate, or return to a stable functional state after being disturbed, or damaged. The Checklists contained in this CRAM component measure resilience (indirectly) by assessing the extent of native vegetation present and what levels of disturbance are present in the area.

Much of the urban and peri-urban areas of the Hawkesbury-Nepean catchment contain bushland as **remnant vegetation**. Patches of remnant vegetation occur after a change of landuse has caused the removal of previously existing habitat. Remnants are important to protect and enhance as they maintain **biodiversity**, especially if they contain protected species and provide habitat for native fauna.

Biodiversity is a complex term describing: (1) the health of an individual species gene-pool (ensuring viable number of a species to maintain populations); (2) the variety of different species living in an area; and (3) the variety of habitats and ecological processes occurring in the area to sustain the healthy function of the entire ecosystem.

In short, the more kinds of living things sustainably live in the area, the greater the chance that the area can continue to support life after some change, or disturbance, has altered the ecosystem balance.

Where remnant stands of vegetation are connected, or linked, by **corridors** of bushland, movement and migration of animals and plant seeds can occur. **Connectivity** of vegetation patches is a strong indicator of an enhanced ability of the landscape to sustain native plant and animal populations and protect biodiversity.

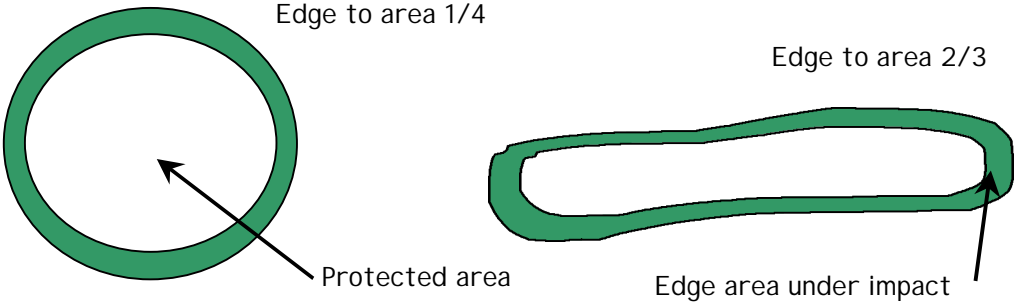
The capacity of remnant stands to withstand physical disturbance depends on 3 main factors – **size**, **shape**, and **position** in the landscape, described as follows:

Remnant Size	Remnant Shape	Remnant Position
<p>Size is important! Larger stands of remnant vegetation are better able to survive as viable areas of native habitat.</p>	<p>The shape of the remnant is important because it determines how much edge is exposed to disturbances such as fire, pesticide spray drift, weed invasions, and impacts from animal pests.</p>	<p>Where the remnant exists in the total landscape is important too. They may protect the land from erosion forces if they remain along gullies or on steep slopes.</p>
<p><i>Please refer to Info-Box 1.</i></p>		

EDGE to AREA RATIO: Most impacts on remnant vegetation occur around its edges and along the banks of streams running from more degraded areas of the catchment.

As a rough guide, circular remnants have less edge relative to their area than do long and narrow stands of vegetation, so the protected area within the remnant is greater for circular stands.

NB* The 'edge to area ratio' is an indicator used in the Site Features Checklist (2), and is applicable to State of Environment reporting.



Info Box 1: Edge to Area ratios of example remnant vegetation stands.

The Sclerophyll Bushland "Rapid Assessment" Checklists

This rapid assessment method is designed to be an early warning system for bushland health. It is described as "rapid" because it only takes a short amount of your time to complete. A number of checklists are included in this assessment guideline.

The checklists have not been designed for professional biologists, and are not intended to replace detailed ecological studies. Community groups, interested people, landholders and government/management agency staff can all readily use CRAM methods to find out more about their environment.

- ✓ The value of using the CRAM checklists is to find out when more detailed studies are needed.

Important Conditions of Use

The checklists are targeted at measuring dry or wet **sclerophyll forest or woodland** dominant in the Hawkesbury Nepean catchment, with the occasional pocket of other vegetation such as rainforest or heathland. Because it is designed specifically for sclerophyll bushland on sandstone or shale bedrock (which covers much of the catchment), it will not function well if used in other vegetation types. Sclerophyll can be described as an evergreen species from Mediterranean climates with a thick cuticle layer covering the leaves, for example, gumtrees. The sclerophyll community derives its name from the dominant species.

Other checklists developed by the Trust to measure aspects of wetlands, saltmarshes, bushcare projects, and riverbanks are elsewhere in the CRAM manual.

The checklists are aimed mainly at **remnant** vegetation, but can be used on any area of sclerophyll vegetation as long as it is carried out in a defined (mapped) zone or site. They are not really designed for large areas of bushland (over 20 ha), but can be used in these areas if the assessments are repeated in smaller 'zones', as shown in Figure 1.

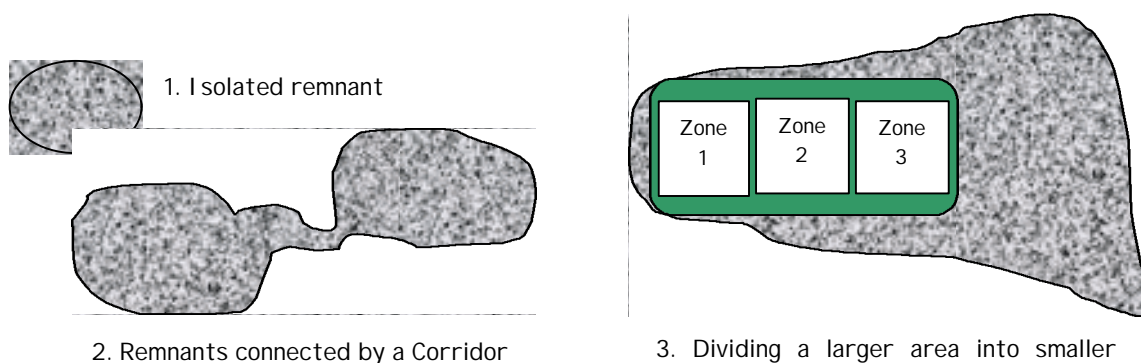


Figure 1. Checklists measure remnant vegetation stands (1 & 2) and smaller zones of larger bushland areas (3).

Checklist Indicators and Scoring Systems

Checklist 1, the Site Description Checklist is **non-scoring**, and is the first **Assessment** to be done on the site that brings together data on things that change slowly, or not at all. Information includes the geology, landscape and topographic map descriptions of sites, landuse history, known disturbances, and predominant vegetation community types. Much of this data can be collected before you venture out onto your site using maps, books and archives.

Checklists 2-6 are **Monitoring** Checklists with a **scoring** system that measures things that can change relatively quickly – eg. over weeks and months. The scores you tabulate provide a number, or index, showing how healthy your site is at that point in time. You can then compare between different monitoring times to see if the health of sclerophyll bushland at your site is improving, stable, or declining. Comparisons can also be made between different sites to measure how management actions are affecting bushland health across a wider region.

✓ The scores for each Monitoring Checklist (No. 2-Description; No. 3-Traversal; No. 4-Biodiversity; No. 5-Habitat; No. 6-Disturbance) are then tabled in a Final Assessment (Checklist 7) to make up a summary index describing the overall health of your sclerophyll bushland site.

What the Monitoring Checklist Scoring System Means

The scoring does not dictate a defined point where native vegetation is not worth keeping. **We believe that the sclerophyll bushland remaining in the Hawkesbury-Nepean Catchment is all worth keeping.** For example, if an area is shown to be degraded and without shrub and herb layers, it may still provide habitat for native animals and plants. Such areas need management and be allowed to regenerate.

If your site returns very high scores from the checklists indicating serious health decline, then your group should refer to experts such as the Royal Botanic Gardens, Australian Museum, the National Parks and Wildlife Service or local government for further **action**.

*As CRAM methods become accepted as **Standard Methods** for community monitoring to provide repeatable and trustworthy information. Community groups stand a better chance of having managers take their environmental concerns more seriously, and engage in positive response.*

If the land is in private ownership, the owner may wish to consider a Voluntary Conservation Agreement with the NPWS to ensure the survival of the bushland.

How You can Use the Checklist Data

The CRAM Bushland Health monitoring methods are not management plans for carrying out bush regeneration or restoring the bushland to its original condition. Instead they give a benchmark for assessing current condition, and for measuring condition over time.

The information gained by **consistent assessment** and **monitoring** of bushland sites can be used for:

- Helping to educate your group on what to look out for in terms of observing bushland change.
- Measuring the success of your own bushland regeneration work over time.
- Demonstrating to government, environmental managers, and the wider community that certain action is needed to protect local bushland – highlighting the complexity and values of bushland vegetation and why it should be conserved.
- Enhancing your groups chance for funding from various grant agencies to help your environmental work.
- Providing information to councils for inclusion in SoE reports.
- Evaluating management or conservation strategies already put in place.

✓ The ultimate use of information you collect through monitoring your bushland site is to lead to the better management of bushland in the Hawkesbury-Nepean catchment.

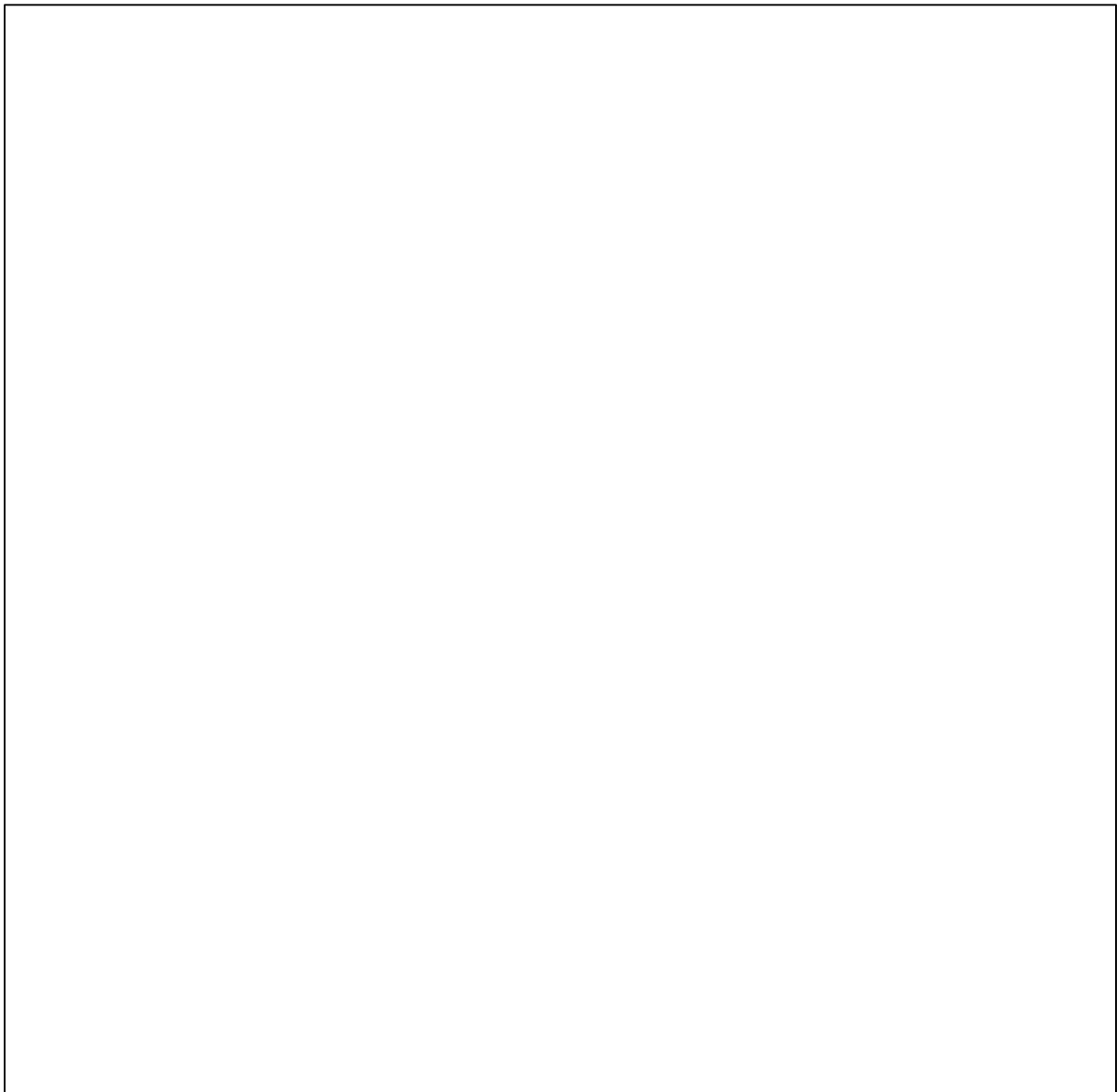


Site Description

Drawing a Map and Marking Zones

- Sketch a map of your sclerophyll bushland site, showing scale, north direction and any major landforms (eg. streams, hills).
- Draw on your map 'zones' of different vegetation types eg. sandstone sclerophyll, shale sclerophyll, She-oak communities, wetlands, heathlands, and rainforest. For small remnants the whole of the area will be one zone.
- Show any connecting corridors.
- Also attach a photocopy 'blow-up' of the relevant 1:25,000 topographic map, with the bushland site marked on it for easy future reference.

Space is provided here for sketching a "birds-eye" view map – as if you were looking down on your site. If your site is divided into zones, you need to draw a map for each zone.



The Site Description Checklist

The site description checklist is an initial evaluation of your whole bushland site and is **non-scoring**. Do some 'desktop research' collecting maps, contacting your local council, Fire Brigade, and library, and talk to locals who know the past history of the area.

Landscape Assessment

- Assess the geology, soils, aspect and slope of your site (**see Methods section in Aspects of Catchment Health ACH p.25**). Consult your local library, council, university and the Hawkesbury-Nepean Catchment Management Trust for maps and information.
- Record the knowledge and experience levels of members of your group doing the checklist as a simple indicator for quality assurance of data collection.

History Assessment

- Provide some background about how the land has been used, and major disturbance events like fire and drought.

Plant Assessment

- Determine what **vegetation type** is present in your site (Benson *et al.*, 1996). Begin by comparing your dominant tree species with those in Table 1 (Vegetation Types).
- Compare the geology, habitat, and sub-catchment types with vegetation type - all four together should give you confidence in your vegetation type description.

Eg., if your site is at Hornsby, with Blue gums (eg Eucalyptus deanei) and turpentines (Syncarpia glomulifera), then you would be in the Berowra sub-catchment (see map in Appendix 2). From the geology sheet you are on Narrabeen sandstone. If your site is in a valley you would see that it meets the habitat requirements of 'better soils in valleys'. Your vegetation type would thus be 2(d) Blue Gum Forests below sandstone ridges'.

- Record your result on the site assessment checklist.
- Determine the **vegetation structure** of your site (Specht, 1970) by estimating the height of your tallest layer and the percentage foliage cover of that layer.

Estimate height - look at a tree some way off and imagine a 2-metre person at its base, then count this distance up the tree.

To find percentage cover look up at the area covered by the canopy, noting the amount of light let through by the gaps in the canopy. Figure 2 (Vegetation structure) shows actual photos of canopy cover to compare with your site to reach an estimate. Get another person to check your result to improve the quality of the data.

- Record if there is evidence of **Succession** - when one plant community replaces another over time. Plant communities are never static - they change over time!

Succession includes rainforest species moving in under eucalypt forest due to the area not being burnt for some time, or when grazing ceases and shrub species grow, followed by trees. Weed invasion can also be 'Succession'.

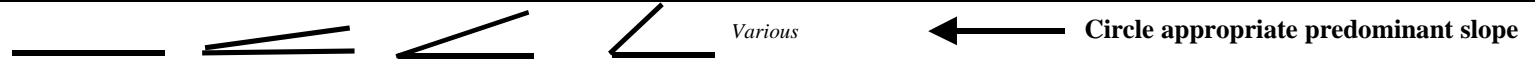
- Note if special or particular vegetation types are found in your bushland, as listed by the Royal Botanic Gardens, or your site contains high biodiversity. Also note any rare and threatened species and endangered communities (under the Threatened Species Conservation Act 1995 - refer to the NPWS web-site) present at your

site.

Checklist 1. Schlerophyll Bushland Site Description - Assessment

Site name:	Date:	Season:	Site location (eg. street directory):
1:25,000 Map Name:	Sheet number: _____	Zone: __	Easting: _____ Northing: _____
Assessor's Name:		Owner's name (if different):	
Comments:	Geology: Hawk. Sandstone Narrabeen Sandstone Alluvial Other	Aspect: N NE E SE S SW W NW	
	Soils: Sandy Loamy Clayey Alluvial Other	flat valley bottom ridge-top various	

Landscape



Map attached: Sketch map Photocopy of 1:25,000 topographic	Knowledge level of assessor: low medium high
Tick if you have completed: course/certificate in bushcare course/certificate in plant ID or Env't. Science degree in biology/Env't. Science other science degree and/or have long term knowledge / observation of the area	
Area of bushland site (ha):	Sub-catchment of Hawkesbury Nepean:
Altitude of site (metres)	DLWC soil landscape unit (if known):
Comments:	

HISTORY

Past land use: grazing horticulture urban forestry industrial vacant Crown land Crown lease Council/ public land Other		
Current land use: grazing horticulture urban forestry industrial vacant Crown land Crown lease Council/ public land Other		
Fire history – last 3 fires and intensity (or unknown):	Next planned hazard reduction burn:	Do you think the bushland is currently affected by drought?
Comments:		

PLANTS

Is your bushland native regrowth or the original bush? Yes No mixture Can't tell	If regrowth, what from. Eg fire, logging etc.	3 most common native trees:
Tick the layers of vegetation you have present: Tree canopy Tree subcanopy Shrub Groundcover Varies		3 most common native shrubs:
Vegetation type (see Table 1):		Specht vegetation structure (see Table 2):
Is the percentage canopy cover: less than 10% (woodland) between 10 and 30% (woodland) between 30 and 70% (forest) more than 70% (forest) (See Fig. 1)		Weed species present:
Is there evidence of plant succession such as: rainforest species moving under eucalypt spp, other native species (eg fire) weed invasion		
Does your site contain: Floodplain forest (on H-N river) Gully rainforest A heathland area A Woronora plateau community		
Does your site contain: Locally rare species Rare species (ROTAP) Vulnerable species Endangered species Endangered community		
Comments:		

TABLE 1. VEGETATION TYPES FOR GEOLOGIES WITH SCLEROPHYLL VEGETATION(Benson *et al.*, 1996)

Vegetation type	Habitat	Geology	Sub-catchment	Most common tree species	Tick box
Sandstone plateau forests (3a)	Sandy soils on plateaus and gullies above 800 m	Narrabeen group sandstone	Blue Mountains, Colo	<i>Eucalyptus sieberi</i> (Black Ash), <i>E. piperita</i> (Sydney peppermint), <i>E. mannifera</i> , <i>E. sclerophylla</i> (Scribbly Gum)	
Heaths, woodlands and forests (2a)	Sandy soils on ridge-tops and hillsides	Hawkesbury sandstone	Berowra, Blue Mtns, Cattai, Colo, Cowan, Macdonald, Mangrove Mid-Nepean, Hawkesbury	<i>Scribbly Gums</i> (<i>Eucalyptus haemostoma</i> , <i>E. sclerophylla</i>), <i>Corymbia eximia</i> (yellow bloodwood), <i>Angophora bakeri</i> (Narrow-leaved Apple), <i>E. oblonga</i> , <i>E. punctata</i> (Grey Gum)	
Turpentine Ironbark forest (2b)	Clay soil on remnant caps – e.g. Springwood	Wianamatta shale	Berowra, Blue Mtns, Cattai, Colo, Cowan, Macdonald, Mid-Nepean	<i>Syncarpia glomulifera</i> (Turpentine), <i>E. paniculata</i> , <i>E. eugenioides</i> (Thin-leaved Stringybark), <i>E. crebra</i> , <i>E. punctata</i> (Grey Gum)	
Mellong Swamps (2c)	Poorly drained low nutrient sandy soils	Alluvial sand	Colo, Macdonald	<i>Eucalyptus parramattensis</i> (Drooping Red Gum), <i>Angophora bakeri</i> , <i>E. sclerophylla</i>	
Blue gum forests below sandstone ridges (2d)	Better soils in valleys	Narrabeen sandstone	Berowra, Blue Mtns, Cattai, Colo, Macdonald, Mangrove, Mid-Nepean, Hawkesbury	Blue gums (<i>Eucalyptus deanei</i> , <i>E. saligna</i>). Turpentine (<i>Syncarpia glomulifera</i>), <i>Angophora floribunda</i> (Rough-barked Apple), <i>Allocasuarina torulosa</i> (Forest Oak)	
Ironbark forest (2g)	Clay soils in upper Macdonald valley	Narrabeen group	Colo	<i>Eucalyptus fibrosa</i> (broad leaved ironbark), <i>E. crebra</i> (narrow leaved), <i>E. behriana</i> , <i>Angophora costata</i> , <i>E. punctata</i>	
Cumberland Plain Woodlands (1a)	Flat to hilly country of western Sydney	Wianamatta shale	Cattai, Mid Nepean-Hawkesbury, South Ck, Upper Nepean	<i>Eucalyptus moluccana</i> (Grey Box), <i>E. tereticornis</i> (Forest Red Gum), <i>E. fibrosa</i> , <i>E. sideroxylon</i> (Mugga Ironbark)	
Castlereagh woodlands (1b)	Low nutrient clay and sandy soils	Tertiary alluvium	Mid Nepean-Hawk., South Ck	<i>Eucalyptus fibrosa</i> , <i>E. sideroxylon</i> , <i>E. sclerophylla</i> (Scribbly Gum), <i>Angophora bakeri</i> (Narrow leaved Apple)	
River flat forests (1c)	Floodplains of H-N river and tributaries	Alluvium	Hawkesbury and Nepean river and tributaries	<i>Angophora subvelutina</i> , <i>E. tereticornis</i> (Forest Red Gum), <i>Casuarina cunninghamiana</i> , <i>Acacia binervia</i> , <i>Backhousia myrtifolia</i> (Grey Myrtle)	

Vegetation type (Table 1 cont.)	Habitat	Geology	Sub-catchment	Most common tree species	Tick box
Glen forests (2e)	Fertile soils, eg. Mt. Wilson	Tertiary basalt	Berowra, Blue Mtns, Cattai, Colo, Cowan, Macdonald, Mangrove	<i>Eucalyptus deanei</i> (Round-leaved Blue Gum), <i>Syncarpia glomulifera</i> , <i>Angophora costata</i> (Smooth-barked Apple)	
Newnes plateau woodland (3b)	Highest Blue Mtns plateaus at 1000-1200 m	Narrabeen group sandstone	Colo	<i>Eucalyptus sieberi</i> , <i>E. oreades</i> (Blue Mtns Ash), <i>E. radiata</i> (Narrow leaved peppermint), <i>E. dives</i> (Broad leaved Peppermint), <i>E. blaxlandii</i> (Brown Stringybark)	
Woodland (4a)	Talus slopes of Capertee and Wolgan valleys	Permian coal measures	Colo	<i>Eucalyptus rossii</i> (Scribbly Gum), <i>E. macrorhyncha</i> (Red Stringybark), <i>E. polyanthemos</i> (Red Box), <i>E. fibrosa</i>	
Valley woodlands (4b)	Foothills, Capertee valley	Permian sediments	Colo	<i>Eucalyptus melliodora</i> (Yellow Box), <i>E. blakelyi</i> (Blakely's Red Gum), <i>E. microcarpa</i> (Western Grey Box), <i>Brachychiton populneam</i> (Kurrajong)	
Valley woodlands (4c)	Upper Capertee valley floor	Devonian sediments	Colo	<i>Eucalyptus albens</i> (White Box), <i>Brachychiton populneam</i> (Kurrajong)	
Tall eucalypt forests (5a)	Sheltered sites and better soils, Illawarra escarpment	Narrabeen group, Cordeaux crinanite	Upper Nepean	<i>Eucalyptus pilularis</i> (Blackbutt), <i>E. paniculata</i> (Grey Ironbark), <i>E. saligna</i> , <i>Syncarpia glomulifera</i> (Turpentine)	
Heaths, woodlands and forests (5b)	Poor sandy soils, sandstone plateaus	Hawkesbury sandstone	Upper Nepean	<i>Eucalyptus piperita</i> (Sydney Peppermint), <i>Angophora costata</i> (Smooth-barked Apple), <i>E. pilularis</i> , <i>E. agglomerata</i> , <i>E. haemostoma</i> , <i>E. sclerophylla</i> , <i>Corymbia gummifera</i> (Red Bloodwood)	
Turpentine Ironbark forest (5d)	Clay ridge soils, Bargo to Hilltop	Mittagong formation	Upper Nepean	<i>Eucalyptus globoidea</i> (White Stringybark), <i>E. crebra</i> (Narrow-leaved Ironbark), <i>E. fibrosa</i> , <i>Syncarpia glomulifera</i> (Turpentine)	
Shale forest remnants (5e)	Clay soils above 600 m elevation, eg Mittagong	Wianamatta shale	Upper Nepean	<i>Eucalyptus quadrangulata</i> , <i>E. globoidea</i> , <i>E. punctata</i> (Grey Gum), <i>E. cypellocarpa</i> (Monkey Gum)	

TABLE 2. VEGETATION STRUCTURE
(System according to Specht, 1970)

Vegetation structure (tick appropriate structural type)				
Growth form of the tallest layer	Foliage cover of the tallest layer (ignore isolated emergents)			
	>70%	30-70%	10-30%	<10%
Tall trees (>30 metres)	Tall closed forest	Tall open forest	Tall woodland	
Medium trees (10-30 metres)	Closed forest	Open forest	Woodland	Open woodland
Low trees (<10 metres)	Low closed forest	Low open forest	Low woodland	Low open woodland
Tall shrubs (>2 metres)	Closed scrub	Open scrub	Tall shrubland	Tall open shrubland
Low shrubs (<2 metres)	Closed heath	Open heath	Low shrubland	Low open shrubland
Hummock grasses	-	-	Hummock grassland	-
Tussocky grasses and grass-like plants	Closed tussock grassland or closed sedgeland	Tussock grassland or sedgeland	Open tussock grassland	Sparse open tussock grassland
Other herbaceous plants	Dense sown pasture	Sown pasture	Open herbfield	Sparse open herbfield

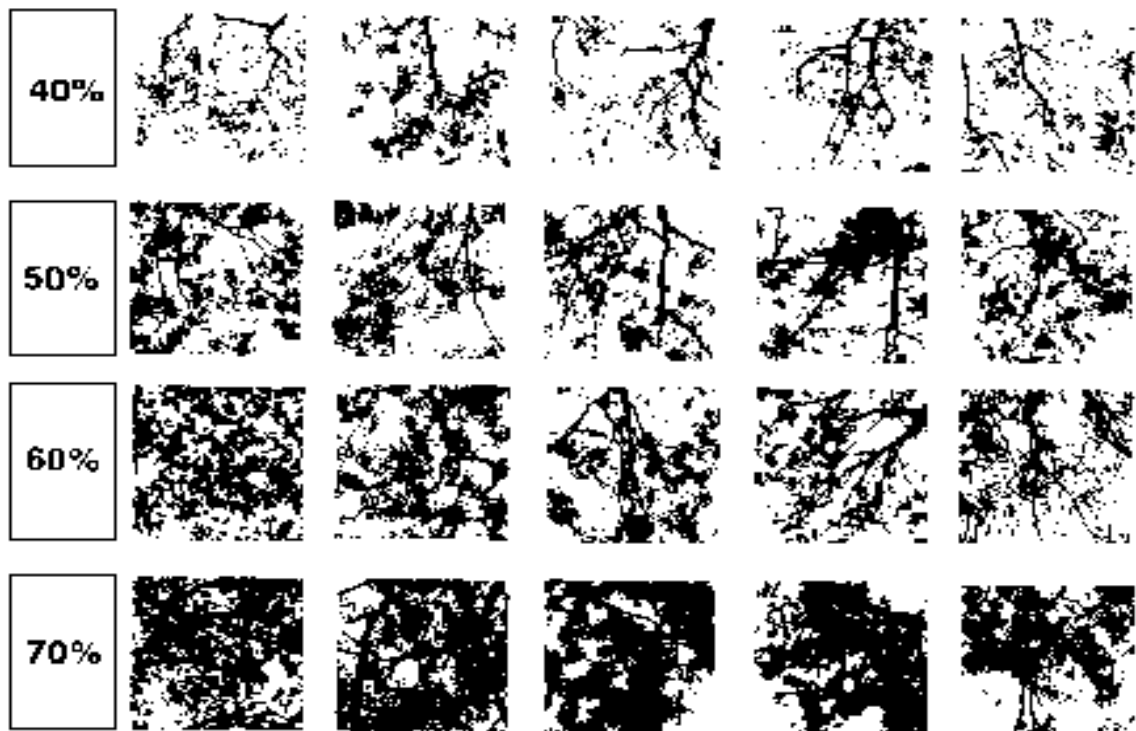


Figure 2. Percentage canopy cover (Source: McDonald *et al.*, 1984)

Checklists for Monitoring Bushland Health

Monitoring your bushland site involves filling out five checklists (2-6) and assigning a score to certain observations. Add up the totals for each checklist. These totals will be used for a final checklist to do an overall assessment of Bushland Health.

Monitoring Checklist 2: Site Features

Q1. Size and Q2. Shape

- The size or area of your bushland site is a critical factor to its health. Small areas suffer from 'edge effects' such as increased fire frequency, easier invasion by weeds and feral animals. Larger remnants have greater resilience enabling them to remain intact in the long term.

A grid is contained in the Appendix to photocopy onto a transparency and overlay on a 1:25,000 map (so you can count grid squares of 1.56 ha). Remember that a hectare is 10,000 square metres (e.g. imagine 100 by 100 metres, or 50 by 200 metres).

- Shape is also important for reducing edge effects - round or compact rectangular shapes have less edge effects than irregular or narrow areas.

Q3. Edge/Area Ratio

- The Commonwealth Government has set this ratio as a national indicator for biodiversity (Saunders and Margules, 1998). The ratio of the perimeter (edge) to the area of a remnant indicates how large edge-effects problems may be. The smaller the ratio the better the remnant in terms of size and shape. See the diagram on page 4.

*eg. A remnant with a ratio of greater than 0.04 will be smaller than a 100 x 100 metre square. A remnant square of 400 x 400 metres (16 ha) will have a ratio of 0.01. A remnant square larger than 16 ha will have ratios smaller than 0.01. The ratio is also sensitive to **shape** as well as **size**. A 100 x 100 metre square (1 ha) has a value of 0.04, while a 20 x 500 metre oblong (also 1 ha) has a ratio of 0.104.*

Q4. Position and Q5. Connectivity

- Note if your site is connected with other areas of bushland. This factor is critical to the health of your bushland.

Small remnants connected to a larger area by a corridor increases the chance of native animals using the area, and plants can propagate in other areas through seed dispersal. This is important if conditions change in localized areas. 'Green corridor' connections have great value, and more than one connection increases the chance of retaining its health in the future. Similarly there is a strong value for positions adjacent to reserved areas.

Q6. Disturbance

- This question assesses what surrounds your bushland. The greater the level of disturbance in surrounding areas, the greater the impact on your site.

Monitoring Checklist 2: Site Features Checklist ♦

Q1. SIZE - Is your Bushland Site:

	Score
♦ Less than 1 hectare	+1
♦ 1-5 hectares	+2
♦ More than 5 hectares	+4

Your Score

Q2. What is the SHAPE of your site?

	Score
♦ No real shape - part of larger site	0
♦ Circular or compact (eg. square)	+2
♦ Oval, oblong or triangular	+1
♦ Irregular with many indentations	-1
♦ Long and thin	-2

Your Score

Q3. EDGE to AREA RATIO

If your site is an isolated remnant, work out the

Edge to Area Ratio by:

$$\frac{\text{Perimeter edge (metres)}}{\text{Area (square metres)}} = \text{Ratio number}$$

Is your Edge/Area Ratio:

	Score
♦ Greater than 4/100 (=0.04)	0
♦ Between 4/100 and 1/100 (=0.01)	+1
♦ Less than 1/100	+2

Your Score

Q5. CONNECTIVITY

If your site is a remnant, does it have more than one corridor connection?

	Score
♦ If yes	+2
♦ If no	0

Your Score

The Site Features Checklist deals with the size, shape, connectivity and position of your bushland site within the surrounding bushland. A low score will mean that your site is most likely small and narrow, and will be at greater risk from edge-effect disturbances that may cause bushland health problems over the longer-term.

Q4. POSITION

If your site is an isolated remnant, is it connected by corridors to an area of native vegetation greater than 20 ha; or is it adjacent to National Park, State forest or other reserved/protected bushland?

	Score
♦ If yes	+2
♦ If no	0

Your Score

Q6. DISTURBANCES

Is your site mainly surrounded by:

	Score
♦ Exotic weeds, cleared land/pasture/crops/urban development/roads	-2
♦ Adjoining small bushland remnants or partially cleared areas	0
♦ Relatively undisturbed bush on most sides	+2

TOTAL SCORE

(-4 to 14)

Monitoring Checklist 3: Biodiversity Traverse

Quadrats and line transects are used by biologists as a form of field assessment. We will use a '**traverse**' instead, which is a modified form of transect.

The traverse is the first assessment of vegetation in a particular mapped zone. The purpose of this checklist is to measure the diversity of species on the site. Low scores here will indicate that the native species number is low in your zone, and also that shrub and groundcover layers have low coverage of the area.

How to set your Traverse

- Walk 40 metres through a particular mapped sclerophyll zone and look at an area 2 metres wide to one side. Alternatively walk across its greatest width if the site is less than 40 m.

The traverse does not have to be in a straight line, especially if there are obstacles in your path, although there is less room for subjectivity if the traverse is in a straight line. Pace the distance out and mark the beginning, centre and end with coloured tape or string. Try and position the traverse across the middle of the zone, making allowance for slope and vegetation.

Deciding Tree Species Numbers (Q1), Dead Trees (Q2), Shrub Species (Q3), and Percentage Cover of vegetation- Shrubs (Q4,) Herbs-Native and Exotic(5).

- Walk through your traverse and record (tally) a '1' for each new tree and shrub species (include those which have been planted if a bush regeneration site), then walk back and determine % cover of shrubs and groundcover.
- Record observations about the types of plants and vegetation layers in the traverse as prompted by Checklist 3. Use Figures 3 and 4 to help estimate Percentage Cover.

Most people can usually guess how many species of trees or shrubs they have, even if they don't know the scientific names they have been given. Groundcovers such as grasses and herbs can be hard to determine, so these are only assessed in terms of percentage cover.

- Remember to look at **all** features of your shrubs and trees when deciding if they are different species, eg. bark, leaf shape and colour, flowers, nuts, fruits, buds, gumnuts.

A pair of binoculars can be useful (but not essential) to check canopy leaves and pick up differences between gum trees which have similar bark, but different gumnuts. There are nearly a hundred eucalypts within the Trust's catchment (see Benson et al., 1996), and the situation can be complicated by hybrids between species. If vegetation is different enough, label it as `species' A, B, C, etc.

✓ **NB - Scoring.** Something to watch out for - a few plant communities (eg She-oak forest) *naturally* do not have high percentage cover in the shrub and groundcover layers, so low scores may not mean the site has been disturbed. **Take into account specific site constraints when interpreting the scores.**

Generally, however, *lower scores will reflect that some disturbance has occurred at the site.*

Example of Results from the Traverse Checklist

After walking the traverse, for example, you may get:

	<u>Tally</u>	<u>Score</u>
No. of Trees	+ + + +	(6)
Dead Trees on Traverse		(1)
No. of Shrubs	+ + + + + + + +	(11)
% Cover Shrubs	30%	
% Cover groundcover	50%	

You thus have 6 tree species (**score +2** in Q1), 1 dead tree (**score 0** in Q2), 11 shrub species (**score +2** in Q3), 30% cover of shrubs (**score 0** in Q4), 50 % cover of groundcovers (**score 1** in Q5). In our example you would **score +5** for Checklist 3 TOTAL Score.

Percentage Cover Estimates:

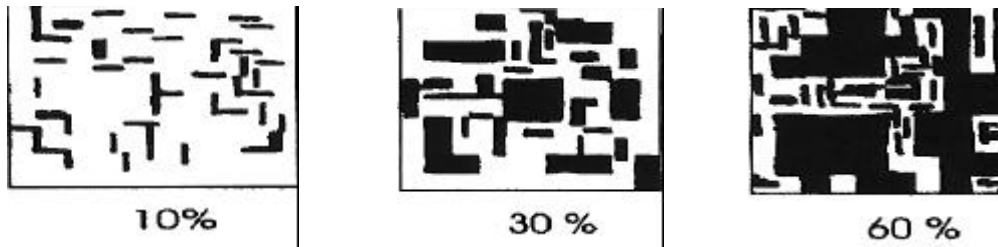


Figure 3.
Percentage cover estimates

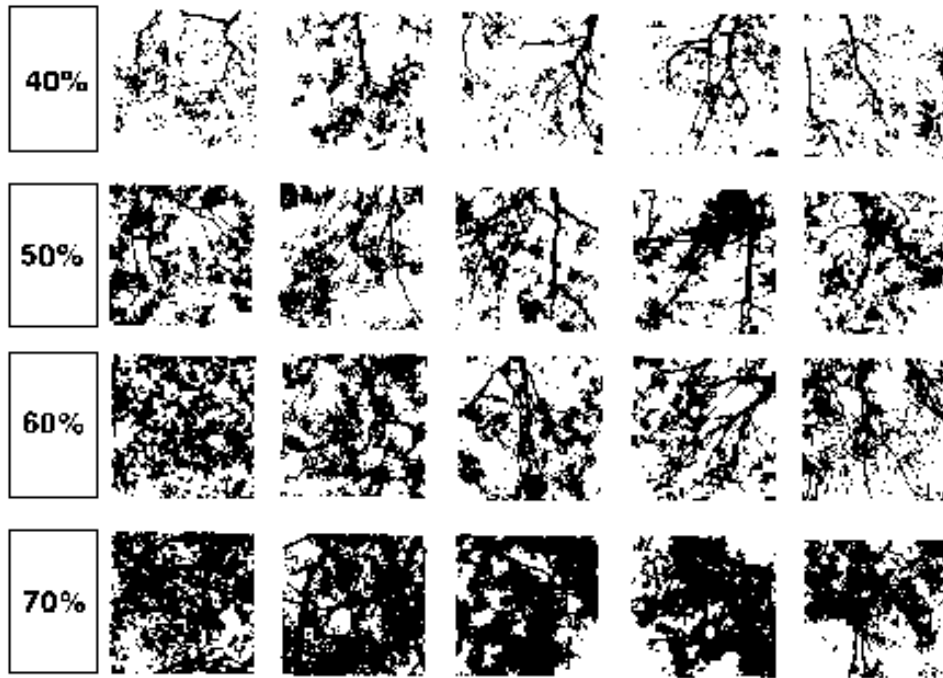


Figure 4. Photos of percentage foliage cover at various percentages (McDonald *et al.*, 1984).

Checklist 3. Biodiversity Traverse

Vegetation Structure and Cover: Initial tally

Tally	
<ul style="list-style-type: none"> ◆ No. of Native Tree Species; ◆ Dead Trees on Traverse: ◆ No of Shrub Species: ◆ % Cover of Shrubs: ◆ % Cover of groundcover: 	

SCORING THE SITE TRAVERSE TALLY

<p>Q1. Native Trees Number</p> <p>Do you have:</p> <table style="width: 100%; border: none;"> <thead> <tr> <th style="width: 80%;"></th> <th style="text-align: right;">Score</th> </tr> </thead> <tbody> <tr> <td>◆ 1-2 species</td> <td style="text-align: right;">0</td> </tr> <tr> <td>◆ 3-4 specie</td> <td style="text-align: right;">+1</td> </tr> <tr> <td>◆ More than 4 species</td> <td style="text-align: right;">+2</td> </tr> </tbody> </table> <p style="text-align: right; margin-top: 20px;">Your Score <input style="width: 100px; height: 20px;" type="text"/></p>		Score	◆ 1-2 species	0	◆ 3-4 specie	+1	◆ More than 4 species	+2	<p>Q2. Presence of Dead Trees</p> <p>Do you have:</p> <table style="width: 100%; border: none;"> <thead> <tr> <th style="width: 80%;"></th> <th style="text-align: right;">Score</th> </tr> </thead> <tbody> <tr> <td>◆ 1-2 dead trees</td> <td style="text-align: right;">0</td> </tr> <tr> <td>◆ 3-4 dead trees</td> <td style="text-align: right;">-1</td> </tr> <tr> <td>◆ More than 4 dead trees</td> <td style="text-align: right;">-2</td> </tr> </tbody> </table> <p style="text-align: right; margin-top: 20px;">Your Score <input style="width: 100px; height: 20px;" type="text"/></p>		Score	◆ 1-2 dead trees	0	◆ 3-4 dead trees	-1	◆ More than 4 dead trees	-2		
	Score																		
◆ 1-2 species	0																		
◆ 3-4 specie	+1																		
◆ More than 4 species	+2																		
	Score																		
◆ 1-2 dead trees	0																		
◆ 3-4 dead trees	-1																		
◆ More than 4 dead trees	-2																		
<p>Q3. Shrub Species Number</p> <p>Do you have:</p> <table style="width: 100%; border: none;"> <thead> <tr> <th style="width: 80%;"></th> <th style="text-align: right;">Score</th> </tr> </thead> <tbody> <tr> <td>◆ 0-4 species</td> <td style="text-align: right;">0</td> </tr> <tr> <td>◆ 5-8 species</td> <td style="text-align: right;">+1</td> </tr> <tr> <td>◆ More than 8 species</td> <td style="text-align: right;">+2</td> </tr> </tbody> </table> <p style="text-align: right; margin-top: 20px;"><input style="width: 100px; height: 20px;" type="text"/></p>		Score	◆ 0-4 species	0	◆ 5-8 species	+1	◆ More than 8 species	+2	<p>Q4. Shrub Percentage Cover</p> <p>Is the shrub cover:</p> <table style="width: 100%; border: none;"> <thead> <tr> <th style="width: 80%;"></th> <th style="text-align: right;">Score</th> </tr> </thead> <tbody> <tr> <td>◆ Less than 10%</td> <td style="text-align: right;">-1</td> </tr> <tr> <td>◆ 10-30 %</td> <td style="text-align: right;">0</td> </tr> <tr> <td>◆ 31-60%</td> <td style="text-align: right;">+1</td> </tr> <tr> <td>◆ More than 60%</td> <td style="text-align: right;">+2</td> </tr> </tbody> </table>		Score	◆ Less than 10%	-1	◆ 10-30 %	0	◆ 31-60%	+1	◆ More than 60%	+2
	Score																		
◆ 0-4 species	0																		
◆ 5-8 species	+1																		
◆ More than 8 species	+2																		
	Score																		
◆ Less than 10%	-1																		
◆ 10-30 %	0																		
◆ 31-60%	+1																		
◆ More than 60%	+2																		

Monitoring Checklist 4: Biodiversity

The Biodiversity checklist assesses the weed level in the structural layers of bushland vegetation. It also assesses regeneration, dieback, fire, and animal presence. A low score in this checklist will show problems with weeds and declining natural regeneration of the plant community.

Generally, the Hawkesbury-Nepean catchment contains native eucalypt forest with a well-developed shrub layer and herb layer. Focusing only on trees ignores a major part of the biodiversity present in the area. A healthy native shrub and herb layer is thus of great importance to the area's biodiversity, but also in many cases is responsible for maintaining its health (eg. regulating mistletoe abundance by providing habitat for its predators). It is important to consider seasonal variation as some species are not present at all times (eg. orchids may only be seen for short periods of time).

PLANTS

Q1-3. ABUNDANCE of Native Tree and Shrub Layers and Groundcover

- Score the abundance of native species in each of the three main vegetation layers found in sclerophyll bushland (a fourth sub-canopy layer is sometimes found in wet sclerophyll forest).

Groundcover can be made up of grasses, sedges, ferns, broad-leaved herbs and small woody shrubs below a metre in height - it can be difficult to distinguish

between 'native' grasses and herbs and introduced ones. Simply decide if the herb layer resembles that of undisturbed bushland, rather than more disturbed areas.

- The Structure of vegetation in your bushland is important, as 80% of plant species occur below the tree canopy. However, some habitats **naturally** do not have much of a shrub layer (eg. forest on basalt, woodland on shale) so this is not an absolute rule.

Q4. REGENERATION

- Assess whether regeneration of native trees and shrubs is occurring on your site.

Lack of seedlings in a plant community indicates that an area is stressed (e.g. overgrazed), hence regeneration of all three vegetation layers is important. An absent shrub layer is often a sign of grazing or other stress.

Q5. AGE range of trees

- Assess whether there are a range of tree ages on your site, indicating a constant recruitment to the adult population.

This is not a high priority score because in some communities (eg. Blue Mountains Ash) it is usual for seed to germinate after fire, so there will naturally be large groups (cohorts) of even-age trees, rather than a mixture of different aged trees.

Q6. DIEBACK

- Trees naturally die in any plant community. Is there an **abnormal/unusual** amount of dieback occurring, such as dieback of young trees.

Dieback can indicate stress (though this could be natural stress such as drought or bushfire). Irrespective of origin, such dieback indicates a problem with ecosystem health.

Q7. FIRE

- We measure the incidence of fire because it is a critical factor in the health of bushland. Most dry sclerophyll vegetation is believed to have a natural fire cycle, burning between every 20 and 50 years.

Signs of burning can be seen most easily on trees such as stringybarks, peppermints and bloodwoods - but it can be difficult to find signs of burning after 10 years (depending on the fire).

- Research has shown that the **biodiversity of eucalypt forests** (particularly dry sclerophyll) decreases both with too frequent burning (less than 10 years) and too rare burning (more than 50 years). Too frequent burning also causes significant nutrient loss and soil erosion. For this reason signs of recent fire such as soot on bark are marked negatively.

ANIMALS

Q8-10. EVIDENCE of ANIMAL PRESENCE

- In some bushland areas under severe stress there may be little evidence of animals. Establishing their presence gives a positive score.
- In a number of stressed communities there may be very little presence of or use by native mammals. This question looks for signs of such use on the ground.
- Look at the tree trunks for evidence of use by native animals. It is not always easy to tell if nocturnal possums/ gliders occur in a bushland site. Large scratches on trunks generally indicate greater gliders or koalas (or sometimes goannas) and are worth reporting to zoologists at the Australian Museum or NPWS. Small fine scratches may be sugar gliders.

It is not always easy to determine what animals live in a bushland site, unless one has visited the area a number of times at different times of the day and year. For this reason there are only three scoring questions on animals in the checklist. Other non-scoring questions relating to animals occur in the 'optional' checklist for Habitat features.

Checklist 4. Bushland Health

PLANTS

Q1. Tree Layer

	Score
♦ Mainly exotic	-1
♦ Mixture native/exotic	0
♦ Mainly native	+1
	<input style="width: 100px; height: 20px;" type="text"/>

Q2. Shrub Layer

	Score
♦ Mainly exotic	-1
♦ Mixture native/exotic	0
♦ Mainly native	+1
	<input style="width: 100px; height: 20px;" type="text"/>

Q3. Groundcover

	Score
♦ Mainly exotic	-1
♦ Mixture native/exotic	0
♦ Mainly native	+1
	<input style="width: 100px; height: 20px;" type="text"/>

Q4. Regeneration - Native plants

Are native tree and shrub seedlings emerging:

	Score
♦ No tree or shrub regeneration	0
♦ Tree species only (ie juvenile trees common)	+1
♦ Both trees and shrub regeneration	+2
	<input style="width: 100px; height: 20px;" type="text"/>

Q5. Presence of varying tree ages

Are various ages of young trees present, ie. Small seedlings, metre-high seedlings, And saplings:

Score +1 if Yes

	<input style="width: 100px; height: 20px;" type="text"/>
--	--

Q6. Presence of Dieback in Young trees

Are young trees and saplings dying back At your site?

Score -2 if yes

	<input style="width: 100px; height: 20px;" type="text"/>
--	--

Q7. Obvious Signs of Fire

Has the site been burnt recently? Score

♦ Soot on bark/burnt < 10 years	-2
♦ Height of fire (intensity)	0
♦ No soot/burnt > 10 years ago	+1

	<input style="width: 100px; height: 20px;" type="text"/>
--	--

ANIMALS

- | | | |
|--|----|---|
| • Q8. Are a number of animals present, such as birds, insects, frogs, fish and native mammals? | +1 | <input style="width: 100%; height: 20px;" type="text"/> |
| • Q9. Any evidence of native mammals using the bushland - scats, burrows, diggings in termite mounds, nests, tracks, etc? | +1 | <input style="width: 100%; height: 20px;" type="text"/> |
| • Q10. Are there scratches on the tree trunks at your site - evidence of gliders, possums, koalas or goannas? | +1 | <input style="width: 100%; height: 20px;" type="text"/> |

TOTAL SCORE
(-7 to 10)

Monitoring Checklist 5: Habitat Features

Habitat is a key component of the health of your site. You may find it hard to assess what animals are present, but you can assess what habitat is present. A low score here will indicate the zone is poor habitat. This may be because it has been disturbed (eg. grazing).

A variety of vegetation, vegetation density and landscapes will allow a greater range of animal species to find food and nesting sites. A complex environment of many features means it has more **habitat spaces** for a variety of plants and animals. Look out for the following features at your site, such as:

- Dense native shrubs allow small native mammals to hide from predators such as feral cats, and also provide habitat for certain plant species.
- Tree hollows and hollow logs are important homes for native wildlife. It can take over a hundred years for hollows to develop in forests, so old trees with hollows are an important resource in supporting wildlife.
- Litter and branches are habitat for many native animals and soil organisms.
- Areas of native grasses are an important resource for animals, and unfortunately have been steadily declining for decades.
- Rocks provide habitat for many animals to live and feed, and for certain species of plants to grow - they are valuable habitat. Rocky areas have been severely degraded in many areas by bushrock collection.
- Mistletoe is a naturally occurring parasite on trees and is an important food source for nectar-feeding birds (eg. honeyeaters), tree-dwelling marsupials such as gliders and possums, butterflies and moths (Reid 1997). Density of mistletoe is controlled by animal grazing and by the fire regime. Restoration of the shrub understorey helps to return many of the control agents for mistletoe (eg. Rosellas).

*A smaller degree of mistletoe is thus a **natural condition** (and necessary for many animals). A major mistletoe infestation can kill the host trees and indicates that trees (and the whole area) are under stress.*

- Wet areas are often sites of rare or threatened species and are major sites of productivity in your ecosystem.
- Streams and water ways (whether or not they are flowing) are an important part of the topography of your bushland, as different species can occur in these areas.

Checklist 5. Habitat Features

Habitat Features	Score	Your Score
Are there any areas of dense native shrub vegetation?	Yes +2 No 0	
Are there any tree hollows in big old trees? (trees may be alive or dead)	Yes +2 No 0	
Are there any hollow logs on the ground?	Yes +2 No 0	
Are there fallen branches/leaves/twigs present on the ground over at least half the area of your site or zone?	Yes +2 No 0	
Are native grasses common (e.g. kangaroo grass)?	Yes +2 No 0	
Are there rocky areas providing habitat and shelter for animals and plants?	Yes +2 No 0	
Is mistletoe present in <u>less than 20%</u> of trees?	Yes +2 No 0	
Are there any wet areas at your site? (including hanging swamps/ shrub swamps/ waterholes/ seeps)	Yes +2 No 0	
Are there stream systems (flowing or dry) in your site or zone?	Yes +2 No 0	
Total	(0 to 18)	

Monitoring Checklist 6: Disturbances

There are many ways bushland can be disturbed, and each disturbance impact can be to a different degree, making it difficult to set uniform disturbance standards. Instead, we determine if there has been major or minor disturbance for a particular activity.

A 'major' disturbance has been defined as affecting 10% or more of the bushland site, or is an ongoing impact with the potential to affect more than 10% of the area, eg:

An actively expanding clump of weeds that is only currently 5% of your zone would still be scored as major due to its potential to spread rapidly.

A 'minor' disturbance affects less than 10% of the area, or is an historical impact no longer causing direct disturbance.

Specific types of disturbances to be observed:

- Heavy grazing by introduced stock, resulting in destruction of the shrub layer and leaving a tree and herb/grass layer (often with many introduced grasses and weeds). Tree seedlings are rare (eaten). Goats and sometimes cattle with stringybarks can also ringbark trees. Pigs dig up wetlands, and root around in other areas (eg. tussock).
- Nutrient rich seepage can cause phosphorus toxicity to native plants. Nutrient addition in seepage can also totally change the plant community by favouring exotic weed growth.
- When determining 'off-road vehicle use', measure **regular use**, ie. if less or more than 10% of the area is covered by tracks or roads that are regularly used by off-road vehicles.

The checklist examines disturbance in terms of six disturbances of the soil surface, nine disturbances of the native vegetation, and a further four disturbances which do not fit easily into either category (and which are hard to define as major or minor). All scores are negative. All major and minor disturbances are scored the same, except for weed invasion, where the scores allotted are doubled due to their impact. Massive mistletoe infestation automatically scores as a major disturbance. If the disturbance is not present, mark with a dash.

✓ **Zero (0) represents the Highest Health** (ie. no disturbance) and the maximum highest disturbance score is set at **-12**. Scoring beyond this point probably indicates that the disturbances are overlapping, and the bushland health impact has to be managed from many different angles.

Checklist 6. Disturbances

Disturbances	Score	Your Score	Comments
Has the soil surface been disturbed by:			
Erosion (e.g. gullies, sheet erosion)	-1 minor -2 major		
Mining of soil, gravel, clay or sand	-1 minor -2 major		
Dumping of gravel/soil (e.g. road construction)	-1 minor -2 major		
Dumping of rubbish or garden waste	-1 minor -2 major		
Bushrock collection (or piling into mounds)	-1 minor -2 major		
Informal access roads, footpaths, trackways and bicycle tracks	-1 minor -2 major		
Has the native vegetation been disturbed by:			
Weed invasion/planting with exotics (e.g. morning glory, honey locust, privet, lantana, balloon vine, blackberries)	-2 minor -4 major		
Logging (e.g. stumps, regrowth of same size and age) or timber harvesting for fencing/farm uses/ firewood	-1 minor -2 major		
Evidence (e.g. dead trees) of changed water table (e.g. nearby fill operations/downstream of a farm dam)	-1 minor -2 major		
Past clearing (e.g. windrows or ringbarked trees)	-1 minor -2 major		
Grazing by rabbits (look for warrens/scats)	-1 minor -2 major		
Grazing by stock such as cattle, sheep and horses	-1 minor -2 major		
Regular off-road vehicle use (4WDs/trail bikes)	-1 minor -2 major		
Nutrient/sewage seepage from adjacent farmland / urban areas or altered stormwater drainage	-1 minor -2 major		
Massive mistletoe infestation (more than 20% of trees infected)	-2 if yes		
Is the site further disturbed by:			
Being adjacent to urban areas	-1 if yes		
Evidence/presence of feral animals e.g. foxes/cats/dogs)	-1 if yes		
Recreational facilities (e.g. picnic areas, camping areas, BBQs)	-1 if yes		
Other disturbance (e.g. sewer line/dams/weirs, burl cutting)	-1 if yes		

TOTAL SCORE (NB. -12 is the maximum score)	(0 to -12 max)		
--	---------------------------	--	--

Overall Assessment

Monitoring Checklist 7: Summary of Bushland Health

Record the scores for the previous checklists 2-6 on Summary Checklist 7, and tick where the score lies in terms of overall sclerophyll bushland health assessment.

The summary checklist measures the Overall Health of the bushland as a sum of its component physical attributes, biodiversity, habitat and disturbances. For example:

*If your **mapped zone** scores moderately in terms of the Site Description (4), and Traverse (4), but scores highly in the Biodiversity (6) and Habitat (9) tables, with moderate Disturbance impact (-7), then this indicates that the bushland has significant conservation values, but its health has been compromised by disturbances.*

The score for your bushland zone can be written as 5 figures to represent your site, eg.

4 / 4 / 6 / 9 / -7.

A Response Guide to Checklist Score Results:

- **Low scores in the DESCRIPTION CHECKLIST** can be improved by planting/regenerating land next to the bushland to enlarge it, or by creating a green corridor to link a remnant to another area of bushland.
- **Low scores in the TRAVERSE CHECKLIST** can be remedied by removing the stress/ disturbance that is reducing shrub and groundcover diversity and cover.
- **Low scores in the BIODIVERSITY CHECKLIST** are likely due to weeds, lack of regeneration, dieback or recent fire - all of which can be addressed by management actions.
- **Low scores in the HABITAT CHECKLIST** may be a function of the nature of your site, but are more likely a function of disturbances such as fire, grazing, bushrock collection, and clearing, etc. Management actions can increase the habitat within the bushland by controlling such factors.
- **High negative scores in the DISTURBANCE CHECKLIST** are clearly stresses that can be removed from the site by management actions.

Checklist 7. Health of your Bushland Summary

Record the Results for Checklists 2-6 in the Table below:

Checklist	Your score	Tick where your score falls in terms of <u>Overall Health</u> Assessment		
No.2 Site Features		-4 to 3 poor <input type="checkbox"/>	4 to 8 average <input type="checkbox"/>	9 to 14 good <input type="checkbox"/>
No.3 Biodiversity Traverse		-4 to 0 poor <input type="checkbox"/>	1 to 4 average <input type="checkbox"/>	5 to 8 good <input type="checkbox"/>
No.4 Biodiversity Checklist		-7 to -1 poor <input type="checkbox"/>	0 to 5 average <input type="checkbox"/>	6 to 10 good <input type="checkbox"/>
No.5 Habitat		0 to 6 poor <input type="checkbox"/>	7 to 12 average <input type="checkbox"/>	13 to 18 good <input type="checkbox"/>
No.6 Disturbances		-8 to -12 poor <input type="checkbox"/>	-5 to -7 average <input type="checkbox"/>	0 to -4 good <input type="checkbox"/>

Record your own Descriptions and Observations

Write down details about your site that you think may be important to help you remember specific conditions on the day you used the checklists. Thinking about what the scores from each checklist mean in relation to each other will help you see the "big picture" about the health of your site.

Making Predictions: How will the Area be in the Future?

The assessment scores determined in the previous standard checklists eliminates bias, so similar scores can be found by different people assessing areas that they do not know. To start making predictions about the future health status of your area you need to consider all you know about the site and surrounding areas, any threats to the area, who owns the land, and proposed future management.

The following 'Qualitative' Assessment is a useful format for collecting and presenting information relevant to the future of sclerophyll bushland health.

Gather information about:

1) The Bushland

- locality of the bushland site
- whether it is next to or likely to be surrounded by urban development in the future
- any history of the site you may have found out about in completing the assessment checklist
- size and shape of the bushland, especially if an isolated remnant
- whether it is regrowth or the original bush (eg large trees with hollows)
- has the bushland become increasingly isolated over time and will this continue in your view

2) The Vegetation

- condition and health of the plants
- presence or absence of weeds, whether these are invading the area (or likely to do so in the near future)
- structure and complexity of the vegetation
- whether it is likely to suffer from nutrient enrichment from farms/houses

3) Animals and Habitat Features

- while you may not have seen many animals, does the diversity of habitat features impress you as good animal habitat?
- is the isolation of the bushland likely to make long term survival of wildlife difficult?
- is the site subject to feral/domestic cat and dog predation?
- is the site subject to significant noise or likely to become so?

4) Disturbances

- are disturbances or threats likely to increase in your judgement?
- are some current disturbances being addressed to improve the situation?
- is the bushland valued by sections of the local community?
- is bush regeneration being carried out?

PROGNOSIS

Based on your qualitative assessment, do you believe that in 5 -10 years the bushland will be:

- **In Better Condition**
 - **The Same**
 - **Worse**
-

Checklist 8: Further Assessment (non-scoring)

There are some aspects of your bushland site which can be difficult to score, are dependent on the time of year you assess the bushland (seasonal), or is based on knowledge of the area gained over many years. Working to conserve and enhance our bushland is all about learning to understand the dominant ecological processes.

For this reason we have created Checklist 8, an “optional” table which is non-scoring, but which you may wish to fill in to gain a better understanding of your site and the ecological processes occurring there. Observations to make at your site include:

- **1. Plants in flower** throughout the year representing a continuous source of food for nectar-feeding birds, insects and mammals.
- **2. Native peas** ('bacon and egg plants'), legumes, and Acacias. They all fix nitrogen in their roots and are an important part of nutrient cycling in native vegetation. Absence of these plants can indicate stress, such as grazing. Repeated burning can stimulate a massive growth of wattles, possibly explaining any large populations.
- **3. Lyrebirds** rely on insects, spiders and other 'bugs' in the plant litter and soil for food. Their presence indicates a reasonably healthy leaf litter community. They are also a significant factor in creating 'beds' of litter with their diggings and aerating the soil to speed up the breakdown and recycling of litter nutrients. Lyrebirds may disappear from an area if the eucalypt forest has not burnt for some decades (Smith, 1988). The presence of lyrebirds in an area also shows that fox/cat predation is moderate rather than extreme.
- **4. Threatened species** - Bandicoots have grown rarer since Europeans arrived in Australia and their presence in a site is significant. Long-nosed Potoroos are even more uncommon (probably only occurring in the east of the catchment). Gliders such as Yellow Bellies are also a significant species. Brush-tailed Rock Wallabies are a vulnerable species in the Hawkesbury-Nepean catchment.
- **5. Soil Macro-invertebrate populations** (bugs and worms). Their absence under leaf litter would be unusual as they are an important part of the soil ecosystem (their numbers will reduce in prolonged drought or in She-oak communities however).
- **6. - Decomposers** are an important part of your ecosystem, breaking down organic matter and recycling nutrients. Some mycorrhizal fungi actually provide nutrients to some plant species (and these plants need their presence to survive). Not all fungi are beneficial of course. Dieback fungus (*Phytophthora cinnamomi*) is one such example which can be brought into an area by vehicles and can kill not only trees but other species such as Grass Trees (*Xanthorrhoea spp.*).

Checklist 8: Further Assessment

Observations	Comments
<p>1. Are native plants flowering throughout the year? (providing a constant source of food)</p>	
<p>2. Are native peas/legumes/wattles present?</p>	
<p>3. Are there nests/diggings/feathers/ display mounds of lyrebirds in your bushland?</p>	
<p>4. Is there evidence of threatened animal species, such as:</p> <ul style="list-style-type: none"> • the characteristic conical digging holes of potoroos or bandicoots • the characteristic triangular cuts of yellow belly gliders in the bark of trees • koalas • brush-tailed rock wallabies <p>If yes, contact:</p> <p>Australian Museum (Mammal Section) 6 College Street, Sydney, 2000, ph (02) 9320 6000</p> <p>or NPWS - * Voluntary Conservation Agreements ph (02) 9585 6512 (Head Office) Richmond Office (02) 4588 5247 Blue Mountains Office (02) 4787 8877</p>	
<p>5. With a gloved hand move the litter layer/ground cover away in an area 30 x 30 cm (not on an ants nest!). Is there evidence of more than 3 types of soil invertebrates (e.g. springtails /ants /millipedes /beetles /centipedes /slaters /spiders /scorpions)?</p>	
<p>6. Decomposers such as fungi are an important part of nutrient cycling in bushland. Is there evidence of toadstools, bracket fungi, puffballs or `mushrooms`?</p>	

Lessons for Management

There are management lessons to be learned from how your bushland rated through using the checklists in this guideline – especially with regards to future management planning. Management actions that can alter the health of your bushland for the better include establishing fencing, stopping grazing, removing exotic weeds, and controlling the fire regime.

You will have noticed points in the guideline referring you to the NPWS, Royal Botanic Gardens or Australian Museum. Contacting such bodies will help them document where rare/ threatened/ unusual species are found - they will **not jeopardise the ownership of your land**. However, if you are the owner of a site which scores highly, **you** may choose to consider entering into a Voluntary Conservation Agreement with the NPWS to protect the remnant bushland part of your property for all time (even should you choose to sell). You may also wish to have a more detailed ecological assessment of your bushland done.

Although we have created the 'poor', 'average', and 'good' categories for the checklist scores in the final assessment checklist, the Hawkesbury-Nepean Catchment Management Trust would like to emphasise that **all native vegetation is valuable**, even if it turns up with a 'poor' rating for biodiversity and habitat. Conservation of our plants and animals needs to take place not only in National Parks, but on all lands, including private land. Your area of bushland could be essential to maintain the native ecosystem in your area.

🕒 In Summary

- The 'Health' of bushland is made up of many different factors, such as plant and animal diversity, habitat diversity, and disturbances impacting on the site, which must be considered together in management plans.
- The checklists in this guideline can be used to quickly and effectively measure the health of bushland. Creating a score or index allows effective comparison of site health over time, in a 'report card' format, backed up by descriptive visual information in maps.
- Good planning and careful documentation and presentation of checklist information is invaluable for sharing and reporting your findings to other people, and for keeping track of progress made at your site in maintaining Bushland Health.

References

- Benson D., Howell J. and McDougall L. (1996), *Mountain devil to mangrove: a guide to natural vegetation in the Hawkesbury Nepean catchment*. Royal Botanic Gardens. 68 pp.
- Benson J. (1995), *Fire mitigation strategies: fire-based*. Paper in 'Bushfire: looking to the future' edited by C Brown and L Tohver, Envirobook, pp 98-106.
- Briggs and Leigh (1996), *Rare or threatened Australian Plants*. CSIRO Canberra.
- Carlton C. (1998), *Community biodiversity survey manual*. NPA/NPWS.
- HNCMT (1999), *Draft guidelines for monitoring a Bushcare project*. Washington H. and Molloy J., HNCMT.
- Keith D. (1995), *Ecological and environmental impacts of natural fire regimes*. Paper in 'Bushfire: looking to the future' edited by C Brown and L Tohver, Envirobook, pp 33-39.
- Kennedy M. (1990), *Australia's Endangered Species*. Simon and Shuster.
- McDonald R., Isbell R., Speight J., Walker J. and Hopkins M. (1984), *Australian Soils and Land Survey*. Inkata Press, Melbourne.
- Reid N. (1997), *Managing mistletoe booklet*. North-West Catchment Management Committee. PO Box 601, Tamworth, 2340 (02-67667977).
- Saunders D. and Margules C. (1998), *Environmental indicators for National State of the Environment Reporting: Biodiversity*. Environment Australia.
- Smith L. H. (1988), *The life of the lyrebird*. William Heinemann Australia. 148 pp.
- Specht, R.L. (1970), *Vegetation in the Australian Environment*. GW Leeper Ed. Fourth edition. CSIRO, Melbourne.
- Triggs B. (1992), *Mammal tracks and signs: a field guide for south-eastern Australia*. Oxford Uni Press.
- Webb H. & Foley A. (1996), *Urban bushland under threat*, Vol.1, Review of urban bushland and recommendations for its protection, report for the Nature Conservation Council of NSW, Inc. & Total Environment Centre, Inc.
- Wilson E. (1988), *Biodiversity*. US Academy of Sciences.

Other useful reading

- Benson D. (1986), *The vegetation of the Gosford and Lake Macquarie 1:100,000 vegetation map sheet*. *Cunninghamia* 1(4):467-490.
- Benson D. (1992), *The natural vegetation of the Penrith 1:100,000 map sheet*. *Cunninghamia* 2(4):541-596,
- Benson D. and Keith D. (1990), *The natural vegetation of the Wallerawang 1:100,000 map sheet*. *Cunninghamia* 2(2):305-336
- DLWC Soil landscape maps. Dept. of Land and Water Conservation.