Planning for catchment biodiversity targets at a local landscape scale: a proposal for the South-west Slopes Bioregion of NSW

Australian Government
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nature conservation trust
OF NEW SOUTH WALES

Murray CMA

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Department of Environment, Climate Change and Water NSW
59–61 Goulburn Street, Sydney
PO Box A290, Sydney South 1232
Phone: (02) 9995 5000 (switchboard)
Phone: 131 555 (environment information and publications requests)
Phone: 1300 361 967 (national parks information and publications requests)
Fax: (02) 9995 5999
TTY: (02) 9211 4723
Email: info@environment.nsw.gov.au
Website: www.environment.nsw.gov.au

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Preface

The NSW Government and the NSW community have, through the catchment management authorities, established targets for natural resource management, including targets for biodiversity. Yet the task of achieving these catchment biodiversity targets across the landscape is a challenging one.

In predominantly agricultural landscapes, these challenges include large landscapes, diverse communities with large numbers of landholdings, and limited data and mapping to identify sites with high biodiversity values or restoration potential. There is also the ever-present challenge of tailoring the right incentives and investments to suit the full range of landholders and property types.

It is important to demonstrate that our investments in landscape health and biodiversity are achieving the greatest real benefit. This relies on targeting investment to higher value sites that have the greatest potential for long-term viability.

The Department of Environment, Climate Change and Water NSW has, over many decades, demonstrated leadership in systematic conservation planning to establish protected areas. One of our challenges now is to develop, together with our partners, systematic approaches to landscape planning to achieve these catchment biodiversity targets. This will entail maintaining and building resilient, viable ecosystems across the landscape through working with landowners and land managers over a range of tenures. These partnerships may require differences in method and approach.

These technical papers advance a method for building ecosystems in partnership that relies on:

- shifting the scale of our focus to ‘local landscapes’
- within these local areas, engaging local and expert knowledge to assist in identifying sites with high biodiversity values or restoration potential
- incorporating this knowledge into a ‘Rapid Assessment Methodology’ which can be easily and quickly applied to identify priorities for targeting incentives and investments.

The methodology has been developed in, and is particularly relevant for, the South-west Slopes Bioregion. However, it serves as a useful contribution to discussions on methods for cost effective planning at the scale between catchment and property in other regions of the state.

We thank the Murray Catchment Management Authority, the Commonwealth Department of Environment, Water, Heritage and the Arts, and the Nature Conservation Trust of NSW for their support for this project.

Thanks also to those who supported the project through their attendance at workshops and seminars, field visits and site inspections, and those who reviewed manuscripts.

From 1 July 2009 the Department of Environment and Climate Change (DECC) referred to in this report, was renamed the Department of Environment, Climate Change and Water (DECCW), with additional responsibilities for water.

Executive summary

The four papers included in this series outline a comprehensive approach to conservation planning for predominantly agricultural landscapes, using an area within the South-west Slopes Bioregion as a pilot. This series of papers commences with a strategic review of key issues, and progresses to more detailed recommendations for methodologies at a 'local landscape' scale.

Paper A describes how the most important biodiversity assets in agricultural areas may be overlooked in broadscale environmental assessments. These assets, including areas of native pasture (derived native grassland), scattered large hollow-bearing trees, rocky outcrops, and riparian and seasonally inundated areas are often not characterised by contiguous tree cover, yet may have some of the highest biodiversity values or the greatest potential for cost effective ecological restoration. If woody extent or tree cover mapping is the chief input into landscape assessment and prioritisation, such areas may be overlooked, resulting in mis-targeting of incentives and investment.

Paper B explores to what extent accepted methods for systematic conservation planning may need to be adapted or modified to work in fragmented agricultural landscapes. It sets out the distinguishing characteristics of such landscapes that need to be taken into account by conservation planning, and argues that the scale of planning needs to focus on smaller units of the landscape. This local focus allows for the essential input of local and expert knowledge, and the identification of high conservation value sites not identified in regional-scale mapping and data.

Paper C defines 'local landscapes' and demonstrates a method for identifying 'priority local landscapes' within the South-west Slopes Bioregion. A number of priority local landscapes are identified, which should be the immediate focus for conservation planning in the bioregion.

Paper D sets out a cost effective method for conservation planning in predominantly agricultural landscapes, by using a Rapid Assessment Methodology. Through this methodology, an initial audit of the local landscape can be conducted, with the input of local and expert knowledge and field observation rather than by using a formal quantitative survey. The methodology identifies sites of high priority that could be targeted for conservation incentives, stewardship arrangements, covenants and the like.

Acronyms

CAR	comprehensive, adequate and representative
CMA	catchment management authority
CMN	Conservation Management Network
CSE	CSIRO Sustainable Ecosystems
CSU	Charles Sturt University
DECC	Department of Environment and Climate Change NSW
DECCW	Department of Environment, Climate Change and Water NSW
GIS	geographic information system
IBRA	interim bio-geographic regionalisation of Australia
NCT	Nature Conservation Trust of NSW
RAM	Rapid Assessment Methodology
RAMV	Rapid Assessment Methodology validation
RLPB	Rural Lands Protection Board
TSR	travelling stock reserve

Contents

Preface .... **i**

Executive summary .... **iii**

Paper A: Identification of biodiversity assets in predominantly agricultural landscapes **1**

A1. Introduction 1

A2. What is 'habitat' in an agricultural landscape? 2

A3. The limitations of a traditional vegetation (tree cover) map 4

A4. What constitutes 'habitat' in the agricultural landscapes of the South-west Slopes? 6

A5. A vision for the South-west Slopes landscape 10

A6. References 13

Paper B: Methodologies for conservation planning in predominantly agricultural landscapes **16**

B1. The goal of conservation planning in agricultural landscapes 16

B2. Characteristics of agricultural landscapes for conservation planning 17

B3. What is 'systematic conservation planning' in an agricultural landscape? 19

B4. A methodology for conservation planning in the South-west Slopes 22

B5. References 24

Paper C: Identifying 'priority local landscapes' in the South-west Slopes Bioregion **26**

C1. Background 26

C2. Methodology 28

C3. References 39

Paper D: Rapid assessment of two 'priority local landscapes' in the South-west Slopes Bioregion **40**

D1. Background 40

D2. Study areas 40

D3. Project aims, objectives and governance 42

D4. Methodology 42

D5. Results 45

D6. Discussion 52

D7. Conclusions 58

D8. References 59

Appendix: Site assessment sheet for Rapid Assessment Methodology **60**

Paper A: Identification of biodiversity assets in predominantly agricultural landscapes

Mark Sheahan, Department of Environment, Climate Change and Water NSW

Abstract

In the predominantly agricultural regions of NSW, significant biodiversity assets remain and have the potential to be protected, enhanced and restored in ways that will enhance landscape connectivity, recover threatened species and increase the extent of threatened communities.

However, the identification of these assets may require different approaches to those used in forested environments. Not only are the targets for conservation in forested and agricultural environments different, the data required are different. For example, forest cover or tree cover mapping has scale limitations that may fail to identify significant components of grassy and grassy woodland ecosystems. These components include areas with high resilience in the understorey ('native paddocks'), and large hollow-bearing trees that are in small clumps or scattered across the landscape at varying densities. These are critical for the maintenance of landscape connectivity and ecosystem function within agricultural landscapes.

Areas without contiguous tree cover but which have a resilient understorey, large scattered trees, and other habitat features such as logs, stumps and rocks can be considered to be irreplaceable environmental assets in the context of this landscape. They are critically important focal points for future restoration activities, for minimal cost and with minimal risk.

It is argued that a critically important action for conservation in and across agricultural landscapes is the restoration of large, structurally complex areas of habitat in relatively fertile parts of the landscape. Important supporting actions include retaining and strengthening connections between these areas through well-managed linear reserves such as stock routes and riparian areas, and sympathetic management of adjacent agricultural lands that encourage retention of large hollow-bearing paddock trees and native pasture.

A1. Introduction

The need to protect, enhance and restore temperate woodland environments in south-eastern Australia has been increasingly recognised over the past decade, and is now well-documented (Watson 1993, Robinson and Traill 1996, WWF 1996, Hobbs and Yates 1999, McIntyre et al 2002). This has resulted in a range of projects and incentives which aim to share the costs of these 'on-ground works' with private landholders (Driver and Davidson 2002, Freudenberger and Stol 2002, Freudenberger and Harvey 2003).

These projects have been successful in raising awareness and engaging with private landholders to protect and manage woodlands on private properties, better integrating production and conservation. Yet the achievement of biodiversity conservation in these landscapes will require a much greater scale of on-ground works and stewardship programs.

The target set by the Australian Government's Caring For Our Country program is to increase the area of native vegetation managed for conservation by one million hectares over five years (Commonwealth of Australia, 2008). Moreover, the natural resource management targets established by the NSW Natural Resources Council and the NSW catchment management authorities require not just protection of some existing areas of native vegetation, but increases in the area of threatened vegetation types. The Murray Catchment Action Plan (Murray Catchment Management Authority 2006) has a target of 'increasing native vegetation extent' through planting, direct seeding and natural regeneration of 15,000 hectares. The Murrumbidgee Catchment Action Plan (Murrumbidgee Catchment Management Authority 2006) has a biodiversity management target of an increase in extent of native vegetation of 25,000 hectares.

Such increases in extent are consistent with many targets set out in conservation planning programs in predominantly agricultural landscapes. Such targets not only seek to protect existing habitat, but also to create new habitat (Robinson and Howell 2003). Fischer et al (2006) confirm that large, structurally complex patches of native vegetation not only need to be maintained, but to be created.

The sheer scale of the landscape requiring protection, enhancement and restoration, coupled with the costs of the works and frequent barriers to adoption has led many environmental professionals to reconsider how best to focus limited resources on projects that will make a difference at a bioregional, state, and even continental scale.

Soule et al (2004) underline the importance of such programs delivering connectivity across the landscape, even at continental scales. This requires that whole landscapes retain their 'bio-permeability', that is, that fauna and flora assemblages are able, over more than one generation, to move across environmental gradients. This is particularly important if Australian flora and fauna are to deal with and adapt to climate change, and, to overcome the 'extinction debts' (Vesk and MacNally 2006) of declining fauna populations which are still not at equilibrium.

Several such 'continental scale' bio-link projects have been proposed or are under-way. These include the Gondwana Link project in southern Western Australia (visit www.gondwanalink.org), and the Great Eastern Ranges (GER) initiative (Pulsford 2006) (visit www.environment.nsw.gov.au/ger/index.htm). The GER initiative is a proposal for a major project to maintain the connectivity of forests and woodlands that extend along most sections of the Great Divide from south-eastern Australia to the wet tropics. As part of the GER initiative, within NSW there are also proposals to link areas to the east and west of this spine, including:

- Kosciuszko National Park to the eastern escarpment and coastal forests (Koscisuszto to Coast project)
- Kosciuszko National Park to the woodlands of the western slopes, with an initial focus on the Woomargama National Park (Slopes to Summit project).

The Regional Conservation Initiatives (RCIs) under the NSW biodiversity strategy discussion paper (Department of Environment and Climate Change 2008) may provide a framework for the implementation of a multi-scale model to facilitate planning for conservation connectivity. In the agricultural landscapes of the South-west Slopes, RCIs may provide the umbrella for a series of projects to conserve threatened woodland ecosystems. In so doing, conservation connectivity could be achieved not only from 'slopes to summit', but from 'range to rangelands'.

A2. What is 'habitat' in an agricultural landscape?

Some (but not all) landscape planning GIS tools rely on the input of spatial information on areas of 'habitat' and 'non-habitat' (Fischer et al 2005, Wilson et al 2005). Tree cover has, on occasion, been used as a surrogate for 'habitat'. This derives from the 'fragmentation model' which perceives the landscape to be comprised of 'patches' of habitat suitable for native species, surrounded by a 'matrix' of generally hostile land uses without habitat value.

In conservation planning in forested landscapes (e.g. along the great escarpment of NSW or in the South East Forests), such 'habitat' is first defined by forest cover mapping. However, in the agricultural landscapes of the NSW Western Slopes, such forest cover mapping, or woody/non-woody mapping, may fail to identify some of the most important biodiversity assets. Biodiversity assets throughout these papers are defined as ‘areas retaining biodiversity values that may or may not be currently managed for conservation outcomes’. Fischer and Lindenmayer (2006), Lindenmayer and Fischer (2007) and Fischer et al (2008) provide some critique of the ‘fragmentation model’ of landscape planning. They contend that this model assumes there is a clear contrast between these patches (as defined by humans) and the surrounding matrix, and that multiple organisms also perceive these human-defined patches as ‘habitat’. Fischer et al (2005) consider that ‘an exclusive focus on patches of trees may lead to sub-optimal conservation outcomes in some modified landscapes’.

In the temperate woodland belt of south-eastern Australia, there is often a lack of clear contrast between woodland patches and grazed native pastures. This led McIntyre and Barrett (1992) to suggest a ‘variegation model’. The variegation model suggests viewing landscapes as habitat gradients, rather than as patches within a hostile matrix. Fischer et al (2005) describe the grazing landscapes of south-eastern Australia as having a ‘soft matrix’.

These concepts have been further developed by Manning et al (2004) in their promulgation of a ‘continua-umwelt’ model. This recognises that species differ in their perception of what constitutes suitable habitat, and that a range of ecological processes may affect habitat suitability through time, in a spatially continuous and potentially complex way. Fischer and Lindenmayer (2006) consider that the continua-umwelt model has several conservation implications, including:

- heterogeneity at a landscape scale, including variation in topography, and a mix of patch size and vegetation types, creates additional niches and enhances species richness
- whilst unmodified or ‘original’ habitats are likely to be beneficial, even highly modified locations may provide habitat, and hence, conservation enhancement can take place across entire landscapes.

Dorrough et al (2005) describes a ‘state and transition’ model for grassy ecosystems in central Victoria, to better define the variability and values of different sites in agricultural landscapes. These seven ‘states’ range from grassy/forest and woodland in various condition, to native pastures without tree cover, to exotic pastures. It is critical that this ‘landscape heterogeneity’ be captured in any spatial representation of habitat, but this is a difficult challenge.

The limitations of the ‘fragmentation model’ for landscape planning are underscored by the definition of the box gum woodland endangered ecological community listed under the NSW *Threatened Species Conservation Act 1995*, which is not defined solely on the presence of the dominant eucalypt species. Highly disturbed sites that have few if any native species in the understorey are specifically included in the community provided ‘vegetation, either understorey or overstorey or both, would, under appropriate management, respond to assisted natural regeneration…’. (NSW NPWS 2003).

In an agricultural landscape, a site’s resilience – the ability to respond to natural regeneration – is perhaps a key factor in determining whether a site can be considered to be a ‘biodiversity asset’. Two other key factors could be considered to be the presence and density of scattered hollow-bearing trees, and the site’s connectivity, that is, the position of the site in the landscape relative to other biodiversity assets. Michael et al (2008) also make the case for granite inselbergs and rocky outcrops being of paramount importance in conserving reptile diversity in fragmented agricultural landscapes. Valuable sites that have all three factors may not be identified at all using a woody remnant vegetation layer.

The achievement of continental scale connectivity and biodiversity targets through the creation of new structurally complex areas of native vegetation, will rely on the identification and restoration of sites with a high degree of resilience.

A3. The limitations of a traditional vegetation (tree cover) map

The outputs of any landscape planning model are limited by the quality of data that is input. It seems clear that the use of a forest cover map, or woody/non-woody layer, has limitations in predicting the location of the potentially highest value sites for biodiversity in an agricultural landscape. Figure A1 illustrates some of these potential limitations.

The 'white areas' on such vegetation maps:

- mask huge variations in biodiversity value. They include intensively cropped and irrigated lands, and other exotic land uses such as plantations, vineyards, horticultural enterprises, and urban and industrial areas. They also include areas of native pasture or native grassland, small patches of native vegetation, areas of recent native regrowth, wetlands, watercourses, and hollow-bearing trees, either in small clumps or scattered across the landscape in varying densities.
- may have higher values than the areas of identified forest cover. For example, in many forest remnants, large hollow-bearing trees have been removed by timber-getters in the past century and now mainly survive as scattered trees in grazed paddocks (Bennett et al 1994). Some woody remnants may constitute regrowth from past catastrophic fires, and may have very high numbers of stems per hectare but low species diversity (i.e. dense poley stands of *E. macrorhyncha/E. dives* regrowth).
- will contain the most 'productive' parts of the landscape, supporting different elements of biodiversity compared to comparatively unproductive parts of the landscape on hills and ridges, which although better vegetated, may be less species-rich (Fischer et al 2005). For example, in northern Victoria, populations of the endangered grey crowned babbler *Pomatostomus temporalis* are within variegated landscapes of higher fertility, and not necessarily associated with large 'core areas' (I. Davidson pers. comm.). These productive areas can provide ephemeral resources (e.g. nectar) that are more abundant than, and asynchronous with, similar resources in less threatened vegetation types (McGoldrick and MacNally 1998, Ford et al 2001).
- may be at greater risk from land-use intensification (such as pasture improvement, vineyard or plantation development) and other threatening processes. Some blocks of native pasture with stands of scattered, hollow-bearing trees, may be a greater conservation priority for conservation management or acquisition than forest remnants, because the regulatory control of land-use change on such sites is weaker. Consequently they are demonstrably more threatened by future land-use change.
- may include areas where cost effective restoration can occur over large sites.

It is considered that estimates of pre-clearing and current extent of the communities may underestimate the amount of box gum woodland that currently exists, as regional mapping exercises tend to ignore isolated paddock trees and small clumps (Mulvaney 2002). Recent developments in image interpretation (e.g. using ADS–40 Digital aerial photography; SPOT–5) show promise in correcting this, but unless the spatial data input into GIS-based conservation planning models and decision support tools includes areas without tree cover but with high restoration potential, conclusions from such models must be drawn cautiously.

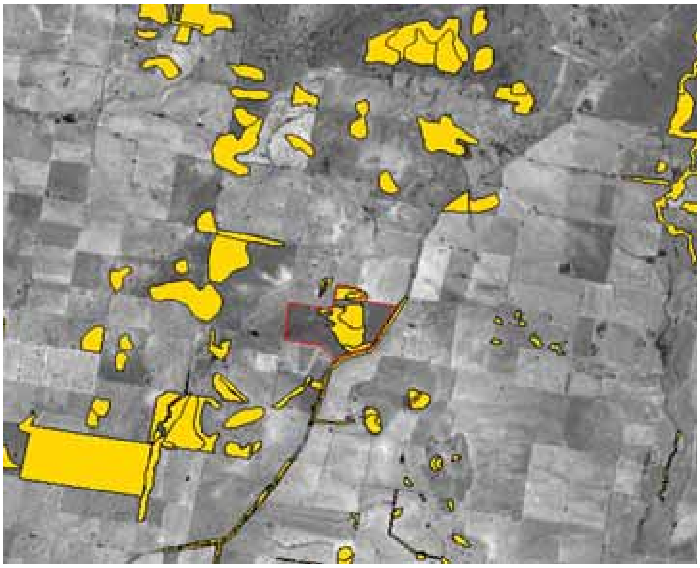

Figure A1a (top)

Tree cover mapping in the Morven–Cookardinia area.

The area in red outline is shown in the photograph at Fig. A1b.

Figure A1b (centre)

The vegetation on the ridge (background) is white box woodland and is shown on the tree cover map (top).

The foreground (not shown on the tree cover map) has logs, stumps, regrowth, and is dominated by native ground cover. It is in a low, relatively fertile part of the landscape.

It would conform to the definition of box gum woodland endangered ecological community under the *Threatened Species Conservation Act 1995*.

Figure A1c (below)

An area of restoring woodland after three years of natural regeneration, This site, near Thoona, in northern Victoria (in the South-west Slopes Bioregion). shows how sites like the one in Fig A1b can regenerate with subtle changes in management, and significantly increase condition and extent.

This represents a cost effective means of achieving catchment biodiversity targets, but sites such as this are rarely identified in conservation planning exercises.

Figure A1: The limitations of tree cover mapping in agricultural landscapes. Even in drought (January 2007) the site's resilience is obvious, and restoration would result in a large core area of box gum woodland endangered ecological community that would support several threatened fauna species (photos: M. Sheahan, DECCW)

A plan drawn from such conclusions may favour the protection of woody remnants of dense poley regrowth on steeper slopes, whilst a neighbouring area of diverse native pasture with hollow-bearing trees (i.e. un-mapped box gum woodland endangered ecological community) may later be 'pasture improved'. Such an area may have been amenable to restoration simply through reduction of grazing, may have dramatically increased the extent of an endangered ecological community, and may have provided habitat for threatened fauna within a reasonably short timeframe.

Clearly there needs to be a better way than 'forest cover' of defining what constitutes 'habitat' in a modified agricultural landscape.

A4. What constitutes 'habitat' in the agricultural landscapes of the South-west Slopes?

How can we define and identify biodiversity assets in such modified, agricultural landscapes? The history of modification and land use in the dryland environments of the South-west Slopes are well described in Benson (2008).

Apart from the granite inselbergs described by Michael et al (2008), there are three key factors that may not be indicated by tree-cover mapping which need to be considered:

- resilience in the understorey
- the presence of large, hollow-bearing trees
- the landscape context.

Resilience in the understorey

Resilience (or the potential for recovery) in the understorey is the key factor in determining the biodiversity value of a site. This has been recognised in the final determination of the NSW Scientific Committee for white box–yellow box–Blakely's red gum woodland which stated that:

> In any particular site not all of the assemblage… may be present. At any one time, seeds of some species may only be present in the soil seed bank with no above-ground individuals present. The species composition of the site will be influenced by the size of the site, recent rainfall or drought conditions, its disturbance history and geographic and topographic location (NSW Scientific Committee 2002).

The mapping exercise included in Fallding (2002) showed that, on the southern tablelands, as much as 39% of pre-clearance extent of yellow box–red gum grassy woodland may still exist as native pasture, with or without the presence of remnant trees.

The best indicator for resilience is the dominance of native plants in the ground layer. 'Native paddocks' (paddocks dominated by native grasses) may have never been cultivated or fertilised. Simple changes to grazing regimes, particularly when they occur in tandem with favourable climatic conditions, may lead to regeneration of palatable understorey species. Davidson (2006) considers that the biodiversity spin-offs from these management actions are significant. These include:

- improving seeding and regeneration opportunities for a range of flora species
- increasing patchiness through an increase in the number of tussock-like perennial grasses
- increasing foraging opportunities for wildlife, with many ground-foraging species being able to access ground litter
- improving the health and condition of standing relict trees
- increasing regeneration of trees.

Dorrough and Moxham (2005) consider that regeneration from naturally dispersed seed is an alternative and cost effective method of revegetation. In a survey of eucalypt regeneration across 519 sites in grassy dry forests and grassy woodlands of central Victoria, eucalypt regeneration was observed in 27% of all sites. The probability of eucalypt regeneration was reduced by intensive past land use (cultivation), regular livestock grazing, increasing distance to remnant trees and high cover of exotic annual vegetation.

The highest probability of regeneration was observed in ungrazed sites, although regeneration also occurred under intermittent grazing regimes. This concurs with Davidson (2006), and Davidson et al (2005), who found that increased rest time between grazing events also had significant biodiversity benefits.

Dorrough et al (2005) found that maintaining or improving vegetation condition is much easier if the vegetation is in moderate to good condition and supports a native-dominated ground layer. In these cases, strategic grazing and encouragement of natural regeneration may be cost effective ways of improving the condition of native vegetation.

Davidson (2006) concludes that woodland bird populations respond rapidly to improvements in habitat structure and size, even in the early stages of regeneration where shrubs and immature trees begin to form a woodland-like canopy. In turn, these populations lead to improvements in the ecological health of the site, by reversing ecological simplification and providing competition for aggressive species such as noisy miners, which are disadvantaged by increased shrub and tussock grass cover (Maron 2009, Martin and McIntyre 2007).

Native paddocks with a history of little or no cultivation or fertiliser application, particularly with an occurrence of remnant paddock trees or the presence of stumps or fallen timber, can be considered to be irreplaceable environmental assets in the context of a modified agricultural landscape.

Presence of large, hollow-bearing trees

Tree hollows have long been recognised as an important resource for a range of wildlife species. They are used for diurnal or nocturnal shelter, nest sites or den sites. It has also been recognised that the availability of suitable hollows is a limiting factor for some fauna populations (Bennett et al 1994).

Even where these large hollow-bearing trees occur as ‘isolated paddock trees’ in ‘farmland’, they can support a rich fauna (Law et al 2000) and significantly influence the connectivity of forest remnants. The value of such isolated trees in farmland cannot be under-estimated, as they contribute significantly to the total number of trees. Gibbons and Boak (2002), for example, found that in the Holbrook area, 54% of all tree cover of the box gum woodland endangered ecological community occurred in patches of less than one hectare, and 41% in patches of less than 0.5 hectares. Hill et al (1997) consider that the very use of the term ‘isolated’ is provocative, inferring from it that such plants are no longer linked to other plants and are no longer involved in the ecological processes of remnant ecosystems. Such a conclusion is erroneous.

Recent work, summarised in Manning et al (2006) agrees with this. They find that scattered trees have a range of ecological roles operating at a range of scales. These roles include:

- at the local scale, provision of distinct micro-climates, and increased soil nutrients, plant species richness, structural complexity and fauna habitat

- at the landscape scale, increased landscape tree cover, connectivity for fauna populations, genetic connectivity for tree populations, and provision of genetic material and focal points for future large-scale ecosystem restoration.

Manning et al (2006) consider that the contribution of large scattered trees to ecosystem function is disproportionately large, and that they should be considered as 'keystone structures' for conservation. Figures A2 and A3 show native paddocks with large hollow-bearing trees. The site shown in Figure A2 is not shown in extant vegetation mapping, yet squirrel gliders, brown tree-creepers, black-chinned honeyeaters and swift parrots have been recorded here.

Figure A2: Native paddock with large hollow-bearing trees, Humula NSW (photo: Mason Crane)

It is also well-established that the numbers of scattered trees are declining across agricultural landscapes. The causes of this include:

- natural decline and senescence
- dieback and eventual death from human-induced land-use change (a complex process involving increased insect attack following increased nutrient loads from pasture improvement, soil compaction or ringbarking by stock, root damage from soil cultivation, waterlogging in irrigated paddocks and salinity)
- authorised and unauthorised felling and removal.

These causes are compounded by a lack of regeneration and recruitment.

The rate of decline of scattered trees has been estimated by a number of researchers. Reid and Landsberg (2000) estimate the rate of loss as between 0.54% and 2.5% per annum, indicating a total loss could occur within 40 to 185 years. Robinson (1994) estimated that if the rate of loss of large trees in a 3,300-hectare study area in Benalla, northern Victoria continues at current rates, all large trees would be lost from this landscape within 77 years.

This rate of decline not only threatens the ecological roles provided by these trees, it limits future options for future restoration of over-cleared landscapes, and the recovery of threatened communities.

Dorrough and Moxham (2005) consider that natural regeneration has the potential to make a considerable contribution to future tree cover in these landscapes. Scenario testing at three farms suggested that under current patterns of tree cover (2.7%), 40% of the total area has a high probability of supporting natural regeneration in the absence of livestock grazing. However, if paddock trees decline this could be reduced to 18% of total farm area if no management action is taken in the next 30 years.

Figure A3: Native paddock with large hollow-bearing trees, Big Springs NSW (photo: Mason Crane)

The effectiveness of a simple change to a grazing regime in woodland ecosystems is confirmed by Spooner et al (2002). They report that 59% of sites in grassy woodland environments fenced to exclude continuous grazing showed tree recruitment, as well as a greater cover of native perennials.

Conservation that focuses only on forest reserves or remnants, while ignoring the matrix, will often have limited success (Law et al 2000), particularly considering that large hollow-bearing trees may be absent from forest reserves or remnants. Manning et al (2006) consider that future landscape management approaches will ideally recognise the complementary contributions of large patches of native vegetation and extensive areas of scattered trees.

Landscape context

Whilst the presence of a resilient native understorey and scattered large trees are indicators of sites with high biodiversity values, the value of each site depends on its size and location in the landscape relative to other biodiversity assets.

The landscape context of a 'patch' is critical in determining its regenerative capacity and long-term viability (Cunningham 2000). While fauna are relatively mobile across the landscape, the ability of plants to occupy new sites depends on the arrival of viable propagules at new sites and therefore depends on connectivity. Plants can also 'move' by taking advantage of newly suitable habitat (Morgan 1998).

The fragmentation and degradation of woodland ecosystems has led to ecosystem simplification. Smaller isolated remnants, or areas of scattered trees which are frequently grazed and have low shrub cover, will be susceptible to invasion and dominance by noisy miners (Grey et al 1998) which affects declining populations of woodland birds.

Parkes et al (2003) summarise the importance of landscape context, and define this in terms of three criteria: the size of a 'patch'; the amount of native vegetation in the 'neighbourhood'; and the distance from that patch to a 'core area' of native vegetation.

It is important to note that 'patch' is not defined in terms of tree cover, but rather on the understorey and ground layer composition. Hence, a 'native paddock' without trees would be considered to be a 'patch', together with any other contiguous native vegetation, whether the connection be broad or narrow. For example, an area adjoining such a 'native paddock' could be a large remnant of woodland or forest, or an adjoining linear area of native vegetation such as a creekline, roadside or travelling stock route, whether it was treed or grassy. If adjoining, these would all be considered as part of the same 'patch'.

Alternatively, a disparate (i.e. unlinked) spacing of vegetation fragments may still allow for the movement of individuals or the dispersal of biotic propagules, and Fischer et al (2006) concur that large 'stepping stones' of habitat are important.

Lindenmayer and Fischer (2007) consider that a careful distinction is required between connectivity of habitat for an individual species, connectivity of human defined patterns of land cover, and connectedness of ecological processes. They argue that, because 'landscape' is a human construct, 'landscape connectivity' should relate only to the physical connectedness of a landscape as perceived by humans. Far more important is 'ecological connectivity', but this is clearly more difficult to measure.

A5. A vision for the South-west Slopes landscape

An appropriate 'vision' for a sustainable, yet still predominantly agricultural landscape, would include:

- the achievement of native vegetation extent and condition targets, as outlined in the catchment management authority catchment action plans
- an increase in the extent, representativeness and quality of threatened ecological communities (Prober and Thiele 2005)
- significantly enhanced ecological connectivity across the landscape; a bio-permeable landscape both latitudinally within the western slopes, but also across the western slopes from the Great Eastern Ranges to the Great Western Rangelands.

On the ground, this will necessitate (not necessarily in priority order):

1. protection of existing areas of large forest (or woodland) habitats where they remain
2. creation of large, structurally complex patches of woodland from large, resilient native paddocks, to act as core areas, to increase native vegetation extent, and to sample biodiversity in the more fertile (and least reserved) parts of the landscape
3. protection and appropriate management of linear reserves, including roadsides and stock routes (travelling stock reserves), which will continue to play a vital role in providing habitat and linking core areas
4. protection and appropriate management of watercourses and riparian areas, which have always acted as movement corridors for wildlife and, when compared to the woodlands that surround them, may retain a higher degree of integrity, resilience and habitat value
5. sympathetic management of a certain percentage of the surrounding agricultural landscape 'matrix' to enable persistence of large scattered trees.

Towards achieving the vision

Conservation assessment and planning in NSW has traditionally focused on the goal of sampling biodiversity in reserves, guided by acquisition targets to achieve a comprehensive, adequate and representative reserve system. As is discussed in Paper B, it has focused less on achieving catchment action plan targets.

For the vision to be realised, conservation assessment and planning programs will necessarily focus on catchment action plan targets across tenures, not just in reserves. This will involve:

- a much fuller understanding of the variability of, and the opportunities that exist within, the 'white areas of the tree cover map'
- consequently, a reduction in the reliance on tree cover mapping in conservation assessment, and an increased reliance on local and expert knowledge and input
- promotion of a range of conservation incentives, instruments and tools, including property vegetation plans, management contracts, conservation agreements and trust agreements, rather than just acquisition for reserves.

Considering threats and values

Choices inevitably have to be made. Of the five landscape components above, large native paddocks (no. 2) are arguably under the greatest threat. Whilst both the *Native Vegetation Act 2003* and the *Plantations and Reafforestation Act 1999* prevent the clearing of large forest and woodland areas with generally intact tree cover, large native paddocks may in practice be fertilised or pasture improved, or developed for plantations (see section D7, Paper D).

If there was a choice between the acquisition or purchase of a large forest block, or alternatively, a large native paddock (in the 'white area of the tree cover map') lower in the landscape with high potential for restoration to woodland, a threat assessment should be carried out in addition to an assessment of values. Conservation assessment and planning must have an explicit process for this threat assessment.

Gibbons (2009) outlines a method for prioritising investment in conservation, based on the **size of the increase** in biodiversity value attainable, rather than on the final biodiversity value to be achieved. Figure A4 shows three possible sites for conservation investment, together with an analysis of their respective potential for achieving an increase in biodiversity value. Sites 1 and 3 have similar potential in terms of the amount of improvement possible with an investment in conservation management. Site 2 however, a native paddock with small clumps of trees, offers the greatest potential **improvement** in condition **and** extent, and should be given priority for conservation investment.

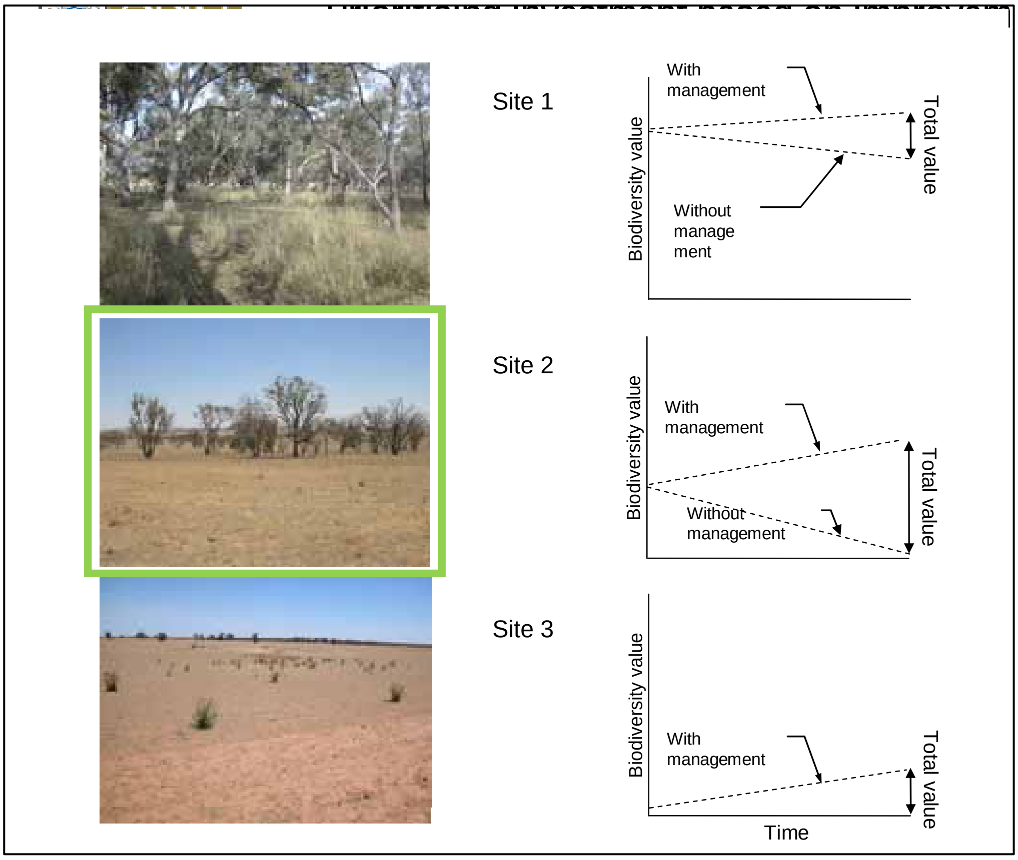

Figure A4: Prioritising investment based on improvement (source: Gibbons 2009)

Using the full range of conservation tools

Acquisition of certain parcels for a formal conservation reserve still has a role to play in the achievement of this vision for the South-west Slopes, but this role is limited. Nevertheless, there will be opportunities to purchase strategically located, large 'native paddocks' (in the order of 500–2,000 hectares) with high resilience and high densities of large hollow-bearing scattered trees. These could become core areas of habitat in fertile, lowland parts of the landscape, providing the best opportunities for achievement of biodiversity conservation with minimal risk and at low cost. These opportunities should be grasped, and purchase and acquisition is an appropriate mechanism to secure such sites.

Alternative mechanisms in surrounding lands will be far more numerous, and will include property-based mechanisms such as property vegetation plans, environmental stewardship agreements, and conservation agreements. The role of economic incentives and market-based instruments in delivering these tools is critical. Also important will be cost-share arrangements for specific works agreed under a management contract.

Public land managers, including the Department of Lands, livestock health and pest authorities (formerly Rural Lands Protection Boards) and local councils own and manage a large proportion of the significant biodiversity assets of the South-west Slopes. The negotiation of management plans and agreements for these areas will also be a critical part of implementation.

Conservation assessment and planning needs to be mindful of these eventual implementation mechanisms. Options for conservation assessment planning programs are discussed in Paper B.

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Paper B: Methodologies for conservation planning in predominantly agricultural landscapes

Mark Sheahan, Department of Environment, Climate Change and Water NSW

Abstract

The South-west Slopes well demonstrates that the history of reserve establishment is focused on land that is infertile for agriculture and unsuitable for other uses. Most of the high conservation value assets in agricultural landscapes exist on the more fertile sites, lower in the landscape, that are predominantly privately owned.

Systematic conservation planning methodologies have been developed to address the deficiencies of reserve systems, but where they have been developed for forested or rangeland landscapes, these may not be appropriate for agricultural landscapes.

The purpose of a conservation planning methodology in a predominantly agricultural region should be focused not on achieving targets through the sampling of biodiversity in reserves, but more broadly on the achievement of a sustainable landscape across all tenures. This requires implementation through a range of conservation tools, including management contracts, market-based instruments, and property agreements and covenants.

Conservation planning that takes place within the paradigm of 'reserve selection' may not be successful in targeting or implementing this range of conservation tools.

A range of approaches has been used in such areas, and could be considered for adoption. However, there are a number of constraints to conservation planning in the South-west Slopes/Sheep-Wheat Belt, and because of these, a two-tier approach to conservation planning is recommended.

Firstly, at the bioregional scale, an expert panel should be used to identify priority 'local landscapes'. Then, within each of these local landscapes, a local conservation plan should be developed that identifies priority sites and actions.

B1. The goal of conservation planning in agricultural landscapes

The South-west Slopes is one of the most cleared, fragmented, and inadequately reserved landscapes in Australia (Benson 2008). Approximately 85% of its vegetation has been cleared, the highest rate of any bioregion in NSW, with only 2.8% of its total area in nature reserves, the lowest rate of any bioregion in NSW (NSW National Parks and Wildlife Service 2003).

These reserves are generally located on the rocky ridges that occur throughout the bioregion, and amply demonstrate the point made by Pressey (1994) that the history of protected area establishment has produced a protected area network that is biased towards infertile or rugged landscapes that are not economically valuable for production.

The biodiversity assets of highest value, including the endangered ecological communities and the more productive threatened fauna habitats, are invariably located on more fertile sites, lower in the landscape. These are predominantly privately owned.

As discussed in Paper A, and evidenced in Benson (2008), despite the long history of modification of the South-west Slopes landscape, high value, irreplaceable biodiversity assets do remain throughout the bioregion but are not evenly distributed across it. To achieve catchment biodiversity targets, conservation planning is necessary to identify the location and extent of these higher value assets, and arguably may best be focused on areas where there is a greater concentration and extent of such assets.

Conservation targets for any particular region of NSW are set within the context provided by state policies such as the NSW Biodiversity Strategy (NSW Government 1999) and the NSW State Plan (NSW Government 2006). The former does not specifically set targets for biodiversity, although it commits to the establishment of a comprehensive, adequate and representative (CAR) reserve system. The latter enshrines the goal of achieving the statewide targets for biodiversity that have been established by the Natural Resources Commission (2005) and sets targets for the extent and quality of native vegetation and the recovery of threatened species.

More recently, the NSW Government has released a discussion paper on a new biodiversity strategy for NSW (DECC 2008a). This recommends commitment to both the CAR reserve system, and the statewide natural resource management targets, including targets for biodiversity.

A traditional purpose for conservation planning in NSW is to identify parcels for the acquisition of new reserves to achieve a CAR reserve system. This approach 'samples' a percentage of a region's biodiversity in conservation reserves. In forested environments, CAR targets enshrined in the Regional Forest Agreement process drove this selection and acquisition.

Systematic conservation planning has been used less often to achieve a sustainable landscape as defined by the catchment targets, using not just reservation but a full suite of conservation tools.

To consider whether a particular approach to conservation assessment or 'systematic conservation planning' is appropriate for the South-west Slopes, it is worthwhile to consider the characteristics of agricultural landscapes.

B2. Characteristics of agricultural landscapes for conservation planning

Benson (2008) describes many of the bio-physical characteristics of the South-west Slopes bioregion. These and a number of other characteristic features of agricultural landscapes represent, for the conservation planner, a stark difference to forested or rangeland landscapes.

Large number of landholdings

Agricultural landscapes will have large numbers of landholdings of a relatively small size. The achievement of biodiversity targets will therefore rely on conservation action on a large number of individual landholdings. In rangeland landscapes, such as the NSW Western Division, conservation targets may be more easily achieved on a small number of holdings.

Many different types of landholdings

Agricultural landscapes will have a larger number of different types of landholders compared to forested landscapes. The achievement of reservation targets in forested landscapes has, in some cases, been achieved through bi-partite negotiations between state agencies (e.g. the Regional Forest Agreement process). In the South-west Slopes, negotiations on conservation action not only rely on dealing with large numbers of individual private landholders, but also with leaseholders, local governments, livestock health and pest authorities (formerly Rural Lands Protection Boards), and a number of state agencies who have land management responsibilities.

Institutionally complex

The large number of landholdings, and various tenures in agricultural landscapes, arguably contribute to an institutional complexity. The South-west Slopes Bioregion is spread across four different catchment management authorities, and includes 38 local government areas, 14 (former) Rural Lands Protection Board areas, 13 Rural Fire Service zones and 37 rural districts.

Unlike many other bioregions, there is no focus on one or two regional towns or centres, but instead there are numbers of local regions focused on towns and cities as widely dispersed as Mudgee, Cowra, Parkes, Griffith, Wagga Wagga and Albury. These each contain their own institutions including Landcare and landholder networks, tertiary institutions, and state and local government agencies that communicate infrequently or not at all with their counterparts in other centres in the bioregion.

Poor data

The South-west Slopes has, compared to other parts of the State, relatively poor data and information on biodiversity. Large areas of the bioregion have no floristic vegetation mapping. The vegetation mapping that does exist is, in many areas, only derived from tree cover mapping, or land-use mapping, and coverage of even this is not comprehensive. The limitations of using this data, particularly in modified or grassy ecosystems, are discussed at length in Paper A.

The use of such incomplete data in GIS models and computer-driven analyses may seriously distort the outcomes, by excluding vegetation not identified by tree cover mapping because it is grassy, or because patches of tree cover in a woodland, within a grassy or shrubby matrix, may be below the area threshold for mapping. This may prioritise non-target or more common vegetation types that are not under active threat.

Local and expert knowledge

Given that there are many landholdings, of small sizes and various tenures, it follows that the most detailed knowledge of conservation assets in a particular landscape or on particular parcels may be held within the landholder and wider local community. This is particularly true in the South-west Slopes where data is poor. Fazey et al (2006) discuss the importance of conservation planning methodologies needing to ensure that this 'local and expert knowledge' can be captured and used effectively (Figure B1).

Figure B1: Conservation assessment and planning methods in agricultural landscapes should strive to incorporate local and expert knowledge. Photos: M Sheahan (left), DECCW; right S. Cohen, DECCW (right).

Range of implementation activities

The achievement of biodiversity targets in agricultural landscapes will not be achieved through reservation alone. Indeed, reservation may have only a relatively minor role to play in achieving biodiversity targets. Opportunity costs for conservation action may also be significant. Conservation action will, therefore, depend on a suite of other mechanisms, including property-based instruments (management contracts and agreements, covenants and registered agreements) and economic instruments (auction-based schemes, stewardship payments). The role of more traditional engagement activities, such as landholder extension, remains critical.

Biodiversity assets not evenly distributed

Unlike forested or rangeland landscapes, which retain more or less contiguous native vegetation cover, the history of modification in agricultural landscapes has been extensive – but not uniformly so. Some areas within the bioregion may be so modified as to present very few opportunities for meaningful conservation action, whereas other areas may have unusually high concentrations of biodiversity assets that are viable in the long term and which warrant conservation action.

Sophistication of implementation mechanisms

Some conservation planning methodologies are complex, resource-intensive and highly technical. Arguably, for a planning methodology to warrant such a degree of sophistication, the implementation mechanisms should be equally sophisticated. Generally, this is not the case in agricultural landscapes, where conservation management actions are often reactive (in response to landholder enquiry or interest) or opportunistic (in response to property sale). Knight and Cowling (2007) argue that such opportunism should be embraced, and that conservation planners need to be poised to take advantage of ad hoc opportunities.

High costs associated with conservation action

Whilst costs of conservation action may be dramatically less than in peri-urban or coastal regions, they may be higher than in rangeland or forested areas – particularly in lower, more fertile parts of the landscape where the opportunity cost of foregone production may be high.

B3. What is 'systematic conservation planning' in an agricultural landscape?

Systematic conservation planning (Margules and Pressey 2000) has been used explicitly in planning processes designed to achieve reservation targets, and the examples provided by Margules and Pressey were used to inform Regional Forest Agreement processes. These excluded private freehold land. Would they be appropriate for an agricultural landscape which is dominated by private freehold land?

There has been some criticism of conservation planning that it has become increasingly obsessed with the refinement of systematic assessment techniques, and less concerned with implementation (Knight et al 2006). Knight argues that conservation planning by definition must include 'planning' and 'management', and that 'many of the publications in peer-reviewed journals represent systematic conservation assessments, not conservation planning, because they contain no links to processes for developing implementation strategies or stakeholder collaboration, and so are unlikely to be effectively implemented'.

Knight et al (2007) and Knight and Cowling (2008) contend that two-thirds of conservation assessments published in the scientific literature do not deliver conservation action, primarily because researchers never plan for implementation. They recommend seven steps to better integrate research and implementation, so that conservation assessment is situated in a 'real world' context, and can actually be translated into conservation action. Invariably, this requires engaging people, and the choices they make.

Pressey and Bottrill (2008) argue that there is a need for systematic conservation planning to better deal with strongly contested circumstances – particularly productive private land. This would involve ‘more and different information’, bridging the divide between technical specialists and decision makers, and the structured use of expert judgement.

Catchment or bioregional scale

There are few examples of a ‘systematic conservation planning’ approach being applied to agricultural landscapes in pursuit of the statewide or catchment natural resource management targets in NSW. For the reasons set out above, the catchment or bioregional scale may be too large for meaningful conservation assessment and planning in agricultural landscapes. A scale between a catchment scale and property scale is required, a ‘piece of the landscape we can get our head around’, where local and expert knowledge can be engaged and the most important biodiversity assets can be identified and ranked for action.

Broad regional scale

Already there has been some investigation of an intermediate scale. Many catchment management authorities are defining smaller geographic units within their catchments for planning and implementation. The intersection of catchment management authority areas and bioregion may, in some cases, be useful as starting points in delineating these areas.

In the North Coast Bioregion, the draft Border Ranges Rainforest Biodiversity Management Plan (DECC 2008b) is at a scale of 15,000 km^2 (1.5 million hectares), which is useful in translating catchment targets, identifying priority assets and vegetation types and describing key management actions, and in focusing some key institutions, such as local government and state agencies.

Yet even this scale may not be able to engage all local and expert knowledge nor identify the characteristics of all parcels and rank these for conservation action.

Local landscape scale

Areas in the range of 400–1,000 km^2 (40,000–100,000 hectares) are at the scale that can engage local people in the planning process, and target conservation incentives and tools to known sites and parcels. The exact ‘right’ scale within this range will vary according to average property size across the landscape, and other variables, but can ‘operationalise’ catchment plans by translating catchment targets to the scale at which Landcare and community groups operate.

These ‘local landscapes’ are recommended as the scale at which meaningful conservation assessment and planning – with ‘implementation in mind’ – should occur in the South-west Slopes Bioregion. It follows successful approaches in Victoria (Platt and Lowe 2002) and Western Australia, which are included in the examples of conservation planning provided in the section ‘Some conservation planning tools and methods’ on the next page.

Despite being unambiguously written for a forested landscape and for a ‘reservation’ outcome, each of the six stages given by Margules and Pressey (2000) remain broadly valid at a local landscape scale. However, given the nature of the catchment action plan targets, the biodiversity assets of the region (as set out in Paper A), the conservation tools employed and the partners involved in the implementation of the plan, some modification of the methodology for each of these six stages is required.

Property and site scale

Ultimately, planning is carried out at a property or site scale, and certainly whenever a property vegetation plan, voluntary conservation agreement or Nature Conservation Trust 'trust agreement' is negotiated.

Some conservation planning tools and methods

Expert panel processes

Todd and McDonnell (2003) describe a process for an 'expert panel' comprising a small group of people who have expert knowledge of the biodiversity of an area. The panel is presented with spatial information which assists in dividing up the area into subprovinces, and in delineating indicative key areas of high conservation value.

GIS based approaches

A range of GIS programs and decision support tools are available to support conservation planning. These include Bio-forecaster, CORE and C-Plan. It is important to view each of these tools, and the analyses they present, as information to support conservation planning decisions, rather than as a 'conservation plan' itself. It is also important the tool and the data used in the tool is appropriate for the landscape. For example, using tree cover as a surrogate for 'habitat' is inappropriate in an agricultural landscape.

Focal species approach

The focal species approach (Lambeck 1997, Lambeck 1999) identifies a suite of sensitive species. Those species that are most sensitive to threats in the landscape are called the 'focal species' and the assumption is that if landscape management meets the needs of these species, the needs of all other species in the group will also be met. The Riverina Biodiversity Project (Todd and McDonnell 2003) incorporated the results of a focal species approach to conservation of grey box (*Eucalyptus microcarpa*) woodland in the South-eastern Riverina, developed by Freudenberger and Stol (2002).

Reviews of the approach include Lindenmayer et al (2002), and Freudenberger and Brooker (2004). Both identified problems with the approach, but concluded that the approach is useful, but should only be considered as one of many tools for guiding conservation efforts.

5-S model (The Nature Conservancy, US)

The conservation planning method used by the US Nature Conservancy is called the 5-S model (The Nature Conservancy 2000). The five 'Ss' represent different stages of the conservation planning process, being consideration of systems, stresses, sources, strategies and success.

This model commonly incorporates elements of expert panel, GIS and focal species approaches. It has been used at a range of scales, but is principally used for 'landscape zones' where a conservation management program is being targeted, to develop a conservation area plan. Examples of these are available online at www.conserveonline.org (the Nature Conservancy's online library) and include Halstead (2002). The 5-S model has been adopted by the Gondwana Link project in Western Australia, and has informed the development of biodiversity action planning in Victoria.

Biodiversity action planning model (Victoria)

Biodiversity action planning is a structured approach to identifying priorities and mapping significant areas for biodiversity conservation at a range of scales: bioregional, landscape, neighbourhood and local (Platt and Lowe 2002).

The process for developing a local conservation plan is described in Robinson and Howell (2003). Using this methodology (or variations to it), local conservation plans have been developed for landscape zones across large tracts of northern Victoria (Goulburn Broken Catchment Management Authority 2008). The work of extension officers is informed by these plans to target individual sites and landholders. The plans are also used to create planning overlays for local government.

B4. A methodology for conservation planning in the South-west Slopes

Conservation planning necessarily occurs at a range of scales. These are set out in Figure B2. In NSW, there is currently a large gap in scale between the catchment scale, where catchment action plans set catchment-wide targets, and the property scale. A methodology is required that is responsive to the characteristics of agricultural landscapes, so these targets can be achieved on the ground.

It is recommended that 'local landscapes' be the scale at which detailed conservation planning takes place in the South-west Slopes Bioregion. Paper C identifies and prioritises these local landscapes.

Paper D states that the conservation assessment within each 'priority local landscape' should have these aims:

- to **define biodiversity assets** that have targets within the catchment action plan – these will include native vegetation types, threatened entities and aquatic ecosystems
- to develop **local landscape targets** for these assets, which are based on targets in the catchment action plan
- to **spatially identify areas of biodiversity assets** (sites) within the landscape, including summary information for each site, that can achieve these targets
- to **prioritise identified sites** for conservation management, based on the values of the sites and the threats or risks to them
- to **identify specific sites for future targeting by specific conservation mechanisms**, including incentive and cost-share arrangements, management payments, property vegetation plans, covenanting and acquisition
- to **ensure landholders have opportunities** to access a range of conservation tools (including financial and other incentives) to manage and protect biodiversity assets, particularly where these are identified as a priority.

These are quite similar to the stages set out in Margules and Pressey (2000), except that instead of 'reviewing existing conservation areas' and 'selecting additional conservation areas', the process identifies biodiversity assets and prioritises biodiversity assets.

The process of spatially identifying biodiversity assets, in an agricultural landscape, is akin to 'remnant cataloguing'. Potentially, each and every remnant of native vegetation is described and assessed, so it can be prioritised for implementation of appropriate conservation action.

To identify biodiversity assets, reliance must not be placed on (often poor) data sets, but on the identification of other sites through accessing local and expert knowledge, and through the field observations of a skilled field ecologist who knows about the broad regional landscape.

Paper D outlines a rapid assessment process which identifies and prioritises biodiversity assets within a local landscape.

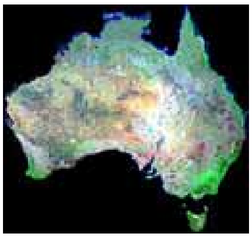
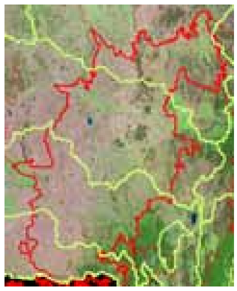
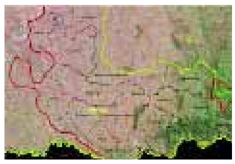
Global – Global Convention on Biological Diversity (Photo: NASA, Apollo 17, NSSDC)	
National – National Strategy for the Conservation of Biological Diversity (Photo: GeoScience Australia)	
State – NSW Biodiversity Strategy (Photo: NSW Department of Lands)	
Catchments – catchment action plans **Bioregions** – bioregional assessment **Department of Planning planning strategy regions** – regional conservation plans (Photo: DECCW)	
Broad regional landscapes – 10–30,000 km^2 biodiversity management plans regional conservation plans (as above) (Photo: DECCW)	
Local landscapes – 400–1,000 km^2 local conservation plans (Photo: DECCW)	
Properties and sites – property vegetation plans management contracts conservation agreements (Photo: Susan Jackson, DECCW)	

Figure B2: Scales for conservation assessment and planning

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Paper C: Identifying ‘priority local landscapes’ in the South-west Slopes Bioregion

Nigel Jones, Nature Conservation Trust of NSW Albury; Mark Sheahan, DECCW Queanbeyan; and David Parker, DECCW Griffith

Abstract

The South-west Slopes region of New South Wales is a highly modified, predominantly agricultural landscape, although it contains a number of iconic biodiversity assets such as the Murrumbidgee, Lachlan and Murray rivers, Lake Cowal, the Tarcutta Hills Bush Heritage Reserve, and Narrandera Ranges. It contains extensive areas of endangered ecological communities, and is critical for the recovery of a range of threatened species, populations and communities.

In such a large modified region, it is important that conservation resources are targeted, as scatter-gun distribution may have negligible benefit. And, in an agricultural landscape with many thousands of parcels under private ownership, it is critical that a conservation planning process is capable of engaging the landholder community, and expert opinion held within the region.

Because of the past history of modification, these biodiversity assets are not evenly distributed through the region, but there are smaller areas (‘local landscapes’) which have unusually high concentrations of biodiversity assets. For example, they may have larger than average areas of woodland or forest, contain important creek and riparian systems, or have known populations of threatened species.

This project has subdivided the South-west Slopes Bioregion (but not including the Central West catchment) into a number of ‘local landscapes’. These local landscapes have been prioritised by three expert panels, based on criteria reflecting their importance for conservation.

These ‘priority local landscapes’ are recommended as the focus for conservation assessment and planning in the South-west Slopes Bioregion. This paper provides a map and description of each, identifying key challenges for those involved in conservation planning and on-ground implementation.

C1. Background

In agricultural landscapes, sites with very high conservation and biodiversity values may not always be identified by remotely sensed data, nor by tree cover mapping, and need to be identified by a combination of approaches that integrate these data sources with local and expert knowledge. These approaches are set out in Paper A.

To achieve this integration, it is necessary to work at a local scale, which enables local knowledge of specific sites, and an intensive appraisal of the landscape down to ‘paddock’ scale. Conservation planning at similar scales is practised in biodiversity action planning in Victoria, and in conservation projects in Western Australia and the USA. These are described in Paper B.

On this basis, the Department of Environment and Climate Change (DECC), the Commonwealth Department of Environment, Water, Heritage and the Arts and the Murray Catchment Management Authority funded a project trial to undertake an assessment of sites with biodiversity values in the Jindera and Woomargama local landscapes using a Rapid Assessment Methodology (RAM). This project is described in Paper D, and in Davidson (2007).

This project trial resulted in all native vegetation remnants within these local landscapes being catalogued and described using 56 attributes. These remnants included those not identified by tree cover mapping or other remotely sourced data, but visible to field observation or known to those with local and expert knowledge. A number of important sites were identified, some of which have now benefited from targeted conservation works. One significant site has been purchased by the Nature Conservation Trust of NSW to be covenanted and re-sold through their revolving fund program. The Department of Environment, Water, Heritage and the Arts subsequently funded a validation of the RAM, and the results of this are also documented in Davidson (2008) and in Paper D.

Given the success of the project trial, DECC agreed to fund the NSW Nature Conservation Trust to undertake a joint project to identify local landscapes in three of the four catchment management authority areas in the South-west Slopes Bioregion , and to determine which of these should be nominated as 'priority local landscapes'. This paper documents the outcomes of this project.

What is a 'local landscape'?

A 'local landscape' is an area that is appropriate for, and amenable to, conservation planning at a 'local' scale. It is characterised by relatively uniform bio-physical features, so the boundaries of local landscapes would reflect bio-physical factors such as the boundaries of IBRA bioregion s or IBRA subregions, the boundaries of landscapes, land-systems or soil-types (e.g. Mitchell landscapes), or catchment or sub-catchment boundaries.

As planning for local landscapes aims to ensure incorporation of local and expert knowledge, and given that plan implementation would be carried out by local or regional groups, the boundaries of local landscapes need to also reflect social and administrative boundaries. These could include roads or highways, local government or Rural Land Protection Board boundaries, areas based on zones in a local environment plan, Landcare group areas, or boundaries of irrigation districts.

The size of each local landscape will depend on the scale of the local population and settlement density, and also reflect the size of average local landholdings. Generally, a local landscape will be 40,000–100,000 ha (400–1,000 km^2) in area.

What is a 'priority local landscape'?

In agricultural landscapes like the South-west Slopes, most vegetation types remain at < 30% of their original area, and many are endangered. For example, box gum woodland has been cleared from approximately 95% of its pre-European extent.

The distribution of this extant native vegetation, and other features of high biodiversity value, is not uniform across the entire bioregion. Some local areas are almost completely cleared, with small remnants remaining only on roadsides, stock routes and other small reserves. Whilst these retain important conservation value and need to be managed appropriately for these values, the 'scatter-gun' expenditure of scarce resources for revegetation or vegetation protection within such local areas may have limited overall conservation benefit.

Other local areas, however, retain significant native vegetation cover, including some larger blocks of woodland and forest, large native paddocks amenable to restoration or significant riparian features. These could be critical for the recovery of some threatened species. These areas are more resilient and small amounts of expenditure for vegetation protection and re-establishment may have great conservation benefit, resulting in greater persistence and recovery of threatened species, and the general strengthening of a functional landscape.

Whilst it will still be beneficial to protect or restore a range of sites, including small sites and sites with little existing tree cover, it may be more effective to do this within local landscapes which are considered to be a 'priority', rather than at sites scattered across the bioregion.

‘Priority local landscapes’ may:

- have an unusually high concentration of biodiversity assets
- have greater areas of extant vegetation
- even where there has been extensive tree-clearing, retain relatively large areas of un-improved pasture or other unmodified lands (including grazing lands with little or no history of fertiliser use)
- contain a large area (or areas) of relatively intact native vegetation (including small parks/reserves or state forests) which serve as core areas (source areas) for fauna populations
- be known to have viable, or persistent, local populations of threatened fauna.

It is difficult to be definitive about the thresholds that could be applied to these criteria. Whilst thresholds could be developed, this would require accurate data uniformly collected from across the bioregion. Such data do not exist, so expert panels have used the criteria above to guide their consideration of the existing data in a qualitative process.

It is also arguable that a priority local landscape is one where there is community or institutional interest in protecting biodiversity assets. In some areas, there are community environmental or Landcare groups with a history of active involvement in vegetation or habitat survey, protection and restoration. In these areas, the likelihood of success in implementing a conservation plan is clearly far greater than in those with less community interest.

C2. Methodology

The methodology outlined here is an ‘expert panel’ method. Whilst systematic (numeric or quantitative) approaches could be explored or developed to define ‘priority local landscapes’ within a bioregion, this would rely on the availability of unambiguous and accurate data uniformly collected from across the bioregion . This data simply does not exist for the bulk of the South-west Slopes Bioregion. What data does exist has been incorporated into an expert panel approach, described in the methodology (below).

Project aim

The aim of the project is to identify those parts of the landscape which would benefit most from conservation and natural resource management activities, and therefore, those which are priorities for conservation assessment and planning. This will guide conservation planners and catchment managers to these parts of the bioregion for more detailed intensive planning, to identify specific sites and actions.

It is **not** the aim of this project report, nor was it the task of the panels, to identify any individual parcel of land for conservation management, nor to develop any specific proposal for incentives, stewardship, acquisition or covenanting.

Collate existing data

Existing environmental spatial data and mapping for the South-west Slopes Bioregion was collated. This included spatial data on:

- latest satellite imagery
- native vegetation, both extant and pre-1750
- flora and fauna records (Atlas of NSW Wildlife)
- waterways and wetlands
- land capability (as a surrogate for site quality and fertility)
- geology, land and soil types, including Mitchell landscape mapping
- catchment and sub-catchment boundaries

- IBRA bioregions and sub-regions
- land tenure, including national parks and nature reserves, state forests, Crown lands, TSRs.

The above information was collated on GIS layers for each of the three catchment management authority areas included in the project – Murray, Murrumbidgee, and Lachlan. These GIS layers were made available to participants in the expert panels, and printed out as hard copy maps for use by the panels.

Convene 'expert panels'

DECC and the Nature Conservation Trust then sought to convene expert panels comprising individuals with local and/or expert knowledge of the biodiversity across each of the three catchment management authority areas within the bioregion. Generally, these panels included, but were not limited to, representatives from the catchment management authority and from DECC. How the arrangement of the expert panels related to the catchment management authorities and the bioregion is shown in Figure C1. The membership of each expert panel is shown below.

Murray expert panel

Nigel Jones	Nature Conservation Trust Covenanting Officer
Ian Davidson	Independent environmental consultant
Jack Chubb	Programs Manager, Murray CMA
David Costello	Vegetation Officer, Murray CMA
Emmo Willinck	Monitoring and Evaluation Officer, Murray CMA
Damian Michael	Ecologist, Australian National University (Albury)
*Judy Frankenburg	Landholder, environmental consultant
Mark Sheahan	Conservation Planner, DECCW, Queanbeyan

Murrumbidgee expert panel

Nigel Jones	Nature Conservation Trust Covenanting Officer
Bindi Vanzella	Program Manager, Greening Australia
David Read	Biodiversity Officer, Wagga Wagga City Council
Rick Webster	Ecologist, Ecosurveys P/L (Deniliquin)
Leigh Thompson	Botanist, GHD Consulting, Wagga
Bruce Mullins	Ecologist, Ecological P/L
Nella Smith	Murrumbidgee Field Naturalists
Eric Whiting	Murrumbidgee Field Naturalists
Damian Michael	Ecologist, Australian National University (Albury)
Geoff Burrows	Senior Lecturer, CSU, Wagga Wagga
*Toni McLeish	Coordinator Grassy Box Woodlands Conservation Management Network
*Owen Whitaker	Natural Capital P/L
*Dick Green	Formerly Regional Manager Greening Australia
*Mason Crane	Ecologist, Australian National University (Gundagai)
*Rebecca Montague-Drake	Ecologist, Australian National University (Gundagai)
*Paul Ryan	Consultant, formerly CSIRO Sustainable Ecosystems (CSE)
Mark Sheahan	Conservation Planner, DECCW, Queanbeyan
Michael Mulvaney	Conservation Planner, DECCW, Queanbeyan
Matt Cameron	Regional Biodiversity Officer, DECCW, Albury
David Parker	Regional Biodiversity Officer, DECCW, Griffith
*Rainer Rehwinkel	Threatened Species Officer, DECCW, Queanbeyan

Lachlan expert panel

Garry Germon	Biodiversity Coordinator, Lachlan CMA
Nigel Jones	Nature Conservation Trust Covenanting Officer
David Crooks	Nature Conservation Trust Covenanting Officer
*Neville Schrader	Naturalist, Parkes
David Goldney	Consultant and Adjunct Professor, CSU, Bathurst
Col Bower	Consultant (Florasearch), Orange
*Paul Ryan	Consultant, formerly CSE
Mark Sheahan	Conservation Planner, DECCW, Queanbeyan
*Rainer Rehwinkel	Threatened Species Officer, DECCW, Queanbeyan
Gary Howling	Coordinator Conservation Planning, DECCW
Robert Taylor	Manager, Environment & Conservation Programs, DECCW, Dubbo
*Andrew Deane	Regional Operations Coordinator, DECCW, Dubbo
*Susie Jackson	Ranger, Dananbilla and Ilunie NRs, DECCW, Queanbeyan
*David Robson	Manager Information & Assessment, DECCW, Dubbo
*Michael Mulvaney	Conservation Planning Officer, DECCW, Queanbeyan
*Toni McLeish	Coordinator Grassy Box Woodlands, Conservation Network Management
*Silvana Keating	Ranger, Nangar & Goobang national parks, DECCW, Forbes.
*Matt Makeham	Ranger, Weddin and Conimbla national parks, DECCW, Forbes
*Steve Woodhall	Ranger, DECCW, Bathurst

* Invited to participate but unable to attend panel meeting. Consulted on the draft reports.

Nominate local landscapes

Each expert panel met for one day only. Each was provided with the background to, and context for, the project (see section C1) and definitions of ‘local landscape’ and ‘priority local landscape’ were outlined and discussed. Each expert panel was then provided with the GIS data and mapping for their area.

Following this, each participant in the panel was asked to nominate two districts within their area that they would consider to be their top two priority local landscapes. These were highlighted on the group map. In each of the three panels, this resulted in a widely dispersed array of local landscapes across the area that opened up discussion about their values and relative importance for conservation.

Through a process of facilitation, starting from each participant’s two nominated priority local landscapes, the whole catchment management area within the bioregion was delineated into local landscapes, with loose boundaries roughly following subcatchment boundaries, main roads or other features.

Describe and prioritise local landscapes

The facilitation team listed the nominated local landscapes and asked each participant to work in small teams to describe these according to:

- known vegetation types
- known threatened species

- unique biodiversity values and features
- priority (high–medium–low).

These were then caucused with the expert panel as a whole, and a list of ‘priority local landscapes’ was agreed to. The panel was then asked to nominate one priority local landscape each in:

- the upper slopes IBRA subregion of their catchment
- the lower slopes IBRA subregion of their catchment
- a riverine environment within their catchment.

This was an attempt to ensure that conservation effort would be spread across the bio-physical variation of the bioregion, but it is possible that all three top priorities might have been located in only one of these areas. These ‘top priority landscapes’ were identified by consensus by the panels, and are set out in section C3.

Refine and confirm local landscapes

In the weeks following the meetings of the expert panels, the authors delineated the boundaries of the nominated local landscapes with regard to the principles set out in section C1 (above). The information contained in section C3 of this paper was then developed.

A draft of this paper was sent to each participant for their comment or amendment.

Results

The expert panels stratified (or subdivided) their geographic areas into local landscapes. Eighty-five (85) local landscapes were delineated across three of the four catchment management authority areas of the South-west Slopes.

The Murray panel delineated 17 local landscapes, the Murrumbidgee panel delineated 35 local landscapes, and the Lachlan panel delineated 33 local landscapes. These are shown in Table C2 and Figure C2.

It is important to note that lower priority local landscapes still have important biodiversity assets, including native vegetation, endangered ecological communities, and records of threatened flora and fauna. The prioritisation process forced the panels to make some hard choices, on the basis that if resources were limited (as they were), which areas should be a priority for conservation planning and assessment. The failure to nominate an area as a high or medium priority did not indicate an absence of biodiversity values in that area.

High priority local landscapes

Of the total 85 local landscapes, the panels recommended 26 local landscapes as priorities for conservation assessment and planning, as shown in Table C2 and Figure C2.

The full report (Jones et al 2009) has maps and full descriptions of each high priority local landscape.

Top priority local landscapes

Of the 26 high priority local landscapes, nine ‘top priorities’ were recommended for immediate conservation assessment and planning (refer to section C2 above). Each panel nominated one local landscape in each upper slopes IBRA subregion, lower slopes IBRA sub-region, and a riverine environment, and the results are shown in Table C1 and Figure C3. A description of each is also provided on the next pages.

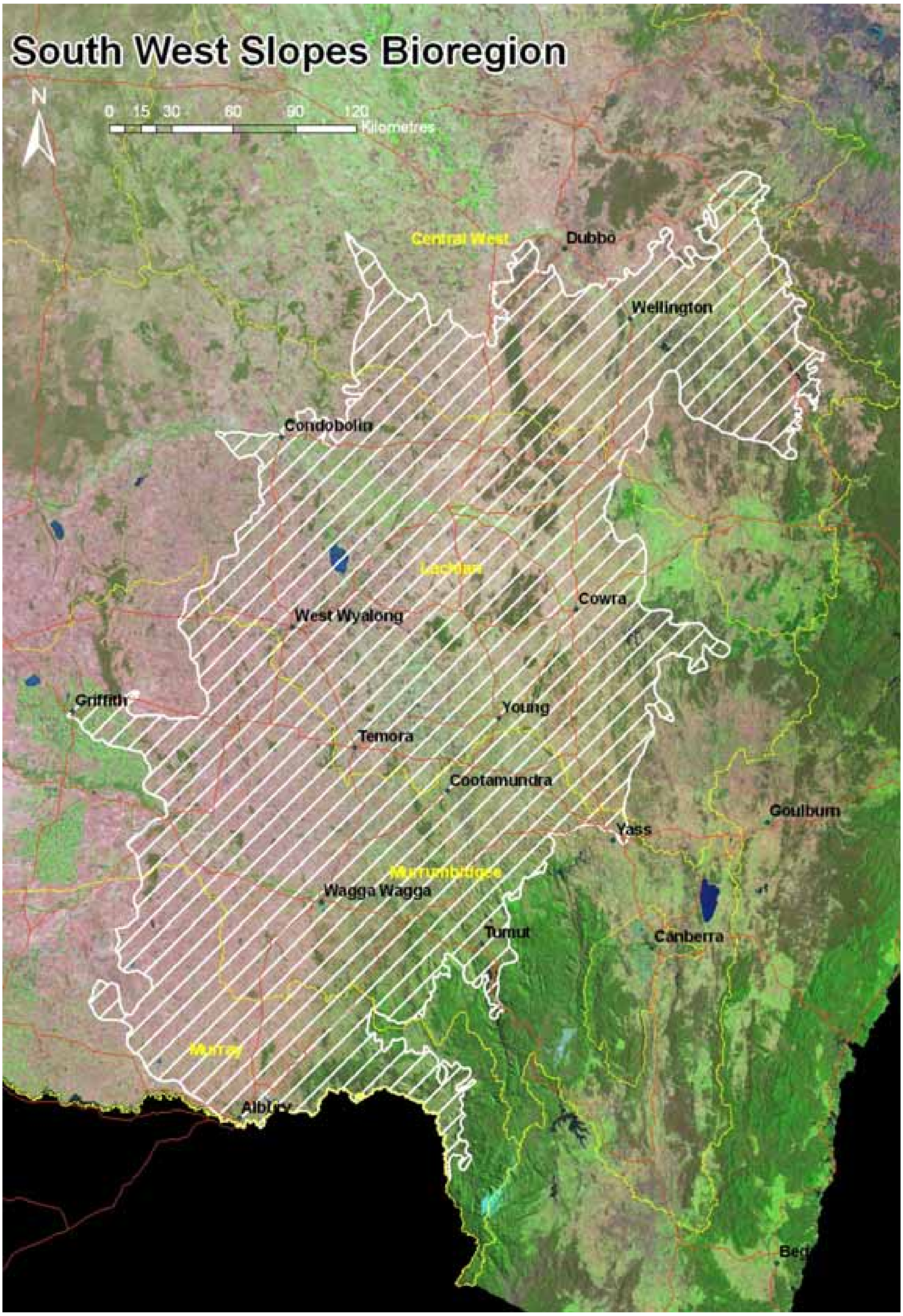

Figure C1: The South-west Slopes Bioregion, showing the four catchment management authority areas labelled in yellow. Expert panels were based on these areas.

Table C1: Top priority local landscapes for immediate conservation assessment and planning

	Murray	Murrumbidgee	Lachlan
Upper slopes	Woomargama	Tarcutta	Dananbilla
Lower slopes	Jindera	Narrandera Ranges	Marsden–Lake Cowal
Riverine	Billabong	Narrandera–Wagga Floodplain	Condobolin

Table C2: Priority of local landscapes across the South-west Slopes

	Murray	Murrumbidgee	Lachlan
High priority local landscapes Underlined landscapes are the nominated 'top priorities' for immediate implementation.	Albury <u>Billabong</u> <u>Jindera</u> Little Billabong Urana <u>Woomargama</u>	Ardlethan Bethungra Combaning Ellerslie Livingstone Minjary <u>Narrandera Ranges</u> <u>Narrandera–Wagga F/plain</u> <u>Tarcutta</u> Wagga – Gregadoo	Bland Creek <u>Condobolin</u> Conimbla <u>Dananbilla</u> Goobang <u>Marsden/Lake Cowal</u> Nangar Upper Bland Waterhole Ck (Mandagery) Weddin
Medium priority local landscapes	Alma Park Brocklesby Coreen Gerogery – B/buttock Lockhart Tumbarumba – Ournie, Wantigong	Ariah Park Buddigower Bullenbung Cooba Gillenbah Harden North Houlaghans Mundarlo Murraguldrie Pleasant Hills The Rock Tallimba Wagga–Gundagai F/plain	Barmedman Fairholme Jemalong Murringo Ootha Temora Wyangala
Lower priority local landscapes These areas still have areas of native vegetation, including endangered ecological communities, and a range of threatened fauna and flora. The panels ranked them as a lower priority for detailed conservation assessment.	Cookardinia Holbrook Tooma Urangeline Wymah	Blowering Bowning Eurongilly Ganmain Harden South Harefield Jugiong Kindra Creek Malebo Mirrool Murrami Muttama	Ballyhooley Boorowa Burcher Burrangong Canowindra Clear Ridge Cowra Cudal Garema Greenethorpe Kenyu Morangorell Parkes Trundle Ungarie Warraderry

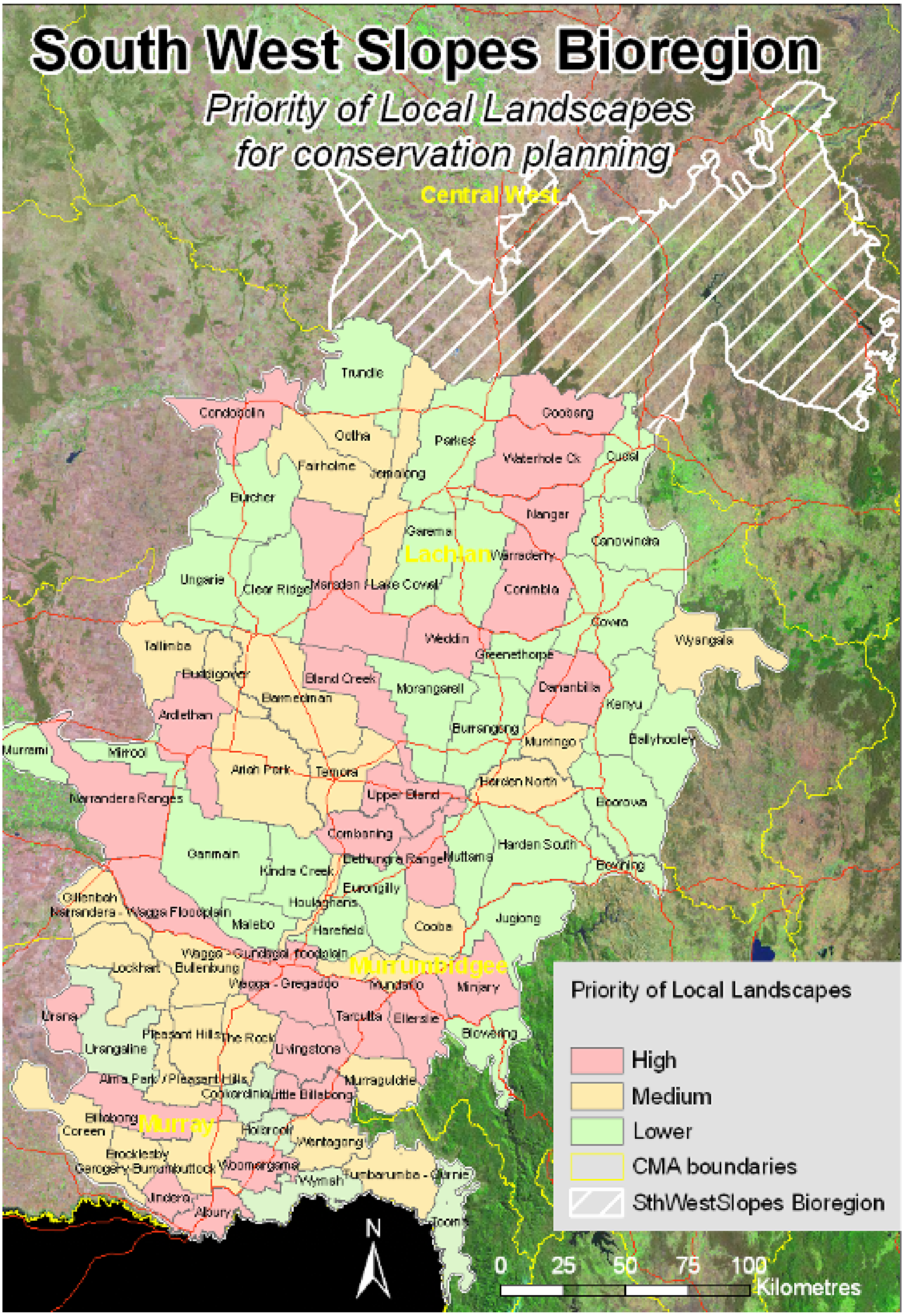

Figure C2: Map showing priority of local landscapes across the South-west Slopes

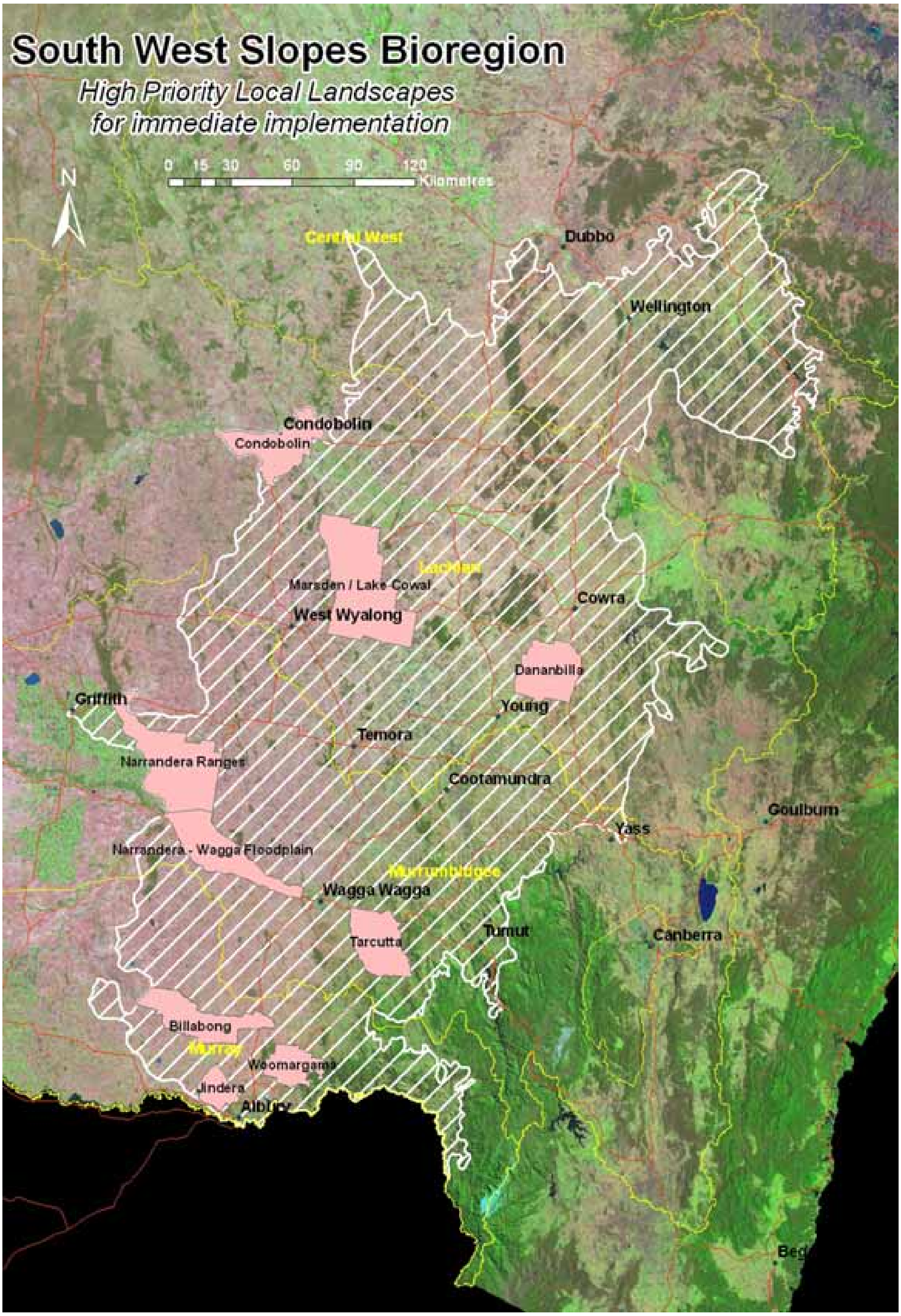

Figure C3: Identified top priority local landscapes recommended for immediate conservation assessment and planning

Top priorities: upper slopes IBRA subregion

Woomargama local landscape (418 km^2)

This landscape comprises the hilly, undulating catchment divide between the Murray River (to the south) and the Billabong Creek (to the north). It represents a 'low point' in this catchment divide between the more elevated Woomargama National Park (to the east) and Great Yambla Range (to the west). This local landscape contains significant areas of box gum woodland vegetation, and ecotonal habitats leading to the foothill forests of both the Woomargama and Great Yambla Range. It is therefore a critically important landscape for the achievement of the Slopes to Summit conservation connectivity project.

Key challenges for conservation are the identification of priority sites for restoration and protection that achieve the overall conservation connectivity objective. The close proximity to Albury means that rural residential subdivision is a potential threat to this goal. Pasture improvement activities are also reported to have increased markedly in recent years, and stewardship approaches to 'whole-of-paddock' restoration are required.

Tarcutta local landscape (720 km^2)

The Tarcutta landscape is centred on the box-ironbark forest and box gum woodlands that extend from the hills south of Tarcutta and east of the Hume Highway down to the junction of Kyeamba Creek and the Sturt Highway. Landcare has had an active history in the landscape.

There are relatively large areas of these vegetation types, including substantial partly modified areas where tree cover may have been removed or reduced but native groundcover remains. The landscape thus presents significant opportunities for ecological protection and restoration, but there is also increasing pressure from land-use intensification.

The area includes the Oberne (Tarcutta) and Umbango creeks which provide important riparian environments that assist the connection of these woodlands and forests down to the riparian environments of the Murrumbidgee River.

A key feature is the Tarcutta Hills reserve owned by Bush Heritage Australia, and the surrounding forested patches which provide habitat for woodland birds and squirrel gliders. One of the most notable remnants of the box-ironbark forests that occur on the hills around Tarcutta is Mate's Gully TSR, which is a known site used by swift parrots during their winter visit to the mainland.

Dananbilla local landscape (779 km^2)

The Dananbilla local landscape contains some very large native vegetation remnants, including large areas of relatively intact grassy woodlands, some of the best examples of lowland grassy woodlands that remain in the South-west Slopes Bioregion. Some of these are already protected in the Dananbilla and Ilunie Ranges Nature Reserve, and many other areas have been identified and protected by voluntary conservation agreements and other mechanisms through the Dananbilla protected areas network.

The ridges are typically covered with a low, shrubby forest of black cypress pine (*Callitris endlicheri*), red stringybark (*Eucalyptus macrorhyncha*) and Dwyer's red gum (*E. dwyeri*). The lower slopes are covered with red ironbark (*E. sideroxylon*) and grey box (*E. microcarpa*) with a sparse understorey. Occurrences of white box (*E. albens*) or yellow box (*E. melliodora*) are found on the eastern slopes, rolling hills and valley floor, often with Blakely's red gum (*E. blakelyi*), and therefore characteristic of the box gum woodland endangered ecological community. A number of riparian strips flanked by river red gum (*E. camaldulensis*) and river bottlebrush (*Callistemon* *sieberi*) flow through this landscape including the Murringo, Top and Crowther creeks.

Substantial areas have been protected to enhance connectivity between the several small conservation reserves in the landscape, and to create large viable 'core areas' of habitat. The key challenge for conservation planning is to formalise the conservation planning already undertaken as part of the protected areas network, and to continue implementation, particularly next to the adjacent Murringo landscape.

Top priorities: lower slopes IBRA subregion

Jindera local landscape (278 km^2)

The Jindera local landscape is adjacent to the Albury local landscape and comprises very similar vegetation, but also connects through to some very extensive areas of box gum woodland along the 'Black Range' north west of Jindera, and the Moorwatha Hills.

Whilst tree cover over much of these hills has been greatly reduced through clearing and tree removal, significant scattered remnants remain and importantly, much of the undulating landscape has not been subject to pasture improvement activities. This means that there are significant opportunities for landscape restoration using a 'multi-property stewardship' approach.

Davidson (2007) has identified, attributed and prioritised sites with biodiversity significance in this local landscape. The key challenge for conservation in this landscape is implementation of protection and restoration activities, and ensuring sound implementation of the Greater Hume Local Environment Plan and specifically the local provisions for environmentally sensitive lands to protect these sites from subdivision and development.

Narrandera Ranges local landscape (1,405 km^2)

The Narrandera Ranges is the most significant aggregation of remnant vegetation in the lower slopes IBRA subregion, and is contiguous with Binya State Forest and Cocoparra National Park to the north. The remnants are mainly restricted to the hills (including within Bunganbil and Mejum state forests), with the lower areas mostly cropped, although there are some wide stands of roadside vegetation in good condition. The sandstone ridges and slopes contain unique high diversity understorey with stands of Dwyer's gum, black cypress pine and drooping she-oak.

The landscape is known habitat for threatened woodland birds and contains a population of the endangered glossy black cockatoo. Most of this landscape has been the subject of surveys by Murrumbidgee field naturalists and a report to the former National Parks and Wildlife Service by Walsh (2004). Threats include overgrazing by domestic livestock and inappropriate fire regimes.

Lake Coolah covers an extensive area in the south and provides potential habitat for waterbirds, including brolgas and painted snipe, when flooded. Mejum Swamp, situated immediately to the east of Lake Coolah, also provides similar habitat.

Marsden–Lake Cowal local landscape (1,806 km^2)

The Marsden–Lake Cowal local landscape comprises many of the features of the Barmedman and Bland Creek local landscapes which, in themselves, make this landscape a high priority for conservation. Additionally, the nationally important wetlands of Lake Cowal make this landscape a very high priority indeed. There is a diversity of vegetation types including dry forests, grassy woodlands, mallee, and plains wetlands/gilgai complexes.

A key challenge for conservation planning is restoration of wetlands, particularly habitat for waterbird breeding, viz river red gum woodlands and lignum. In addition there is an imminent threat of salinity reaching Lake Cowal via a plume of underground water from the Jemalong–Wyldes Plains Irrigation area. Salinity has caused severe decline of riparian vegetation along Bogandillon Creek to the north. Other challenges are to protect areas of gilgai habitat which are not conserved in any reserves, and the associated threatened weeping myall/belah communities. Some areas of gilgai and myall are in relatively good condition on private land and deserve increased protection. There are also significant travelling stock routes with outstanding examples of natural herb grassland groundcover communities that also warrant protection from excessive grazing and roadworks. Mallee communities dominated by bull mallee (*Eucalyptus behriana*) are very fragmented, increasingly rare, and warrant protection.

Top priorities: riverine environments

Billabong local landscape (817 km^2)

Billabong Creek rises in a small catchment area above Holbrook, and then flows 500 km westwards across the plains of western NSW before joining the Edward River at Moulamein. On this basis it is sometimes locally described as 'the longest creek in the world'.

For much of its length, the creek has a parallel Travelling Stock Reserve (TSR), and this has ensured that the riparian floodplain forests and an adjacent strip of woodlands remain in an otherwise extensively cleared landscape. The TSRs, located at regular intervals along the route, retain some of the most significant woodland remnants in the bioregion as they are located on fertile valley floors.

Consequently, the Billabong Creek is an environmental feature of paramount significance in the lower south-west IBRA subregion, and arguably one of the more significant environmental features of inland NSW. It provides habitat for a range of threatened and declining fauna, and provides connectivity between the rangelands to the west, and the woodlands and forests to the east, particularly for altitudinal migrants.

The creek has been a focus for the CSIRO Heartlands study. In the late 1990s, the Murray Catchment Management Authority supported a project which facilitated landholders fencing off sections of the creek on their properties from stock, and installing alternative watering points and systems.

A key challenge for conservation planning in this landscape is ensuring further protection of the creek frontage from degrading impacts, ensuring that the stock route and reserves are managed appropriately, and building connections from the creek and TSRs to the woodland remnants in the creek's hinterland.

Narrandera-Wagga Floodplain local landscape (910 km^2)

The floodplain of the Murrumbidgee River in this landscape contains some examples of river red gum forest in relatively good condition. The Murrumbidgee River itself is an iconic natural feature and is an exceptionally high priority in its own right for actions to repair its health. The river is a natural corridor that facilitates faunal movement and dispersal. There are some patches where the floodplain forest is linked to remnant stands of yellow box dominated woodland on higher ground.

A small number of extensive stands of river red gum forest remain along this section of the Murrumbidgee River, particularly in Berry Jerry State Forest and further west towards Narrandera. River red gum also occurs as narrow strips along some of the large creeks associated with this floodplain.

Creek systems associated with the Murrumbidgee floodplain in this landscape include the Old Man, Sandy and Bundidjerry creeks and Green Swamp (south east of Narrandera).

Most of the landscape is subject to intensive agriculture and there are increased pressures on remaining native vegetation, especially on scattered paddock trees. This landscape contains many known sites of cultural significance for the Wiradjuri people.

Condobolin local landscape (840 km^2)

The Condobolin local landscape is significant for its riparian and floodplain forests and woodlands, and its aquatic habitats which provide significant habitat for threatened aquatic fauna including native fish. In addition to the Lachlan River itself, the landscape contains large numbers of braiding and effluent streams and tributaries, making a fine mosaic of riverine, riparian and aquatic habitats that is highly significant in a regional context.

A key challenge for conservation planning is the identification of significant floodplain forests and wetlands, and prioritising these for protection and restoration. Equally important is the identification of flooding regimes and environmental water requirements, and translating these into action plans for implementation.

This local landscape could be considered for conservation planning jointly with the Fairholme and Ootha local landscapes.

C3. References

Davidson I 2007, *Developing a local landscape biodiversity plan in the Woomargama and Jindera local landscapes using Rapid Assessment Method*, report to the Department of Environment and Climate Change, Murray Catchment Management Authority, and Commonwealth Department of Environment, Water, Heritage and the Arts.

Davidson I 2008, *Validation report of Rapid Assessment Method*, report to the Commonwealth Department of Environment, Water, Heritage and the Arts.

Jones N, Sheahan M and Parker D 2009, *Identification of priority local landscapes for conservation planning in the South-west Slopes Bioregion* , Nature Conservation Trust of NSW (Albury) and Department of Environment and Climate Change (Queanbeyan).

Walsh M 2004, *Remnant woodlands – Narrandera Range and Brobenah Hills*, final project report, Murrumbidgee Field Naturalists and NSW National Parks and Wildlife Service, Griffith.

Paper D: Rapid assessment of two ‘priority local landscapes’ in the South-west Slopes Bioregion

Ian Davidson, Regeneration Solutions, Glenrowan; Mark Sheahan, DECCW Queanbeyan; and Richard Thackway, Bureau of Rural Sciences Canberra

Abstract

Existing mapping and spatial data for the South-west Slopes Bioregion is generally inadequate for conservation assessment and planning. A significant proportion of biodiversity assets, such as secondary native grasslands (‘native paddocks’), large hollow-bearing trees at densities under mapping thresholds, wetlands and rocky habitats are simply unmapped. Their locations may only be revealed by local and expert knowledge, or by field observation by a skilled field ecologist familiar with the landscape.

Two ‘local landscapes’ were chosen, at Jindera (278 km^2) and Woomargama (418 km^2), for trial conservation assessment at this scale. Such scales are amenable to rapid assessment, input of local and expert knowledge, and implementation of results.

A Rapid Assessment Methodology was developed that used existing mapping and information as a base to define and identify sites with biodiversity assets. This was then expanded on through the use of satellite imagery and field observation to revise and review the boundaries of these sites, and to identify additional sites. Each site was identified with a unique number, and attributes for 56 separate fields were collected.

The information collected enabled the sites to be described in terms of vegetation type, vegetation condition and habitat features present. This enabled each site’s conservation significance to be ranked, representing a priority for conservation action.

Through this rapid assessment, substantial increases in the area of habitat and vegetation were recorded, identifying large areas of secondary native grassland (native paddocks) that could be restored. This information was required for implementing catchment targets through a variety of conservation instruments and tools.

D1. Background

This project is part of a pilot study developed collaboratively between the Australian Government (the former Department of the Environment and Water Resources), the Department of Environment and Climate Change (DECC), the Murray Catchment Management Authority and the NSW Nature Conservation Trust.

Staff from these organisations formed the project team which was convened by DECC to oversee the project. The project team developed a project brief to collect and analyse the biodiversity data and information for the development of a local biodiversity plan. It also acted as a steering committee for the project, to oversee the selection of, and advise, the contractor, and to provide local and expert knowledge.

A field ecologist with considerable experience working in western slopes environments was contracted to implement the brief in consultation with, and reporting to, the project team. The Spatial Data Analysis Network at Charles Sturt University was also contracted to undertake the GIS component of the project brief.

D2. Study areas

The locations of the Jindera and Woomargama local landscapes are shown in Figure D1. The Jindera study area is 27,800 hectares within the Greater Hume Shire to the north of the boundary with Albury City. The landscape comprises low hills straddling the watershed between the Billabong Creek (to the north) and the Murray River (to the south). It was selected because of these factors:

- the presence of a box gum woodland endangered ecological community and a range of threatened fauna including species listed in the *Environment Protection and Biodiversity Conservation Act 1999*, the regent honeyeater and swift parrot
- current data sets show a low cover of extant vegetation, but anecdotal knowledge suggests that there may be significant additional areas of biodiversity value
- the area contains a critical link of biodiversity significance between the Nail Can Hill Woodland (and Murray Riverine Forest areas) within Albury City and the Black Range and Jindera Hills in the Greater Hume Shire. In turn this provides linkages to important habitat areas of the Gerogery Hills, Table Top Range, Walla Swamp and Billabong Creek, further north
- close proximity to a major regional centre (Albury 15–30 km) and associated pressure for subdivision and rural residential development.

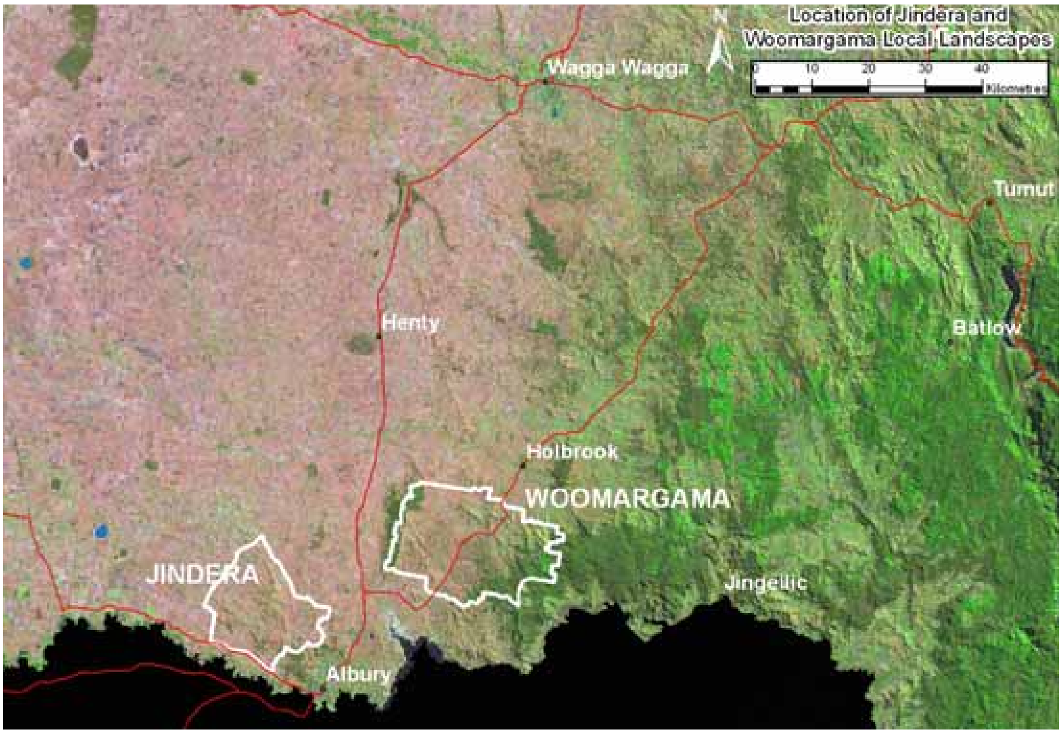

Figure D1: Location of the Jindera and Woomargama local landscapes

The Woomargama study area is 41,800 ha, and also occurs within the Greater Hume Shire. It consists of steeper hills in the east (Woomargama Range) and the west (Yambla Range), with low undulating woodland country in between. It was selected because of these factors:

- it overlaps the DECC and Nature Conservation Trust Slopes to Summit project area which may provide additional mechanisms for financial options to landholders for covenanting, management agreements and acquisition by revolving fund
- it contains a range of biodiversity assets which are also targets for the Murray catchment action plan
- there has traditionally been strong community interest in on-ground works for biodiversity
- the presence of box gum woodland endangered ecological community, and a range of threatened woodland fauna including the swift parrot and regent honeyeater which are listed in the *Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth)

- current data sets show a low cover of extant vegetation, but anecdotal knowledge suggests that there may be significant additional areas of biodiversity assets
- the area contains a critical link of bioregional significance between Woomargama National Park and the forests and reserves of the Yambla Range (including Benambra National Park and Table Top Nature Reserve)
- the area is bisected by the Hume Highway – there is potential to identify property for purchase by the NSW Roads and Traffic Authority as compensatory habitat for freeway duplication, that meets ‘like for like’ criteria
- the proximity to a major regional centre (Albury: 30–40 km) and associated pressure for subdivision and rural residential development.

The method used to select the Jindera and Woomargama study areas priority local landscapes is described in section C3.

D3. Project aims, objectives and governance

The project aim was:

> to support the delivery of biodiversity targets in the Murray catchment action plan, by trialling a rapid methodology to define and map priority biodiversity assets (including assets listed under the *Environment Protection and Biodiversity Conservation Act 1999* and the *Threatened Species Conservation Act 1995*), and recommend mechanisms for their restoration and protection that would contribute to the development of a local biodiversity plan.

Specific objectives for areas within the two priority local landscapes were:

- to define biodiversity assets which have targets within the Murray Catchment Action Plan (including assets listed under the *Threatened Species Conservation Act 1995* and *Environment Protection and Biodiversity Conservation Act 1999*), including native vegetation types, threatened entities, and aquatic ecosystems
- to develop local landscape targets for these assets based on targets in the catchment action plan
- to spatially identify areas of biodiversity assets (sites) within the landscape, including summary information for each site
- to prioritise identified sites for conservation management, based on the values of the site and the threats or risks to those sites
- to identify specific sites for future targeting by specific conservation mechanisms, including incentive and cost-share arrangements, management payments, property vegetation plans, covenanting and acquisition.

D4. Methodology

The methodology was informed by Davidson et al (2004) and Davidson et al (2005) but was amended and formalised into a Rapid Assessment Methodology comprising three stages:

1. preliminary data collation
2. field assessment
3. analysis and prioritisation.

Stage 1 Preliminary data collation

a) Assemble existing data – DECC collated existing information and spatial data on the biodiversity assets in the study areas.

b) Expert panel – the methodology would normally require the use of a wider expert panel, in addition to the project team. In this instance, this was not considered necessary, given the thorough local knowledge held by the project team and the contractor, and given that this was a pilot project.

c) Define biodiversity assets – the contractor, with the assistance of members of the project team, listed asset features (attributes) which could be mapped or recorded using rapid field assessment techniques (refer to Appendix 1 – Local biodiversity plan assessment sheet).

d) Develop site assessment sheet – this was developed so information on biodiversity assets at a particular site could be recorded in a consistent manner for entry into a project database. The assessment sheet is shown in Appendix 1. Biodiversity assets and attributes were categorised or rated consistent with existing biodiversity measures, e.g. adopting the same thresholds and using the same vegetation typing as in the Biometric Tool. This ensured that the final products were compatible with existing data sets, and could be readily adopted for use by DECC and Murray Catchment Management Authority staff.

The site assessment sheet is included in Appendix 1.

Stage 2 Field assessment

a) Prepare field map sheets – using relevant GIS and remotely sensed data sets and data layers, the consultant produced two field map sheets to use in the field to define site/polygon boundaries and to locate potential features in the landscape.

The key layers making up the field base-maps were coloured SPOT 4 imagery (indicating tree cover, land use, roads and drainage lines, a Public Land layer indicating opportunities to gain physical access to sites for closer scrutiny than from roadsides near or adjoining sites on freehold land), a point source floristic data layer (this DECC layer enabled the contractor to compare the field assessment with more detailed floristic information to ensure that the typing of vegetation was consistent) and the cadastral layer (indicating paddock sizes and possible fence lines).

The contractor also used topographic maps (assisted in identifying public accessibility and high points in the landscape suitable for viewing sites with poor public access), reviewed derived vegetation type maps for the areas from DECC (assisted in developing an initial mental map of the vegetation of the areas, helpful for the contractor in setting timeframes for field data collection) and met with two members of the project team with good local knowledge regarding access issues. The final field maps were printed at 1:25,000 scale which was helpful in providing direct comparison with topographic maps.

b) Field test prototype assessment sheet – the contractor spent time in the field with an experienced native vegetation field officer from the project team to determine the suitability of the assessment form and investigate issues of habitat discernment, e.g. identification of native pastures (compared with the introduced pasture grasses and weeds) from distances of up to 500 metres. As a result, the assessment form was refined and finalised.

c) Field assessment – the contractor mapped polygons of identified sites onto the relevant field base-map. An example is shown in Figure D2.

Sites were demarcated on the basis of apparent uniform vegetation type and condition. It should be noted that a site may include areas with various topography, vegetation types or condition where recommendations for future management are likely to be consistent across the site. Sites usually have consistent tenure.

Each site was given a unique number when mapped. Determining a site’s boundary varied from being very simple, in the case of remnant woodlands surrounded by cleared, cropped or pasture-improved agricultural land, through to difficult where areas were hilly, dominated by grazing landscapes where variations in native pasture composition may have been difficult to discern. The field mapping was done by the contractor using high quality binoculars from the nearest roadside or other public land. Field mapping was done to confirm or expand sites already identified by the existing GIS data and information, or to add new sites not previously identified by existing GIS mapping or data.

Apart from the field mapping the assessor also completed an assessment sheet for each identified site (see Appendix 1).

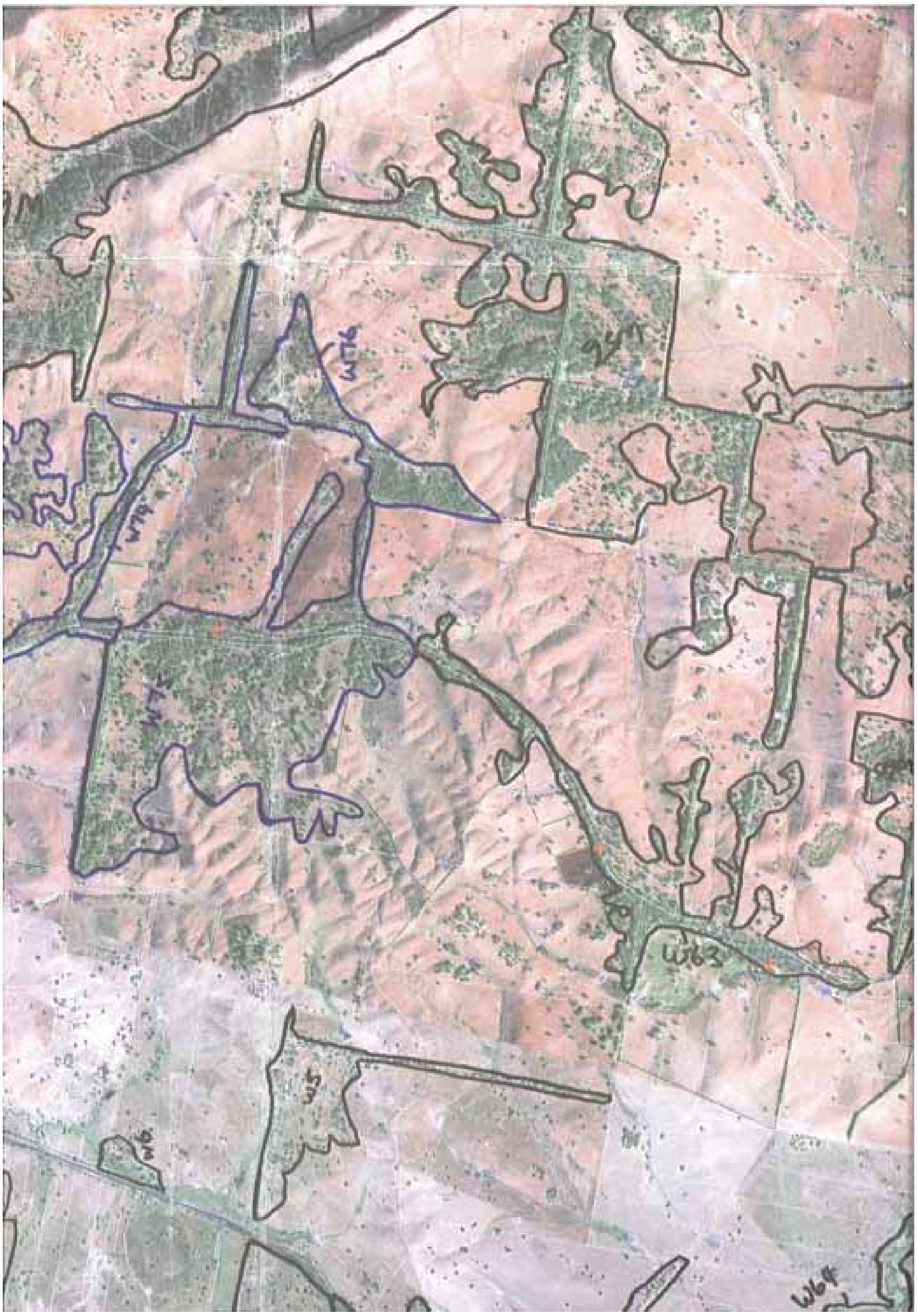

Figure D2 A section of the field assessment map sheet for the Woomargama local landscape.

The boundaries of identified sites can be seen, marked with the unique number that identifies each site.

d) Site digitising – The field maps were scanned using a wide bed colour scanner and the digital copy was used by SPAN to complete the line work for each site. The line work was reviewed by the contractor, and once finalised was rectified to the GIS image.

e) Spreadsheet design and data entry – The data from the assessment sheets was entered into an Excel spreadsheet, and corrected to ensure the spreadsheet was compatible with the ArcMap database and could be used as a .dbf file for the ArcMap project. Other data layers provided by DECC were added to the ArcMap database as attribute fields, including Mitchell landscapes and land capability. The area of each site was also automatically recorded using GIS.

Stage 3 Analysis and prioritisation

The field assessment sheet also included criteria for scoring an overall conservation significance for a site. This was based on four criteria:

1. vegetation status – whether the vegetation type was over-cleared (> 70% cleared), depleted (40–70% cleared) or of the lowest concern (< 40% cleared)[1]
2. vegetation condition – whether the vegetation on-site was in medium–good condition, low condition, or was paddock trees (as per Biometric definitions)
3. landscape context – the score assigned from either landscape value or landscape connectivity
4. habitat value – a rating of habitat value as described in the assessment sheet.

Based on using scores from these four criteria, an overall conservation significance rating was assigned. This five-tier rating system was set out in Table 1 of the assessment sheet in Appendix 1, and each site identified in the project was given a conservation significance rating.

It is intended that this conservation significance rating will be used in conjunction with the land capability of a site to target critically important sites. Land capability is derived from the NSW Government's eight-class land capability mapping as a surrogate for site fertility. Sites with a land capability class of 1, 2 or 3 are likely to be located lower in the landscape, and be more naturally productive and fertile. Such sites may have higher 'site quality'.

The field assessment sheet also included criteria for scoring a threat rating for each site. This rating is used to determine an overall priority for each site.

Stage 4 Validation

To gauge the success of the RAM, the Commonwealth Department of Environment, Water, Heritage and the Arts funded a validation project, and this is described in Davidson (2008). A selection of sites was chosen by the Murray Catchment Management Authority, where the RAM had ascribed vegetation composition and type. Eleven (11) sites were chosen in the Jindera local landscape, and 10 in the Woomargama local landscape. Table D6 shows the site attributes subject to field validation.

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[1] The vegetation types used for this project pre-date the publication of Benson (2008) which has now classified 135 plant communities in the bioregion and audits their areas in all protected areas and assigned threat codes based on threat criteria.

D5. Results

The Rapid Assessment Methodology identified sites with biodiversity assets across the entire Jindera local landscape (27,800 ha) and 38,205 ha (91%) of the 41,800 ha Woomargama local landscape (Davidson 2007). This is shown in Figures D3a and D3b. Figure D4 shows the attributes recorded for each site.

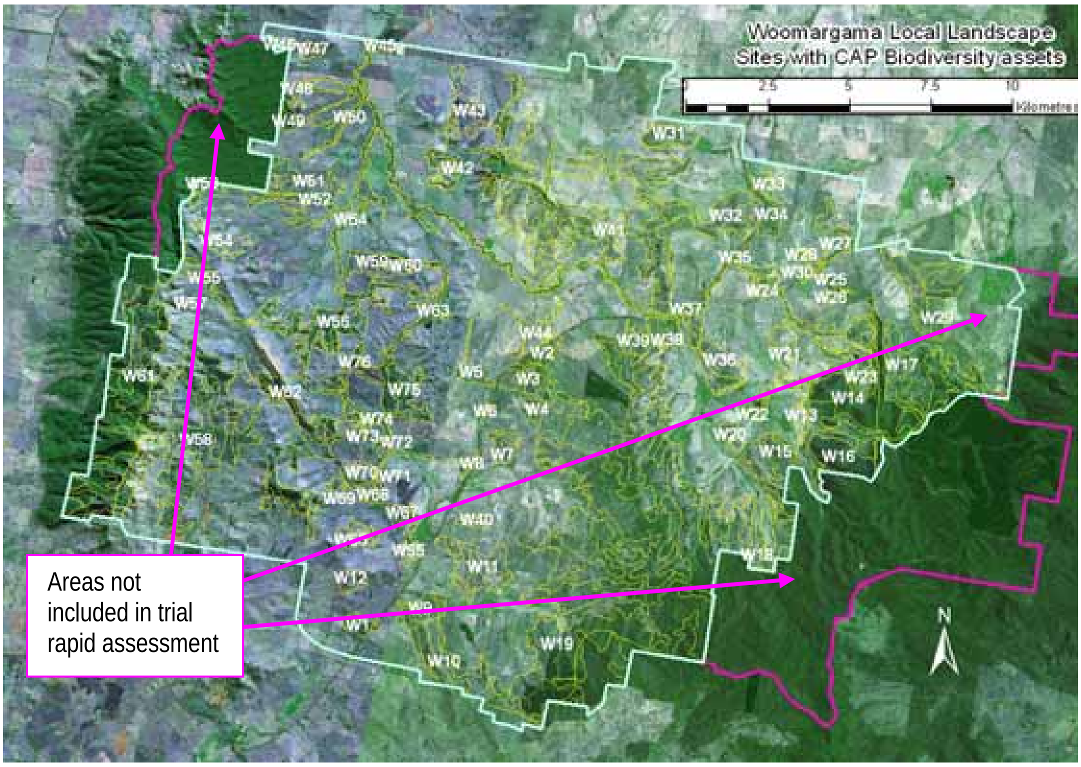

Figure D3a: Sites with biodiversity assets in the Woomargama local landscape

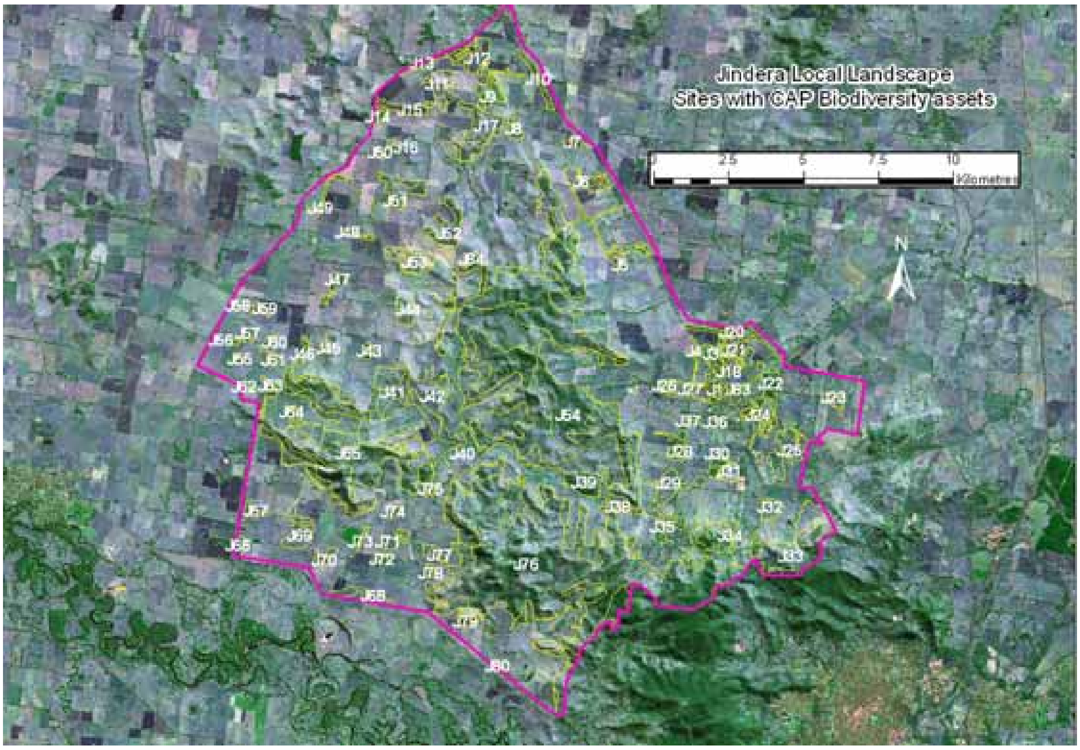

Figure D3b: Sites with biodiversity assets in the Jindera local landscape

Within the Woomargama area, sites totalling 15,339 ha were identified as having biodiversity assets consistent with the objectives. This represented 40% of the area assessed. The alternative approach to conservation assessment of using tree cover mapping identifies only 11,704 ha, or 30% of the area, as having biodiversity assets, as shown in Table D1.

Table D1 Area and vegetation type of biodiversity assets, Woomargama local landscape

	Tree cover mapping (ha)	Rapid assessment method (ha)
Box gum woodland	196	398
Tablelands and slopes box gum woodland	683	2,613
Eastern rain shadow woodland	6,676	9,965
Dry foothill	3,984	2,363
Box-Ironbark forest	9	–
River red gum	148	–
Stringybark black cypress pine open forest	8	–
	11,704 (30% of area)	15,339 (40% of area)

Attributes of woom_rapid_veg_assessment

FID	Sha	SITE_ID	DATE_INS	TENURE	MITCHELL_L	LAND_C	LANDFORM	MAIN_VEGET	PERCE	TREE_SPP	CANOPY_	BVT	KEITH_VEG_	
0	Poly	W10	10/05/2007	Freehold	Tipperary Hills Granites	6	Ridgeline/Gentle slope	Treeless	40%	Yes	30%	Dry foothill forest	Eastern rainshadow	>50%
1	Poly	W10	10/05/2007	Freehold	Tipperary Hills Granites	3	Ridgeline/Gentle slope	Treeless	40%	Yes	30%	Dry foothill forest	Eastern rainshadow	>50%
2	Poly	W10	10/05/2007	Freehold	Tipperary Hills Granites	5	Ridgeline/Gentle slope	Treeless	40%	Yes	30%	Dry foothill forest	Eastern rainshadow	>50%
3	Poly	W10	10/05/2007	Freehold	Tipperary Hills Granites	6	Ridgeline/Gentle slope	Treeless	40%	Yes	30%	Dry foothill forest	Eastern rainshadow	>50%
4	Poly	W10	10/05/2007	Freehold	Tipperary Hills Granites	7	Ridgeline/Gentle slope	Treeless	40%	Yes	30%	Dry foothill forest	Eastern rainshadow	>50%
5	Poly	W10	10/05/2007	Freehold	Tipperary Hills Granites	5	Ridgeline/Gentle slope	Treeless	40%	Yes	30%	Dry foothill forest	Eastern rainshadow	>50%

Attributes of woom_rapid_veg_assessment

NATIVE_GRO	SHRUBS	TREE_REGEN	VEGETATION	NATIVE_VEG	LANDSCAPE_	CONNECTIVI	LANDSCAPE1	HABITAT_FE	BOX_GUM_WO	BOX_GUM__1	DISTRIBUTI	ASSESSED_H	
>50%	Absent	Sparse	Overcleared	Low	High	Medium	High	No	No	No		High	L
>50%	Absent	Sparse	Overcleared	Low	High	Medium	High	No	No	No		High	L
>50%	Absent	Sparse	Overcleared	Low	High	Medium	High	No	No	No		High	L
>50%	Absent	Sparse	Overcleared	Low	High	Medium	High	No	No	No		High	L
>50%	Absent	Sparse	Overcleared	Low	High	Medium	High	No	No	No		High	L

Attributes of woom_rapid_veg_assessment

EBLAKELYI	EALBENS	EMELLIODOR	EPOLYANTHE	EGONIOCALY	EBRIDGESIA	ECAMALDULE	EMACRORHYN	EDIVES	EMANNIFERA	EROSSII	CALL_ENDLI	CALL_GLAUC	
Common	Common		Common				Common						Co
Common	Common		Common				Common						Co
Common	Common		Common				Common						Co
Common	Common		Common				Common						Co
Common	Common		Common				Common						Co
Common	Common		Common				Common						Co

Attributes of woom_rapid_veg_assessment

AC_IMPLEXA	ALLO_VERTI	EMICROCARP	BRACH_POPU	INTACTGRND	SHRBY_UNDS	RCKY_SBSTR	LOGSWDYDEB	STANDGDEAD	HOLLOWTRS	CREEK_DRL	WETLANDS	AREA_HA
Common	Sparse		Sparse	Common	Absent	Abundant	Sparse	Common	Sparse	Absent	Absent	11.19
Common	Sparse		Sparse	Common	Absent	Abundant	Sparse	Common	Sparse	Absent	Absent	0.41
Common	Sparse		Sparse	Common	Absent	Abundant	Sparse	Common	Sparse	Absent	Absent	54.45
Common	Sparse		Sparse	Common	Absent	Abundant	Sparse	Common	Sparse	Absent	Absent	108.8
Common	Sparse		Sparse	Common	Absent	Abundant	Sparse	Common	Sparse	Absent	Absent	115.06
Common	Sparse		Sparse	Common	Absent	Abundant	Sparse	Common	Sparse	Absent	Absent	53.14

Figure D4. Attribute tables for GIS files from rapid assessment

Within the Jindera area, sites totalling 10,566 ha were identified as having biodiversity assets consistent with the objectives. This represented 38% of the area assessed. The alternative approach to conservation assessment of using tree cover mapping identifies only 6,407 ha, or 23% of the area as having biodiversity assets. This is shown in Table D2.

Table D2: Area and vegetation type of biodiversity assets, Jindera local landscape

	Tree cover mapping (ha)	Rapid assessment method (ha)
Box gum woodland	5,185	10,360
Wetland	–	39
Grey box woodland	651	131
Tablelands and slopes	–	36
Dry foothill forest	604	–
Box ironbark	25	–
River red gum	12	–
	6,477 (23% of area)	10,566 (38% of area)

Using the agreed assessment methodology, a range of outputs can be generated. Figure D4 shows the attribute table from the GIS files from which the area estimates from Tables D3, D4, and D5 have been derived.

Table D3: Native groundcover for the Jindera and Woomargama sites

Native groundcover	Jindera (ha)	Woomargama (ha)
>50%	5,450	9,380
10–50%	4,038	5,347
<10%	1,078	612
Total area	10,566	15,339

Table D3 shows that Woomargama sites had relatively more native groundcover (>50%) than Jindera sites (80% and 61% respectively). Both Jindera and Woomargama had similar relative areas of native groundcover in the 10–50% class, i.e. 38% compared to 34%. Figure 5a shows the distribution of these classes in the Woomargama study area.

Table D4: Vegetation condition of biodiversity assets, Jindera and Woomargama local landscapes

Vegetation condition	Jindera (ha)	Woomargama (ha)
Medium–good	6,654	12,165
Low	774	2,924
Paddock trees	127	250
Variable*	3,009	
Total area	10,566	15,339

* A very large site not able to be verified but considered to be medium–good

Table D4 shows Jindera sites had 63% of the area of all identified sites in medium–good condition (and potentially another 28% in medium–good condition; although this latter estimate was not able to be verified in the field). This compares to 79% of the area of all identified sites in the Woomargama study area in medium–good condition. Jindera had a smaller area of sites in low condition compared to Woomargama, 7% compared to 19%.

Table D5: Conservation significance of biodiversity assets, Jindera and Woomargama local landscapes

Conservation significance	Jindera (ha)	Woomargama (ha)
High	9,407 (1,995*)	11,279 (1,900*)
Medium–high	358	2,220
Medium	728	1,204
Medium–low	73	636
Total area	10,566	15,339

* Figures in brackets are the area of sites with high conservation significance and a land capability class of 1, 2 or 3.

Table D5 shows Jindera had 89% of the area of identified sites with high conservation significance compared to Woomargama which had only 74% of the area of identified sites. However, Woomargama had more medium–high conservation significance sites than Jindera, 14% compared to 3%.

Figures D5a and D5b show examples of mapped outputs from rapid assessment in the Woomargama local landscape.

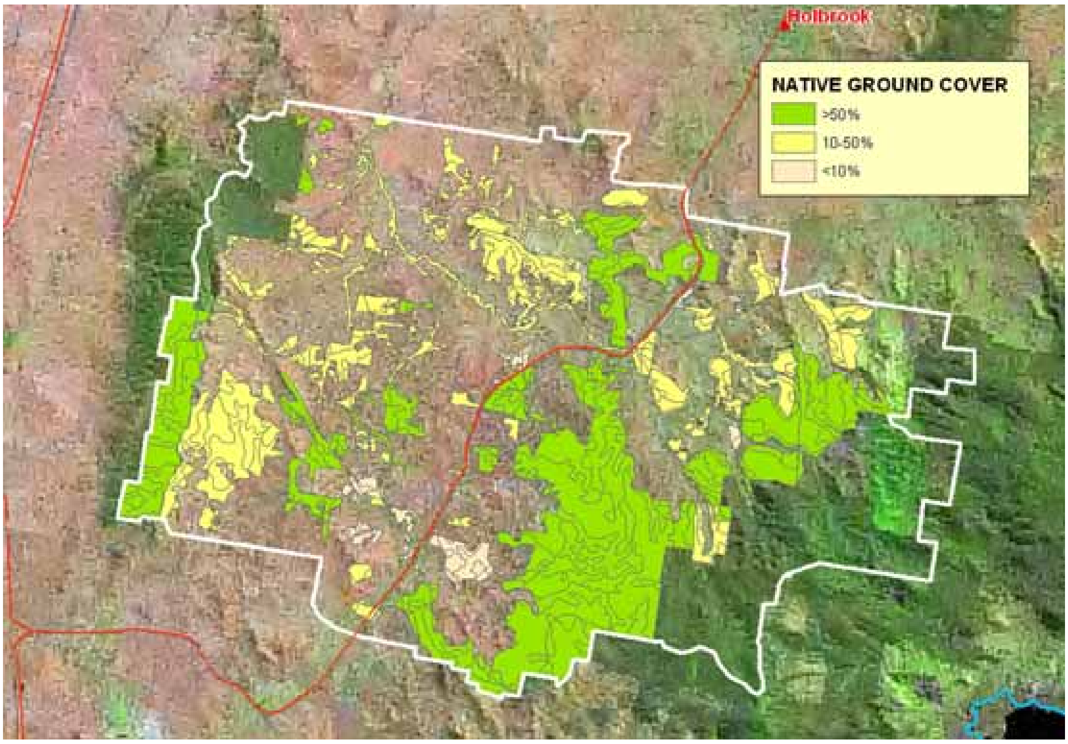

Figure D5a: Native groundcover of biodiversity assets

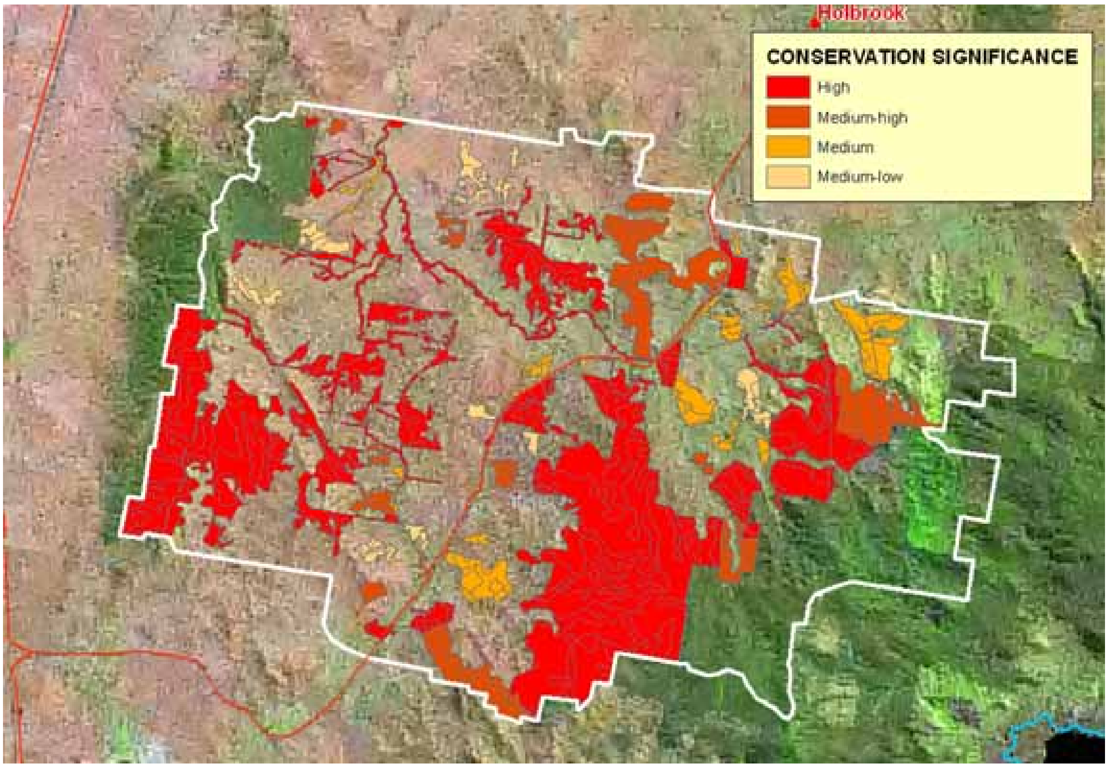

Figure D5b: Conservation significance of biodiversity assets

Table D6 shows the site attributes subject to field validation. The validation of the RAM showed that of the 13 attributes described, 11 were correct for > 80% of sites.

Table D6: Validation of Rapid Assessment Method at 21 sites (Davidson 2008)

Values		RAM	RAM validation (RAMV)	%RAM correct	No of sites RAM over-estimate	No of sites RAM under-estimate	Comment
Tree species	BRG	19	21	90%		2	RAM was incorrect at sites J42 and J64
	WB	19	21	90%		2	RAM was incorrect at sites W20 and W22
	YB	16	21	76%	2	3	RAM incorrectly listed yellow box at two sites (J9 and J32) and did not record it at three sites (W19, W20 and W62)
	Other	13	13	100%			
Vegetation type (Keith)		20	21	95%		1	Site W22 was incorrectly listed as box gum woodland with RAM instead of eastern rainshadow woodland

Values	RAM	RAM valid-ation (RAMV)	%RAM correct	No of sites RAM over-estimate	No of sites RAM under-estimate	Comment
% native ground cover	18	21	86%	1	2	Site J11 was listed as having > 50% native groundcover with RAM; while the RAMV showed it to have < 10% cover. W20 and W56 were recorded as having 10–50% native cover but scored > 50% native cover during the RAMV
Shrub cover	19	21	90%		2	Sites J15 and W56 were listed as having no shrubs by RAM and were found to have sparse shrubs with RAMV
Tree regeneration	17	21	81%	4		RAM listed sparse tree regeneration for sites J11, J64, W20 and W22 which were found to contain no tree regeneration with RAMV
Intact ground cover	16	19	84%	3		RAM listed sites J32, J40 and J42 as sparse cover which was found to be absent with the RAMV
Rocky substrate	19	21	90%	1	1	W20 had no exposed rocky substrate but was listed as common by RAM whereas W56 had a sparse rock cover and assigned rocky substrate as absent
Logs/woody debris	20	21	95%		1	J32 had sparse logs and woody debris and the RAM listed it as having none
Standing dead timber	21	21	100%			
Hollow-bearing trees	21	21	100%			
BGW (NSW)	19	21	90%	1	1	Site J42 was incorrectly listed as meeting the threshold for NSW box gum woodland listing by RAM and W19 was found to meet the threshold by RAMV having not been listed
BGGW (EPBC)	15	21	71%		6	Sites J15, J64, W19, W56, W58 and W62 all had at least part of the site that qualified as box gum grassy woodland and were incorrectly listed as not meeting the listing threshold by RAM
VAST	13	21	62%	2	6	Sites J15, J33, W3, W19, W20 and W56 showed a one state improvement in RAMV and sites J11 and J40, being in a poorer state

D6. Discussion

Application of the RAM at a local landscape scale has highlighted several issues including accuracy, improved targeting of high value sites, vegetation management and threats, and consistency of national reporting.

The accuracy of the Rapid Assessment Methodology

The RAM methodology uses existing GIS mapping and information collected in the field to identify sites with biodiversity values, delineates these sites on a field map, and then confirms or extends these sites through field observation. This method shows that identifying sites on the basis of tree cover mapping does not capture the full spatial extent of the native vegetation community. Only with the addition of field survey can these disturbed sites be identified and mapped. The advantage of the RAM approach is that it validates GIS vegetation mapping.

Broader application of this approach depends on the contractor/field ecologist having thorough experience in the local landscape. In the case of this pilot project in these two landscapes, an essential skill was the ability to discern native pastures from introduced (‘improved’) or weedy pastures. For a skilled field ecologist, this is relatively easy if seasonal conditions allow (in this case the early summer curing of exotic annual grasses was used to demarcate native from non-native pastures). Engaging other people in addition to the contractor with local and expert knowledge on the project team or as an ‘expert panel’, is also critical to this task.

Results from the validation of the RAM show the approach is a useful tool for mapping and defining biodiversity values of grassy woodlands at a local landscape scale, providing added certainty to biodiversity conservation planning and management in a cost effective manner.

Cost effectiveness

The RAM for the two trial landscapes employed the field ecologist/consultant for 20 days. The 20 days included the three stages set out in section D4 (above) plus data entry and GIS. Consultant rates varied so cost will vary according to the aptitude of, and rates charged by, the consultant or contractor.

Costs will be reduced on a ‘per landscape’ basis the greater the number of local landscapes included, provided the local landscapes are adjoining or in the same region. For one local landscape of 30,000 ha, approximately 12 days could be envisaged as being required. For four local landscapes, 35 days could be envisaged.

Apart from contractor costs, the costs of project preparation (data discovery and compilation), project management (contract management, project team meetings) and analysis/implementation, should also be taken into account.

The inclusion of grassy sites

The limitations of tree cover mapping are discussed in detail in Papers A and B. The RAM allows for the inclusion of grassy sites with native groundcover which have a high potential for restoration. This generates a very different view of the landscape, as shown in Figures D6a, b and c. Large core areas of ecologically-connected habitat are identified, by including areas of scattered trees and native pasture which connect up and consolidate the treed remnants.

Figure D6a: Image of the central part of the Jindera local landscape.

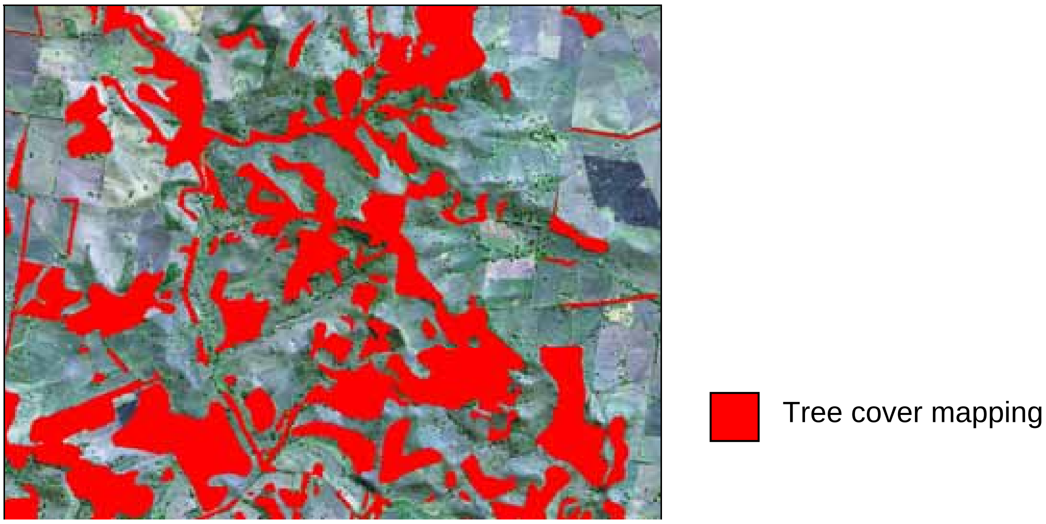

Figure D6b: As above, but with vegetation mapping derived from tree cover mapping. Treed remnants present the image of a highly fragmented landscape.

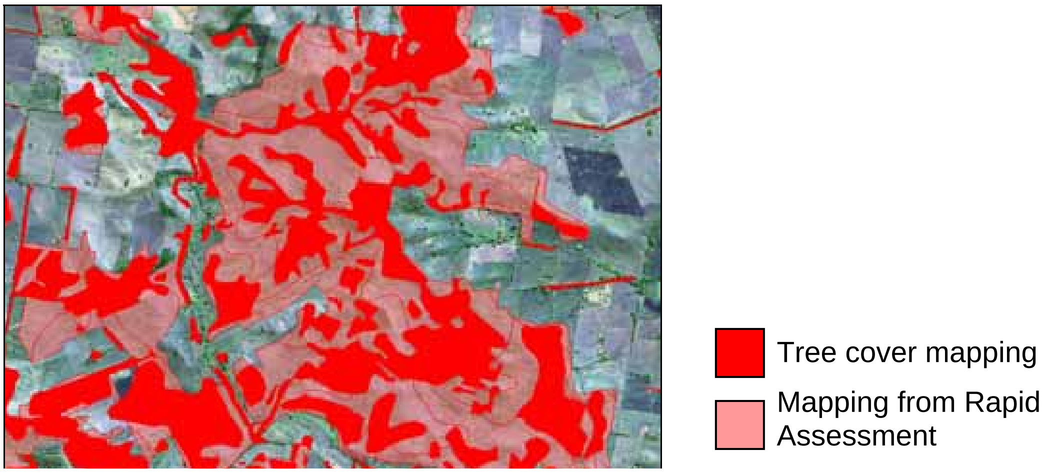

Figure D6c: As above, but with mapping from the Rapid Assessment Methodology. When native paddocks and small clumps of trees are added to tree cover mapping, the percentage of vegetation cover increases, and a different reality of the 'ecological connectedness' of the landscape is revealed.

Targeting high value sites

Conservation planning and assessment at a local landscape scale may allow better targeting of incentives for and agreements with landholders. The examples in Figures D7a and D7b clearly show how the RAM, and particularly its ability to define conservation significance, can identify sites of the highest value.

Figures D7a and D7b show sites which (through the RAM) are assessed as having high conservation significance and which have a land capability class of 1, 2 or 3. Land capability is used as a surrogate for site fertility to identify fertile sites low in the landscape that are likely to be more productive, i.e. that support larger tree sizes or greater nectar flows.

Application of the methodology has identified 1,900 hectares (5% of Woomargama) and 1,995 hectares (7% of Jindera) of these local landscapes (as shown in Figures D7a and D7b) for priority targeting of incentives or stewardship payments by implementation staff from natural resource management and conservation organisations.

These areas form just a part of the 15,339 hectares (40% of Woomargama) and 10,566 hectares (38% of Jindera) identified through the study, where natural resource management activities such as protection and restoration through incentives, management contracts and stewardship payments, will assist in achieving biodiversity targets.

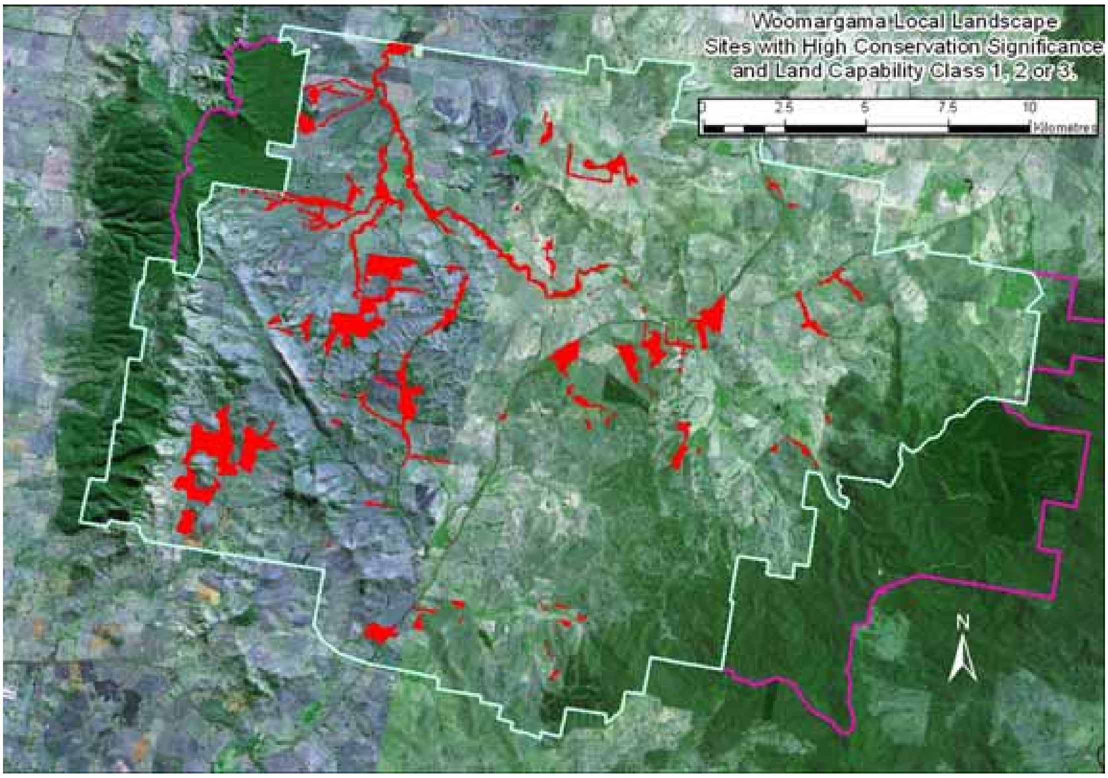

Figure D7a: The location of high conservation significance woodland sites, with high site fertility – Woomargama study area

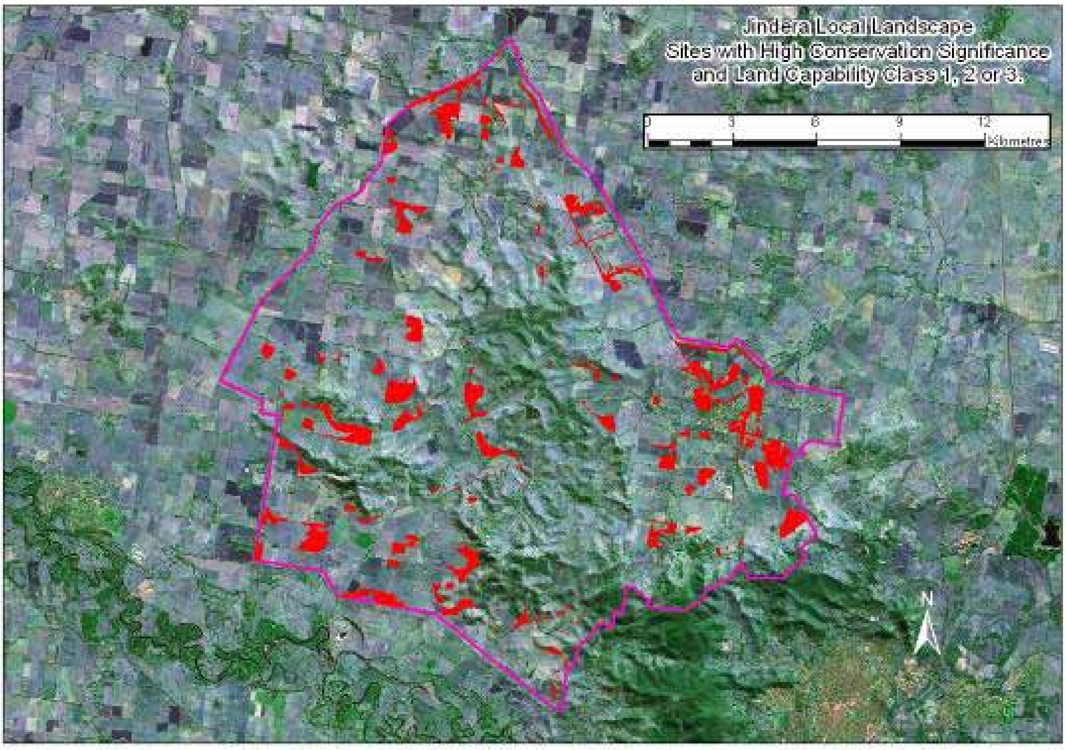

Figure D7b: **The location of high conservation significance woodland sites, with high site fertility – Jindera study area**

The areas shown in Figures D7a and D7b arguably represent the areas of greatest opportunity for restoration of high conservation significance sites. Given that most of these sites have tree cover below thresholds for tree cover mapping, restoration of these sites will lead to increases in extent and condition. Given their higher inherent fertility, restoration activities are likely to be more successful in shorter timeframes, due to potentially higher growth rates.

These areas are also at potentially highest risk of loss and further degradation. Given their high inherent fertility and patchy tree cover, they are at higher risk from degrading activities, including pasture improvement. This is discussed in the next section.

The methodology has identified 5% of Woomargama local landscapes and 7% of Jindera local landscapes for targeting of incentives or stewardship payments by implementation staff from natural resource management and conservation organisations.

Consistency with national reporting

The RAM conservation assessment for mapping vegetation condition implicitly defines sites in good condition where the native vegetation shows little or no evidence of modern land use and land management practices. This approximates to a pre-1750 benchmark condition for each vegetation type; i.e. where recent and current land management practices left the structural, floristic and regenerative integrity of vegetation communities intact. This benchmark perspective is embodied in several of the RAM attributes including groundcover, regeneration, habitat features and threatened entities (Appendix 1). Consequently, when the scores are aggregated for the individual attributes, higher scores will lead to a higher final ranking for condition and significance.

Although the RAM conservation assessment was developed for use in southern NSW in the context of grassy and grassy woodland communities and at a local landscape scale, this approach shares several characteristics with the national framework, Vegetation Assets States and Transitions (VAST) developed by the Bureau of Rural Sciences (Thackway and Lesslie 2006, Thackway and Lesslie 2008). The national framework is a state and transition model where modifications from an assumed fully natural benchmark are measurable in terms of three diagnostic attributes: vegetation structure, floristic composition and regenerative capacity. Regenerative capacity is independent of vegetation structure and floristic composition, but is closely tied to the historic and current land use and land management practices. Existing benchmarked condition datasets, both site and mapped information, can be translated and compiled with the VAST framework, using these three diagnostic attributes.

Provided a vegetation condition dataset shares these common features, it can be translated into condition classes using the VAST framework (Thackway and Lesslie 2008). Accordingly, the shared diagnostic attributes enabled the Jindera and Woomargama datasets to be translated and compiled into a national map of vegetation compiled from regional scale datasets (BRS unpublished). Other examples of datasets that have been translated into condition classes using the VAST framework include datasets developed based on modelling site-based scores, as well as datasets derived from maps/models of the interactions between land use and land management practices on vegetation communities (Thackway and Lesslie 2008).

VAST comprises seven classes:

1. Where the site is naturally bare of all vegetation, the site is classified as VAST 0 *Naturally bare*.
2. Where there is little or no evidence of modern land use and land management practices, the site is classified as VAST I *Residual*.
3. Where the vegetation has been modified and is likely to naturally ‘bounce back’ to a fully natural benchmark, i.e. Residual, the site is classified as VAST II *Modified*.
4. Where the vegetation has been significantly modified and unlikely to naturally ‘bounce back’ to a fully natural benchmark, i.e. Residual, the site is classified as VAST III *Transformed*.
5. Where the vegetation has been removed and replaced with species that are not indigenous to the site, i.e. the site is dominated by weed species, the site is classified as VAST IV *Adventive*.
6. Where the vegetation has been removed and replaced with planted food and fibre crops the site is classified as VAST V *Replaced–Managed*.
7. Where the vegetation has been removed with non-vegetated land cover types including bare ground, infrastructure, urban, industrial and water reservoirs, the site is classified as VAST VI *Replaced–Removed*.

VAST Classes 0, IV, V and VI were not available in either of the Jindera and Woomargama study areas. Provided land use and land cover datasets at the same resolution as the primary condition dataset are available, these classes can subsequently be added in a separate process.

Table D7 shows the relationship between the RAM condition assessment for sites in the Jindera and Woomargama study areas and the VAST framework. The authors used expert judgement to translate and compile RAM condition classes into VAST classes based on a combination of condition classes, land capability, tree cover, landscape value and connectivity, as well as site based scores including ground cover, tenure, land form and vegetation structure and special habitat features.

Table D7: Relationship between the RAM condition assessment for sites in the Jindera and Woomargama study areas and the VAST framework

RAM condition class	Interim VAST class translated from RAM condition class	Final VAST class
Medium–good	1	I Residual
		Iz Residual (based on tenure)
Medium–good	2	II Modified
Medium–good	3	IIIa Transformed
Low	3	IIIb Transformed
Paddock trees	3	IIIc Transformed
		V Replaced – Managed

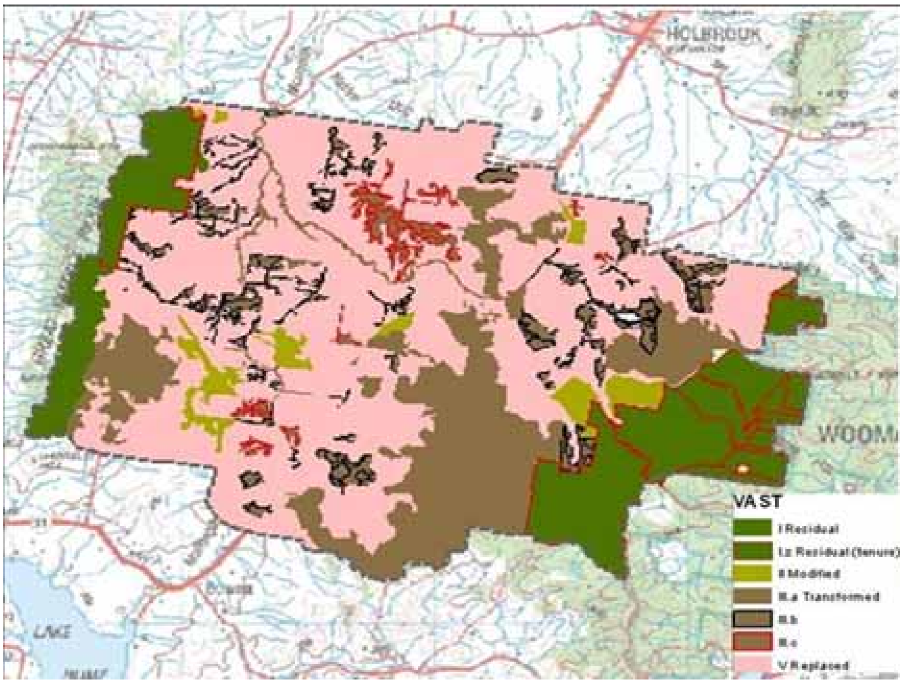

Figure D8. The distribution of VAST classes compiled from the Woomargama RAM condition class dataset

D7. Conclusions

General conclusions

The application of the RAM approach enables the validation of GIS-based vegetation mapping in disturbed (agricultural) sites. Further, RAM provides a useful tool for mapping and defining a range of biodiversity values at a local landscape scale to add certainty to planning and management.

RAM may be a very cost effective approach for collecting biodiversity conservation data in local landscapes, subject to contractor suitability.

RAM was primarily helpful in identifying grassy sites with native groundcover and sparse or no tree cover in agricultural landscapes which often provide important habitat linkages within a local landscape.

The application of RAM may allow for accurate targeting and prioritisation of actions (e.g. incentives) for biodiversity conservation, through its ability to discern relative conservation significance.

The RAM conservation assessment shares several important characteristics with the national framework (VAST) which are both tied to pre-1750 benchmark conditions. This enables RAM assessed landscapes to be considered in a broader 'Australian' context.

In implementing RAM on the ground, there are some particular issues that need careful consideration:

- **purpose of mapping** – it must be clear to stakeholders that the purpose of the mapping is to better target incentives, and not to administer native vegetation clearing regulation. Landholders with sites identified in a local landscape plan will benefit from priority access to a range of financial assistance, incentive and stewardship programs.
- **local stakeholder engagement** – where this approach is to be employed elsewhere, it will be necessary to engage local stakeholders, not just to provide 'local and expert knowledge' for the planning process, but to ensure there is local understanding of and support for the purpose of the mapping (as above).
- **need for ground-truthing** – whilst the RAM has been shown to be sufficiently accurate for conservation planning at a local scale, it does not purport to replace the need for detailed site assessment where this is required. The development of a vegetation management plan for a particular site would rely on more detailed assessment, with the landholder. In particular, Davidson (2007) notes that a site survey is required to confirm the presence of box gum woodland (as defined under either NSW or Commonwealth legislation).

Conclusions specific to Jindera and Woomargama local landscapes

Davidson (2007) identifies a range of issues regarding management of the vegetation in these local landscapes. He notes that whilst 'tree-clearing' per se appears to be occurring either very little or not at all, important biodiversity assets are actively degrading and this threatens the achievement of catchment action plan targets. He notes that: 'the practice of pasture improvement in remnant woodland/grassland appears to be one of the greatest current risks to these woodland relics'.

Other sources of degradation are noted as stock containment (for drought management purposes) being located primarily in woodland areas, the absence of a 'spell' period in grazing regimes, the management of small public reserves (and in particular, over-grazing on these reserves), increasing populations of noisy miners, and rural-residential subdivision.

Nevertheless, there is great potential for stewardship agreements with land holders to arrest this decline, and the project has clearly identified where these should be a priority. In some cases, the purchase of properties where they are on the market, or by negotiation with willing sellers, will be important in securing conservation values. The Revolving Fund mechanism employed by the NSW Nature Conservation Trust will allow this to happen.

D8. References

Davidson I, Datson G and McLennan B 2004, *Thurgoona Threatened Species Conservation Strategy*, Albury-Wodonga Development Corporation, Albury.

Davidson I, Datson G and McLennan B 2005, *Albury Ranges Threatened Species Conservation Strategy*, Albury–Wodonga Corporation, Albury.

Davidson I 2007, *Developing a local landscape biodiversity plan in the Woomargama and Jindera local landscapes using Rapid Assessment Method*, report to the Department of Environment and Climate Change, Murray Catchment Management Authority, and Commonwealth Department of Environment, Water, Heritage and the Arts.

Davidson I 2008, *Validation report of Rapid Assessment Method*, report to Commonwealth Department of Environment, Water, Heritage and the Arts.

Thackway R and Lesslie R 2006, 'Reporting vegetation condition using the Vegetation Assets States and Transitions (VAST) framework', *Ecological Management and Restoration*, vol. 7, supplement 1, pp 53–62.

Thackway R and Lesslie R 2008, 'Describing and mapping human-induced vegetation change in the Australian landscape', *Environmental Management*, vol. 42, pp 572–590.

Appendix: Site assessment sheet for Rapid Assessment Methodology

Site assessment sheet (2 pages)

1: General information

1a: Site no: ___________ Date of field inspection: _____________

1b: Area: _________ (ha)

1c: Tenure

❑ Freehold ❑ Crown leasehold
❑ Crown (RLPB) ❑ Crown (Council) ❑ Crown (other reserve)
❑ State Forest ❑ DECCW reserve ❑ Other _____________

2: Land form

2a: Land capability: (quote class 1 – 8) ____________

2b: Generalised description:

❑ Ridgeline ❑ Steep slope ❑ Gentle slope ❑ Valley ❑ Flat

A: Vegetation

3: Vegetation structure

❑ Contiguous forest/woodland _____ %
❑ Smaller clumps of forest/woodland _____ %
❑ Scattered trees _____ %
❑ Treeless _____ %
❑ Riparian strip _____ %
❑ Linear reserve _____ %

4: Tree species

❑ Verified (see below) ❑ Not verified Canopy cover ________%

	Sparse	Common	Abundant		Sparse	Common	Abundant
Blakely's red gum				Red stringybark			
White box				Broad leaf peppermint			
Yellow box				Brittle gum			
Red box				Scribbly gum			
Long leaf box				Black cypress pine			
Apple box				Other_________			
River red gum				Other ________			

5: Vegetation types

5a: Broad Veg Type (Murray CMA)		**5b: Vegetation type** (*sensu* Keith 2004)	Cleared #	Conservation status
Grassy woodland*		Tablelands and slopes box gum woodland	95%	
		Box gum woodland	95%	
Dry foothill forest		Eastern rainshadow woodland	75%	
		Dry foothill forest	45%	
		Rocky scarps and ranges complex	10%	
Riparian woodland		River red gum forest	40%	
		Wetland formation	70%	
Other (describe)				

* sites consistent with box gum woodland endangered ecological community will be contained within this classification.
# Vegetation types >70% cleared = 'Over-cleared'; 40–70% cleared = 'Depleted'; <40% cleared = Lowest concern

6. Vegetation condition

6a Native groundcover ***(as % of total plant cover)***		❑ <10%	❑ 10–50%	❑ >50%
6b Shrubs	❑ absent	❑ sparse	❑ common	❑ abundant
6c Tree regeneration	❑ absent	❑ sparse	❑ common	❑ abundant

Assessed vegetation status: ❑ Over-cleared ❑ Depleted ❑ Lowest concern

Assessed vegetation condition: ❑ Medium–good ❑ Low ❑ Paddock trees

B: Landscape context

7: Landscape value	❑ Very high	❑ High	❑ Medium	❑ Low
8. Connectivity value	❑ High	❑ Medium	❑ Low	❑ Very low

Assessed landscape context value: ❑ High ❑ Other

C: Habitat features and threatened entities

9. Special habitat features

❑ **Verified (see below)** ❑ **Not verified**

❑ Intact ground layer	❑ absent	❑ sparse	❑ common	❑ abundant
❑ Shrubby understorey	❑ absent	❑ sparse	❑ common	❑ abundant
❑ Rocky outcrops or substrates	❑ absent	❑ sparse	❑ common	❑ abundant
❑ Logs/coarse woody debris	❑ absent	❑ sparse	❑ common	❑ abundant
❑ Standing dead timber	❑ absent	❑ sparse	❑ common	❑ abundant
❑ Large hollow-bearing trees	❑ absent	❑ sparse	❑ common	❑ abundant
❑ Creek/drainage line	❑ absent	❑ sparse	❑ common	❑ abundant
❑ Wetland	❑ absent	❑ sparse	❑ common	❑ abundant
❑ Other ___________________	❑ absent	❑ sparse	❑ common	❑ abundant

10. Threatened communities

❑ Box gum woodland (NSW definition) ❑ Box gum woodland (Commonwealth definition)

❑ occurs across most of the site ❑ patchily distributed across site ❑ discrete patch within site

Assessed habitat value : ❑ High ❑ Other

D: Site significance and summary

11. Site variability

❑ Uniform throughout ❑ 2 habitat types ❑ 3+ habitat types

Overall conservation significance rating (see attached Guide)

❑ High ❑ Medium–high ❑ Medium ❑ Medium–low ❑ Low

Comments. Note any further comments including threatened species, likely threats and risks to the site, and recommendations for future management (e.g. protect, restore and naturally regenerate, revegetate).

Guide to the site assessment sheet for RAM (4 pages)

Note: This sheet is being piloted for wider use in the Sheep Wheat Belt State Landscape Zone.

Some attribute fields are however specific to the South-west Slopes Bioregion and the Murray Catchment Management Authority Upper Slopes subregion.

1. General information

Each site should have a unique number (W1, W2, etc. for Woomargama and J1, J2, etc. for Jindera). Sites are identified and defined on the basis of apparent uniform vegetation type and condition. However, one site may include sites with various vegetation types or conditions where recommendations for future management are likely to be consistent across the site. Sites usually have consistent tenure.

Information on 1b) Area and 1c) Tenure are to be derived automatically from spatial data.

2. Land-form

Land capability is being used as a surrogate for site fertility. It will be derived automatically from spatial data. Where the site has been field-verified, a generalised description may be useful, particularly where the site includes more than one land capability class.

A: Vegetation

3 Vegetation structure

These relate to the ‘asset categories’ from the methodology. Most of the categories will not appear on the woody/extant vegetation mapping, except for contiguous forest/woodland. This is initially defined as areas > 5 ha with > 10% canopy density. If there is more than one structural type within the site, tick more than one box, and add ‘%’ to the estimated percentage of the area.

4. Tree species

For field-verified sites only. Not mandatory. Where field observation is not taken, record this category as not verified. 1. Sparse = scattered, occasional occurrence 2. Common = regular occurrence throughout. 3. Abundant = Dominant lifeform on site. An assessment of the tree cover should also be made.

5. Vegetation types

The vegetation on the site should be field verified and assigned to one of the categories in both the Broad Vegetation Types (BVT) and the Vegetation Types (as in the property vegetation plan). Where sites are not field verified, they will be assigned a vegetation category from the GIS. (Note: some sites in the study area have already been assessed, or have plot data available. If so, this existing information will be utilised during the field assessment.)

The **vegetation status** whether over-cleared (> 70% cleared), depleted (40–70% cleared), or of lowest concern (< 40% cleared) is a critical factor in determining conservation significance.

6. Vegetation condition

Assessments of percentage of native groundcover (as a percentage of total plant cover), shrubs and tree regeneration are made. Some sites in the study area have already been assessed, or have plot data available. Where possible, this existing information will be considered.

On the basis of the above, and the tree canopy cover from (4), the site is assigned to one of three **vegetation condition** categories:

- ‘native vegetation in medium to good condition’ for forests and woodlands where the overstorey percentage foliage cover is > 25% of the lower overstorey percentage of foliage cover benchmark for that vegetation class or > 50% of vegetation in the ground layer is made up of indigenous species.
- ‘native vegetation in low condition’ for forests and woodlands where the overstorey projected foliage cover is < 25% of the lower overstorey percentage of the foliage cover

benchmark for that vegetation type and < 50% of vegetation in the ground layer is made up of indigenous species, or > 90% of the site is ploughed or fallow.

- 'Paddock trees' are native vegetation where the overstorey percentage of the foliage cover is < 25% of the lower benchmark for the vegetation type, and the ground layer is either exotic crop, ploughed fallow or almost exclusively perennial or annual exotic pasture (> 90% of the cover is exotic species).

B: Landscape context

7. Landscape value

Where the Spatial Links Tool GIS program has been run for the study areas, a 'class' for landscape value may automatically be assigned. Where this is not the case, the assessment should strive to be consistent with the methodology used in the Biometric assessment. This determines the amount of native vegetation in the landscape within a 1.75, 0.55 and 0.2 km radius of the site.

For this rapid assessment methodology, only the 1.75 km radius (1,000 ha) will be used to determine landscape value and will determine whether the landscape is relictual (< 10% cover), fragmented (11–30% cover), variegated (31–70% cover) or intact (> 70% cover).

Landscape type	High value patch	Landscape type	High value patch
Relictual (<10% veg)	5 hectares	Variegated (31–70% veg)	30 hectares
Fragmented (11–30% veg)	10 hectares	Intact (>71% veg)	80 hectares

8. Connectivity value

'Connectivity value' is the degree to which the site is connected with other native vegetation. For this rapid assessment methodology, four categories consistent with Biometric will be used, but a qualitative assessment will assign a site to one of these four classes, as follows: **high** – part of a larger remnant, timbered creekline or connects two important remnants; **medium** – partial link between two remnants or good linear reserve which connects small remnants; **low** – small patch or linear reserve < 1 km from another remnant; **very low** – isolated patch or linear strip > 1 km from another remnant.

The **landscape context** score will be the highest of (7) Landscape value or (8) Connectivity value, and is classified as either High or Other.

C: Habitat features and threatened entities

9. Special habitat features

Where possible, special habitat features can be noted. This is particularly important where a selected set of threatened species (focal species) is being used in the project methodology. Assign abundance measures where possible: 1. Sparse = scattered, occasional occurrence; 2. Common = regular occurrence throughout; or 3. Abundant = Dominant across site. Where field observation is not taken, record the data as not being verified. A high habitat rating considers those features that are important elements for threatened woodland wildlife – for example, tree hollows, standing and fallen dead timber, and intact ground layer – and may have been missed in scoring the vegetation in previous sections. This measure is used in the consideration of overall conservation significance of the site. A high habitat score = > 50 large hollow-bearing trees, or > 50 dead standing or fallen trees.

10. Threatened communities

Within the study areas the one threatened community is white box–yellow box–Blakely's red gum grassy woodland (box gum woodland). This is listed under both NSW and Commonwealth legislation, but the definitions are not consistent. The NSW definition includes degraded sites, without trees and even with degraded groundcover but with some capacity for natural regeneration. The Commonwealth definition states that where trees do not exist, the ground layer must be relatively intact. The NSW definition is available at: www.threatenedspecies.environment.nsw.gov.au/tsprofile/profile.aspx?id=10837

The Commonwealth definition is available at: www.environment.gov.au/biodiversity/threatened/communities/pubs/box gum.pdf

Assessed habitat value is 'High' where there are habitat features likely to support populations of threatened species, or where there is a threatened community in moderate–good condition.

D: Site significance and summary

11. Site variability

This should be apparent in the descriptions above. Where there are clearly multiple landholders, or multiple management actions, then the site should be split.

Conservation significance

The **overall conservation significance rating** (see table below) considers:

- the status of the vegetation type (based on 5b) classified as over-cleared (> 70% cleared), depleted (40%–70% cleared) and of lowest concern (< 40% cleared)
- the condition of vegetation (based on 6) classified as medium–good condition, low condition, or paddock trees (consistent with Biometric)
- the landscape context (based on 7 and 8) classified as High or Other
- the habitat rating (based on 9 and 10) classified as High or Other, based on whether the habitat on site is likely to be important for one or more threatened species.

Table 1: Determining overall conservation significance

<table>
<tr><th>Vegetation status</th><th>Vegetation condition</th><th>Landscape context</th><th>Habitat value and threatened species</th><th>Overall conservation significance</th></tr>
<tr><td rowspan="12">Over-cleared</td><td rowspan="4">Medium–good</td><td rowspan="2">High</td><td>High</td><td rowspan="3">High</td></tr>
<tr><td>Other</td></tr>
<tr><td rowspan="2">Other</td><td>High</td></tr>
<tr><td>Other</td><td rowspan="2">Medium high</td></tr>
<tr><td rowspan="4">Low</td><td rowspan="2">High</td><td>High</td></tr>
<tr><td>Other</td><td rowspan="2">Medium</td></tr>
<tr><td rowspan="2">Other</td><td>High</td></tr>
<tr><td>Other</td><td>Medium low</td></tr>
<tr><td rowspan="4">Paddock trees</td><td rowspan="2">High</td><td>High</td><td>Medium high</td></tr>
<tr><td>Other</td><td rowspan="2">Medium</td></tr>
<tr><td rowspan="2">Other</td><td>High</td></tr>
<tr><td>Other</td><td>Low</td></tr>
<tr><td rowspan="9">Depleted</td><td rowspan="4">Medium–good</td><td rowspan="2">High</td><td>High</td><td>High</td></tr>
<tr><td>Other</td><td rowspan="2">Medium high</td></tr>
<tr><td rowspan="2">Other</td><td>High</td></tr>
<tr><td>Other</td><td>Medium</td></tr>
<tr><td rowspan="4">Low</td><td rowspan="2">High</td><td>High</td><td>Medium high</td></tr>
<tr><td>Other</td><td rowspan="2">Medium</td></tr>
<tr><td rowspan="2">Other</td><td>High</td></tr>
<tr><td>Other</td><td>Medium low</td></tr>
<tr><td>Paddock trees</td><td>High</td><td>High</td><td>Medium</td></tr>
</table>

Vegetation status	Vegetation condition	Landscape context	Habitat value and threatened species	Overall conservation significance
			Other	Medium low
		Other	High	
			Other	Low
Lowest concern	Medium–good	High	High	High
			Other	Medium high
		Other	High	
			Other	Medium
	Low	High	High	Medium high
			Other	Medium low
		Other	High	
			Other	Low
	Paddock trees	High	High	Medium
			Other	Medium low
		Other	High	
			Other	Low

Other attributes for GIS data

In addition to the attributes listed above, the GIS attribute file for both study areas should include fields for Mitchell landscape, threats, risk rating, priority, management.