Bushlinks 500:

Linking revegetation, remnant restoration and ecosystem management priorities in Tasmania's lowland grazing districts

Australian Government Biodiversity Fund project LSP-946647-1308

Final Report

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SOUTHERN MIDLANDS COUNCIL

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natural resource planning

NRM SOUTH

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1.0 Introduction

Bushlinks500, a collaborative project between Southern Midlands Council, Natural Resource Planning and NRM South, was funded in 2012 through the Australian Government's Biodiversity Fund. The project focused on implementing environmental restoration works in Tasmania's lowland grazing districts centred on the Midlands Biodiversity Hotspot region and surrounding landscapes.

The aims of Bushlinks500 were to:

- Deliver 500 ha of enhanced biodiversity outcomes within and adjacent to Tasmania's Midlands Biodiversity Hotspot region, as a contribution to a long-term vision for the region to stem the decline in important natural values.
- Implement cost-effective methods of biodiverse, ecologically functional landscape revegetation and restoration by:
    - establishment of native grassland through seeding and planting of up to 6 native grass species;
    - establishment of copses of native vegetation using up to 32 site appropriate native shrub and tree species; and
    - protection and restoration of biologically important native vegetation remnants buffering the revegetation sites through fencing, stock management and weed control.
- Foster landholder innovation in regard to native grassland seed collection, propagation and marketing.
- Advise landholders of their options for carbon trading in relation to vegetation established on their properties under the Project.

This report details the approach that was taken to deliver the Bushlinks500 Project inclusive of site selection and implementation of site works. An analysis of project environmental, social and economic outcomes is given, together with and evaluation of the Project's effectiveness.

2.0 Project Detail

2.1 Project Sites

Priority areas for Project site works were determined through detailed modelling using Natural Resource Planning's 'Regional Ecosystem Model' (REM). The Regional Ecosystem Model (REM) is a comprehensive system for:

- Integrating spatial data on the distribution of the major components of biodiversity, and the factors affecting them;
- Analysing relationships among the components of biodiversity and the environment; and
- Spatially identifying areas which have immediate or potential conservation concerns, and providing indicators of their relative importance, to inform approaches and priorities for management.

The REM was first developed with funding from the Australian Government's Caring for Our Country program in 2008 and has since been expanded, enhanced and used in a wide variety of natural resource planning and management projects. The REM systematically and spatially identifies a range of important biodiversity factors in terms of their biological significance and contribution to landscape-scale ecological function, for example vegetation type, conservation significance, reservation status, patch size, vegetation health, and position in the landscape. It then integrates the biodiversity attributes of an area to identify classes of 'Level of Concern' and priorities for management. Attachment 1 provides a summary of the REM.

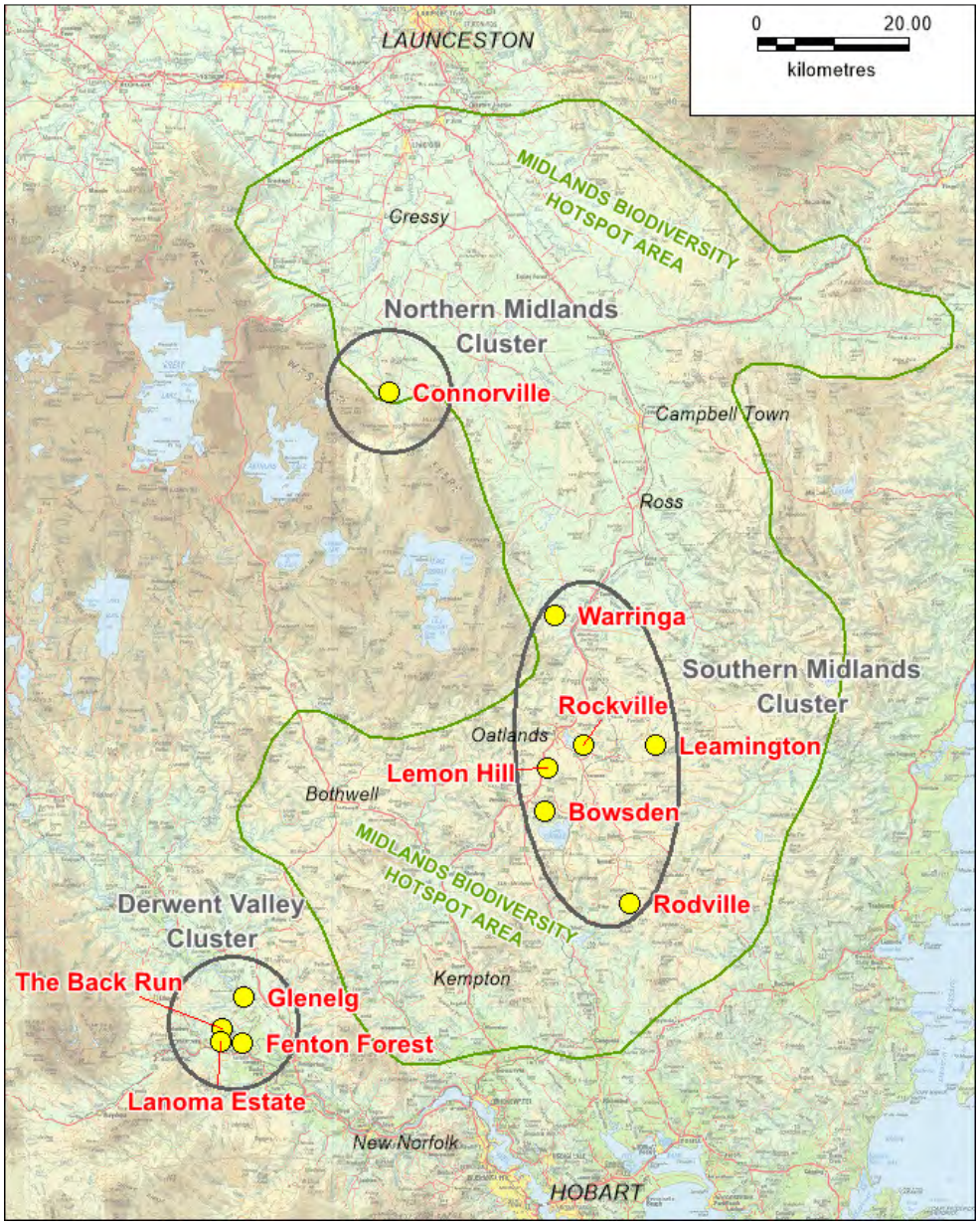
For the current project the REM issues and outputs were adapted into a set of criteria defining the eligibility and relative priority of potential sites, based on the project objectives and those of the Biodiversity Fund. The criteria are included as Attachment 2 and can be summarised as giving priority to:

- Areas of 'High' or 'Very High' level of concern for their landscape ecological function, based on proportional clearing of land types('clearing bias'), connectivity, remnant patch sizes, riparian vegetation and vegetation condition.
- Areas of native vegetation of 'High' or 'Very High' level of concern for their biological values, based on their vegetation (status, rarity and reservation), priority flora and fauna species (threatened and other priority species) and habitat for hollow dwelling species; and
- Areas whose overall immediate biodiversity management priority is 'Very High'.

Across the Project area, the intention was to select groups of properties within three 'clusters' - areas determined to be of the highest priority by the REM for ecological restoration work. The priority clusters were based on both the relative need for action to maintain and/or enhance biodiversity values, and on an assessment of what the project could achieve within funding constraints. In practice this meant clusters were identified where landscape ecological function needs were variegated at property scales, as distinct from being continuous across large areas of the landscape. Areas with the latter characteristics were considered to have limited prospects for the project to make a realistic contribution to biodiversity outcomes and need to be approached differently.

Based upon the site selection criteria, 11 properties were selected on which to undertake Project site works (**Figure 1**).

Figure 1: *Bushlinks500 Project area and site works locations*



2.1.1 Site assessment & modelling

Data from desktop sources and available from previous field assessments of other projects were used to initially generate a 'raw' version of the REM. These data were used to identify prospective sites for the project. An initial field assessment of prospective sites was used to confirm broad consistency with the project's eligibility and priority criteria (Attachment 2).

Suitable sites were surveyed in detail. Field assessment of project sites involved mapping and recording a range used as inputs to the REM. These included vegetation communities, biophysical naturalness, vegetation structure and maturity, vegetation diversity & health indicators, and invasive weed status for all proposals. Incidental data collection was also undertaken where data in the desktop analysis was found to be incorrect. For example, where geological substrate was found to differ from published maps this was corrected in the REM data to ensure correct identification of land components and their use in analysis of 'clearing bias'.

Vegetation communities occuring both within and adjoining project sites were mapped primarily using the Tasveg 2.0 classification for Tasmania[1]. Exceptions were the mapping of two vegetation types not considered to be appropriately dealt with in Tasveg – dry eucalypt plantings (i.e. revegetation) and dry eucalypt forests dominated by almost pure stands of *E. dalrympleana* occur at higher altitudes (500-700 m) around the Oatlands cluster.

Vegetation structural characteristics were also recorded as follows:

- For forest communities, whether old growth forest as defined in the field methodology for the Forest Conservation Fund;
- For eucalypt forest communities, the canopy cover dominance of mature and regrowth elements (mature, predominantly mature/some mature, predominantly regrowth/some mature, regrowth or regeneration (very young or planted regeneration); and
- Non-forest vegetation structure as a single class.

Vegetation condition was assessed using a rapid assessment method for mapping biophysical naturalness developed by Natural Resource Planning. The method is designed to facilitate efficient mapping in the field and to produce spatial outputs that can be integrated into the existing Statewide biophysical naturalness layer (initially developed for the Regional Forest Agreement but updated extensively by NRP over a range of projects). The method assesses vegetation health, modification and composition using elements of the Forest Conservation Fund field mapping methodology, simplified understorey and mid-storey assessments based on the Tasmanian Vegetation Condition benchmarks, and a range of customised inputs and integration procedures. Data are recorded on a standard pro-forma (Attachment 3) and biophysical naturalness values calculated by entering data to a spreadsheet. Where it was not feasible to collect data using the pro-forma, biophysical naturalness classes were assigned based on previous field experience of observed characteristics.

[1] Tasveg 3.0 was released during the project period but it was not considered appropriate to revisit sites so work continued with Tasveg 2.0 to ensure continuity.

Discussions with landowners was used to design detailed on ground works that aligned as far as possible with the project objectives and were consistent with the priorities and needs of the property manager. Data from the both the initial field assessments and final site design were then entered to the REM base data layers to generate a field-verified version of the REM. This version of the REM provides the basis for a standardised reporting of biodiversity characteristics and needs across all sites in the projects (see Section 3.2).

The REM was then run with anticipated outcomes on the project sites entered as if medium term results from successful works had been achieved. Such changes included changes in native vegetation patch sizes, connectivity/isolation, percentage of riparian vegetation, biophysical naturalness and vegetation structural characteristics. This version provides indicators of the benefits to biodiversity of the project sites being successfully managed into the medium term.

2.2 Site works methodology

2.2.1 Tree planting

Tree planting and establishment work was undertaken using best practice methodology. Up to 32 species were planted at each site (Table 1). Site preparation was undertaken well in advance of planting and involved elimination of invasive weeds, spraying herbicide along planting lines, and deep ripping and mound ploughing using equipment supplied by Private Forests Tasmania.

All plant propagation and planting was undertaken by experienced contractors using methods designed to maximise survival rates of trees and shrubs (tube-stock). These included: use of local provenance seed and propagation by experienced nurserymen; frost-hardening of all stock; location of each plant according to the specific preferences of the species; use of 'planting gel' for fertilisation and moisture retention; use of a mulch mat and core-flute tree guard; watering at planting; and follow-up watering when deemed necessary.

Figure 2: *Tree planting in progress at the 'Connorville' site*

Figure 3: *Tree planting at 'The Back Run' site*

Table 1: *Tree & shrub planting list for Bushlinks500 revegetation sites*

Acacia dealbata	silver wattle	*Eucalyptus dalrympleana*	mountain white gum
Acacia genistifolia	spreading wattle	*Eucalyptus globulus*	blue gum
Acacia melanoxylon	blackwood	*Eucalyptus ovata*	black gum
Acacia mucronata	caterpillar wattle	*Eucalyptus pauciflora*	cabbage gum
Acacia stricta	hop wattle	*Eucalyptus rodwayi*	swamp peppermint
Acacia verniciflua	varnished wattle	*Eucalyptus tenuramis*	silver peppermint
Acacia verticillata	prickly moses	*Eucalyptus viminalis*	white gum
Allocasuarina littoralis	bull oak	*Grevillea australis*	grevillea
Allocasuarina verticillata	sheoak	*Hakea epiglottis*	beaked needlebush
Banksia marginata	silver banksia	*Hakea microcarpa*	smallfruit needlebush
Bursaria spinosa	prickly box	*Leptospermum lanigerum*	woolly teatree
Callistemon pallidus	bottlebrush	*Leptospermum scoparium*	manuka
Davesia latifolia	hop bitterpea	*Melaleuca ericifolia*	paperbark
Dodonaea viscosa	hop bush	*Melaleuca pustulata*	yellow paperbark
Dodonaea filiformis	fineleaf hopbush	*Notelaea ligustrina*	native olive
Eucalyptus amygdalina	black peppermint	*Pomaderris elliptica*	yellow dogwood

2.2.2 Native grasses

Native grasses were considered an important component of biodiverse revegetation at Project sites. A variety of techniques was used to facilitate their establishment: hand planting of seedlings (Table 2); direct seeding; and grazing management. These three techniques enable native perennial grass reestablishment to occur at different scales and to spread risk (in terms of establishment success and survival rates).

Hand sown grass seedlings were planted primarily along ripped lines between trees and shrubs. This more labour intensive approach was utilised over small areas and was considered 'low risk' in terms of probability of survival, establishment and subsequent localised seeding and spread.

Direct seeding of grasses enabled the prospect of greater efficiency i.e. broad scale establishment at much lower cost than hand planting. However it also had increased risk of seasonal conditions effecting germination and establishment. At direct seeding sites, site preparation and sowing was undertaken according to protocols from the seed supplier. Sites were sprayed twice with herbicide in advance of sowing with seed sown through a triple disc direct seeder at the rate of 10 kg/seed per hectare.

'Grazing management' sites were chosen for their potential to regenerate native perennial grasses and also afforded the possibility of restoring large areas where direct seeding or planting was not a viable option. Site specific techniques were negotiated with the landholders, the outcome dependent upon individual preference for cell grazing, rotational grazing, holistic management, seasonal grazing or a combination of techniques. Sites chosen often had a history of continuous grazing at set stocking rates, were dominated by annual grasses and flat weeds, and had remnant native perennial grass component.

Table 2: *Native grass planting/sowing list for Bushlinks500 revegetation sites*

Austrodanthonia geniculata	wallaby grass
Dicelachne crinata	plume grass
Microlaena stipoides	weeping grass
Poa rodwayi	tussock grass
Poa labilliardierei	silver tussock
Themeda triandra	kangaroo grass

Figure 4: *Planting of native tussock grasses at the 'Connorville' site*

Figure 5: *Copse establishment – trees & native grass tussocks at the 'Glenelg' site*

2.2.3 Protection of remnant vegetation

Areas of remnant native vegetation were a crucial factor in determining the location of Project site works, as a key objective was to link remnants using biodiverse vegetation establishment. Key factors determining the relative importance of remnants for inclusion in Project sites were integrated by the REM and included: conservation significance; reservation status within the bioregion; clearing bias within the land-system; patch size and community health (e.g. dieback, regeneration, diversity, structure, and weed presence). Protection of remnants included in Project sites was considered to mean: fencing to enable spelling from stock access and limit access by feral animals (e.g. deer); control of threats such as weed invasion; reinstatement plantings to assist with regeneration; and bolstering of patch size through biodiverse plantings and establishing connected corridors to other native vegetation patches.

Figure 6: *Grassy white gum community fenced and protected at 'Rockville'*

Figure 7: *Regenerating silver peppermint woodland following fencing at 'Glenelg'*

2.2.4 Weed management

The primary focus of weed management work was to eradicate Weeds of National Significance (WoNS) at all project sites . The most commonly occurring WoNS were gorse (*Ulex europaeus*) with willow (*Salix* sp.) identified at one site. Other weeds that were also controlled at Project sites were: Californian thistle (*Cirsium arvense*), horehound (*Marrubium vulgare*), hawthorn (*Crataegus monygyna*) and briar rose (*Rosa rubiginosa*).

Figure 8: *Gorse infested riparian white gum community at 'Warringa'*

Figure 9: *Gorse cleared at the same 'Warringa' site*

2.2.5 Fencing

All fencing at Project sites was undertaken to specifications designed to protect remnant bush areas from stock grazing and to eliminate stock and native browsers from tree establishment areas. Deer fencing was utilised at sites where high numbers of fallow deer were present.

Figure 10: *Fencing for native bushland restoration at 'Rockville'*

Figure 11: *Deer fencing for protection of revegetation sites at 'Connorville'*

3.0 Environmental Outcomes

3.1 Summary of environmental outcomes for the Project

3.1.1 Biodiversity

Bushlinks500 exceeded the target of 500 hectares of environmental rehabilitation and protection work by 57 hectares or 11% (Tables 3 & 4). Through the Project the following environmental outcomes were achieved:

- 68 hectares of farmland and degraded woodland were revegetated and/or restored with site appropriate biodiverse native vegetation utilising 18,919 native trees and shrubs (32 species) and 54,320 native grass seedlings (6 species);
- 58 hectares of pasture/grassland were rehabilitated through direct seeding (300 kg of native grass seed) and altered grazing management i.e. cell grazing; and
- 431 hectares of biologically important native vegetation in remnants were protected buffering the revegetation sites through strategic fencing, stock management and weed control.

The project achieved the desired objective of improving the ecological function at identified sites within the landscape (refer to Section 3.2 for more detail) by creating a mosaic of grassland and wooded areas between identified important remnants of vegetation.

Figure 12: *Native kangaroo grass regeneration in a copse at 'The Back Run'*

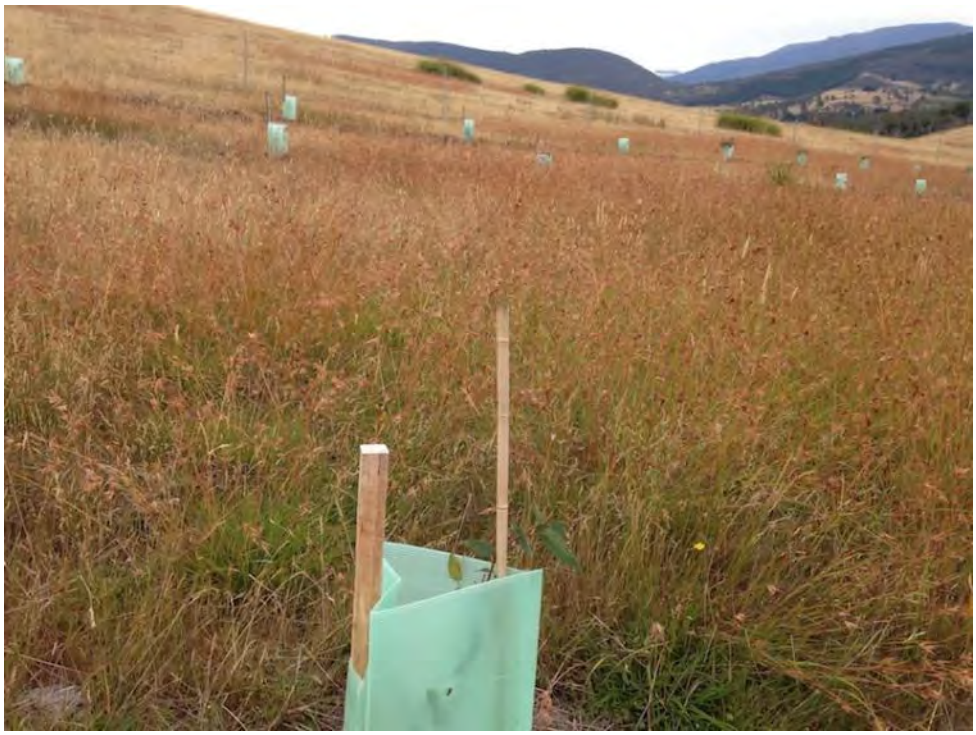


Table 3: *Bushlinks500 environmental outcomes versus project targets*

Activity	Project Target (ha)	Achieved (ha)	% achieved against target
Revegetation (copses and restoration plantings)	25	68	272%
Revegetation (grassland seeding & management)	75	58	77%
Priority vegetation remnants protected	400	431	108%
Total	**500**	**557**	**111%**

Figure 13: *Protected silver peppermint (Eucalyptus tenuiramis) forest and woodland at 'Rodville'*

Table 4: *Bushlinks500 summary of environmental outcomes per property*

SITE	Area revegetated as copses (ha)	Area of restored & managed pasture/grassland (ha)	Area remnant vegetation restored by replanting (ha)	Area remnant vegetation protected (ha)
Lemon Hill	**6.2**	**13.7**	**18**	**6**
Rockville	**1.5**	**9.9**	**2.7**	**22**
Warringa	**2.2**		**4**	**29**
Leamington	**1**			**47**
Bowsden	**4.7**			**49.5**
Glenelg	**4.9**	**34**		**132**
Connorville	**7.3**			**8.6**
Lanoma Estate				**36**
The Back Run	**10.6**		**3**	**12.5**
Fenton Forest			**2**	**77**
Rodville				**11**
PROJECT TOTALS	**38.4**	**57.6**	**29.7**	**430.6**

Additional to the areas revegetated and protected under the Project, 18,919 native trees and 54,320 native grass seedlings were planted; and 53.7 hectares of invasive weeds were controlled (Table 5). Of the native trees planted, very high survival rates (92% overall) were recorded as at January 2015 (Table 6).

Table 5: *Bushlinks500 site works statistics*

SITE	Trees planted	Native grasses planted	Weed control area (ha)	Copse fencing amount (km)	Restoration fencing amount (km)	Remnant fencing amount (km)
Lemon Hill	**2,550**	**5,385**	**1**	**2.8**	**0.4**	**0.6**
Rockville	**750**	**1,500**	**14.5**	**1.6**	**0.4**	**0.5**
Warringa	**2,700**	**6,260**	**6.7**	**2.4**	**1.8**	**4.0**
Leamington	**460**		**4**	**1.0**		**1.5**
Bowsden	**2,643**	**12,140**	**4.7**	**4.7**		**4.5**
Glenelg	**2,323**	**7,035**	**4.9**	**2.1**	**1.7**	**6.7**
Connorville	**2,250**	**11,000**	**7.3**	**2.5**		**0.8**
Lanoma Estate						2.0
The Back Run	**4,954**	**11,000**	**10.6**	**3.8**		**1.7**
Fenton Forest	**289**					**5.8**
Rodville						**0.8**
PROJECT TOTALS	**18,919**	**54,320**	**53.7**	**20.9**	**4.2**	**28.8**

Table 6: *Survival rate of trees planted under Bushlinks500*

SITE	Trees planted	Survival Rate (as at January 2015)**
Season 1		
Lemon Hill	2,550	68%
Rockville	750	75%
Season 2		
Warringa	2,700	95%
Leamington	460	95%
Bowsden	2,643	98%
Glenelg	2,323	96%
Connorville	2,250	100%
The Back Run	4,954	96%
Fenton Forest	289	97%
PROJECT TOTALS	**18,919**	**92%**

** The difference in survival rates between seasons 1 and 2 is explained as follows:

i. Season 1 was very dry with a series of heavy frosts experienced post planting. Despite most of the initial trees killed by frost being replaced, further tree losses were experienced in the summer of 2013/14 – one of the hottest and driest ever recorded in parts of Tasmania.

ii. All trees planted in season 2 were sourced from different nurseries than those for season 1 and were rigorously 'hardened-off' to build resilience against 'frosting'.

iii. For all trees planted in season 2, planting methodology was adapted to maximise success with alternative contractors being engaged to undertake the work.

iv. For most sites planted in season 2, a later-season planting (September to November) was adopted as a contingency to avoid the dry winter of 2014 (and potential for frosting) and to advantage the actively growing seedlings with warmer spring conditions, particularly warmer soil temperatures

The project protected 430 ha of remnant vegetation. The area was comprised of 18 communities across two bioregions, representing a total of 21 bioregional vegetation types. The area of vegetation communities mapped to the Tasveg classification was 396 ha. Some areas were not able to be mapped to communities within the classification, as they were observed to be in either degrading or regenerating successional stages. However, management arrangements provided by the project will protect these areas and favour their regeneration. The figure also includes some areas where fences were set back slightly in pastures from the existing bush. These areas are likely to revert to native vegetation over time.

The area of native vegetation included 166 ha (42%) of vegetation communities listed under either Commonwealth or Tasmanian legislation. This was comprised of:

- 4 ha of one community listed as Critically Endangered under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999;* and
- 158 ha in four communities listed as Vulnerable and 5 ha of one community listed as Endangered under the Tasmanian *Nature Conservation Act 2002.*

An indication of the relative importance of appropriate management of the vegetation on private land was derived using the REM 'Level of Concern' classes for native vegetation. The native vegetation index integrates legislated status, with both the areal extent and percentage reservation of each community in the bioregion.

Vegetation of higher Level of Concern was strongly represented in the selection of project sites, and is consistent with the generally lower levels of reservation, condition and formalised management arrangements on private land:

- Very High – 226 ha (57%)
- High – 9 ha (2%);
- Medium – 133 ha (34%); and
- Low – 14 ha (4%).

Table 7: *Vegetation communities protected under Bushlinks500*

Property	Vegetation community	Bioregion[#]	EPBC / NC Act status*	REM Level of Concern[+]	Area(ha)
Back Run	DTO – *Eucalyptus tenuiramis* forest and woodland on sediments	SE	- / V	Very High	12.3
	GCL – Lowland grassland complex	SE	- / -	Medium	3.0
	NAD – *Acacia dealbata* forest	SE	- / -	Medium	2.4
Bowsden	DDA – *E. dalrympleana* forest and woodland	SE	- / -	Very High	32.8
	DDE – *E. delegatensis* dry forest and woodland	SE	- / -	Low	3.0
	DVG - *E. viminalis* grassy forest and woodland	SE	- / -	Medium	4.1
	GCL – Lowland grassland complex	SE	- / -	Medium	16.8
Connorville	DAZ – *E. amygdalina* inland forest and woodland on Cainozoic sediments	NM	- / V	Very High	5.6
	GSL – Lowland grassy sedgeland	NM	- / -	High	2.2
	NAD – *Acacia dealbata* forest	NM	- / -	Medium	1.6
Fenton Forest	DOV – *E. ovata* forest and woodland	SE	- / E	Very High	3.0
	DPO – *E. pauciflora* forest and woodland not on dolerite	SE	- / -	Very High	15.6
	DVG - *E. viminalis* grassy forest and woodland	SE	- / -	Medium	52.7
	GCL – Lowland grassland complex	SE	- / -	Medium	7.5
Glenelg	DTO – *Eucalyptus tenuiramis* forest and woodland on sediments	SE	- / V	Very High	81.5
	GCL – Lowland grassland complex	SE	- / -	Medium	6.7
	NAV – *Allocasuarina verticillata* forest	SE	- / -	Very High	3.9
	NBA – *Bursaria-Acacia* woodland and scrub	SE	- / -	Medium	12.8
	SRI – Riparian scrub	SE	- / V	Very High	6.9
Lanoma	DAM – *E. amygdalina* forest and woodland on mudstone	SE	- / -	High	7.1
	DOB – *E. obliqua* dry forest and woodland	SE	- / -	Medium	3.8
	DOV – *E. ovata* forest and woodland	SE	- / E	Very High	0.4
	DTO – *Eucalyptus tenuiramis* forest and woodland on sediments	SE	- / V	Very High	24.1

Property	Vegetation community	Bioregion[#]	EPBC / NC Act status*	REM Level of Concern[+]	Area(ha)
Leamington	DAS – *E. amygdalina* forest and woodland on sandstone	SE	- / V	Very High	1.4
	DDA – *E. dalrympleana* forest and woodland	SE	- / -	Very High	2.2
	DDE – *E. delegatensis* dry forest and woodland	SE	- / -	Low	5.5
	DDP – *E. dalrympleana-E. pauciflora* forest and woodland	SE	- / -	Very High	6.9
	DGL – *E. globulus* grassy forest and woodland	SE	- / V	Very High	13.2
	DOV – *E. ovata* forest and woodland	SE	- / E	Very High	6.9
	GPL – Lowland *Poa labillardierei* grassland	SE	CR / -	Very High	6.5
	NAD – *Acacia dealbata* forest	NM	- / -	Medium	0.8
Lemon Hill	DAS – *E. amygdalina* forest and woodland on sandstone	SE	- / V	Very High	2.6
	DDA – *E. dalrympleana* forest and woodland	SE	- / -	Very High	2.9
	DDP – *E. dalrympleana-E. pauciflora* forest and woodland	SE	- / -	Very High	4.5
	DOV – *E. ovata* forest and woodland	SE	- / E	Very High	1.0
	DPO – *E. pauciflora* forest and woodland not on dolerite	SE	- / -	Very High	1.4
	GCL – Lowland grassland complex	SE	- / -	Medium	6.0
	GPL – Lowland *Poa labillardierei* grassland	SE	CR / -	Very High	3.8
Rockville	DPO – *E. pauciflora* forest and woodland not on dolerite	SE	- / -	Very High	11.0
	DVG - *E. viminalis* grassy forest and woodland	SE	- / -	Medium	7.8
	GCL – Lowland grassland complex	SE	- / -	Medium	5.7
Rodville	DOB – *E. obliqua* dry forest and woodland	SE	- / -	Medium	3.0
	DTO – *Eucalyptus tenuiramis* forest and woodland on sediments	SE	- / V	Very High	8.7
Warringa	DAS – *E. amygdalina* forest and woodland on sandstone	NM	- / V	Very High	16.1
	DOV – *E. ovata* forest and woodland	NM	- / E	Very High	0.4
	DVG - *E. viminalis* grassy forest and woodland	NM	- / -	Low	11.3

Notes to Table 7.

Bioregions

SE – South East

NM – Northern Midlands

* Conservation status under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* and Tasmanian *Nature Conservation Act 2002:*

CR – Critically endangered

E – Endangered

V - Vulnerable

+ REM Level of Concern classes are an integration of area of community in bioregion, EPBC/NC Act listing and percentage reservation in bioregion. See: Knight, R.I. & Cullen, P.J. (2010). Specifications for a Regional Ecosystem Model of natural resources in the Tasmanian Midlands. A report of the Caring for Our Country Project 'Using landscape ecology to prioritise property management actions in Tasmania'. Natural Resource Planning, Hobart, Tasmania.
http://www.naturalresourceplanning.com.au/assets/REM_specifications_v1-0.pdf

3.1.2 Carbon

Project activities have potential to contribute to the effort to reduced atmospheric greenhouse gases through:

i) Capture and storage of carbon dioxide at revegetation sites if successful in the long term; and
ii) Avoided deforestation at sites where forest and woodland has been protected from damaging effects of over-grazing and weed invasion and set aside for conservation. This approach facilitates the maintenance of existing stored carbon at the sites, and ongoing carbon sequestration as the forest and woodland continues to grow and regenerate.

All Project participants have been informed that they may be eligible for carbon credits under the Emissions Reduction Fund by participating in Bushlinks 500, however a number of components of the fund are still subject to change (e.g. determinations of methodologies are still only available as draft[2]). Project participants have been informed of the methodologies and rules for 'reforestation' and 'avoided deforestation' on the Emissions Reduction Fund website and that it is at their discretion whether they pursue the opportunities.

3.2 Environmental outcomes detail

The project involved selecting sites for investment with a wide range of characteristics and circumstances across a relatively large geographic area. Use of the REM, eligibility and priority criteria and consistent methods of field data collection and process were used to ensure alignment of sites and works with the Biodiversity Fund and the project's objectives.

The REM also forms the basis for a consistent and comprehensive reporting template for the environmental outcomes of the project. It provides a set of 12 indicators of Level of Concern for biodiversity, comprising eight primary indicators and four integrated indicators.

The REM profiling routine (see Attachment 1) has been used to generate a summary of the indicators for the individual sites within the project.. The profiles present the indicators standardised as the percentage breakdown of the area in the REM's Level of Concern classes (Low, Medium, High and Very High). The outcomes on sites selected for the project are discussed below in terms of the biodiversity values which the project has contributed to protection of, the importance of the sites to

[2] http://www.environment.gov.au/climate-change/emissions-reduction-fund/methods
Accessed: 29 January 2015

landscape ecological function, and the major changes that are to be expected from the site activities and management provisions it has provided.

Property: Back Run

Summary of activity: Project activities at the Back Run, located in the Derwent Valley, were focussed on protection and restoration of forest that had been heavily impacted by recent wildfire, and on revegetation across and extensively cleared area to connect existing forest patches in multiple directions.

Biological significance: Native vegetation on the site is dominated by the listed Vulnerable community *E. tenuiramis* on sediments (Vulnerable). Areas now mapped as the community *Acacia dealbata* forest and lowland grassland complex are degraded examples of this community. Two listed threatened species, and one non-listed priority species are modelled as having habitat in the area based on having been recorded within 2.5 km of the site. The Tasmanian Bettong is also likely to be present in the area, as it favours *E. tenuiramis* on sediments for habitat, but has not been recorded in the vicinity. All the native eucalypt forest on the site is of High concern for hollow dwelling species, as there are currently no mature trees on the site and relatively few in nearby areas.

Species	EPBC / TSP act status	Notes
Eastern Quoll - habitat	- / -	Species recorded within 2.5 km. Not listed but extinct on mainland Australia.
Spotted-tailed Quoll –habitat	VU / r	Species recorded within 2.5 km.
Tasmanian Bettong – potential habitat	- / -	Likely to be present but not recorded. Not listed but extinct on mainland Australia.
Tasmanian Devil – habitat	EN / e	Species recorded within 2.5 km and since 2005.

Landscape ecology: About 46 % of the site area is of High Concern for landscape ecological function. This arises from all the native vegetation being part of a patch less than 200 ha and having low biophysical naturalness and limited connectivity to larger patches.

Projected outcomes: Fencing and management of remnants, and active restoration by interplanting some of the remnants are intended to lead to increased biophysical naturalness of the vegetation including regeneration which is currently largely absent. In the absence of these actions the listed threatened eucalypt forest at the site may cease to even be the community. Revegetation activities at the site will significantly reconnect a relatively isolated remnant to another project site on the property Lanoma and within the property to an area being fenced by Landcare Tasmania as part of another Biodiversity Fund project. About half of the revegetation activity will increase the area of native riparian vegetation along 600 m of currently cleared streamline. The revegetation also includes an area where tunnel erosion is present and is likely to reduce risk of further impact of the erosion downstream.

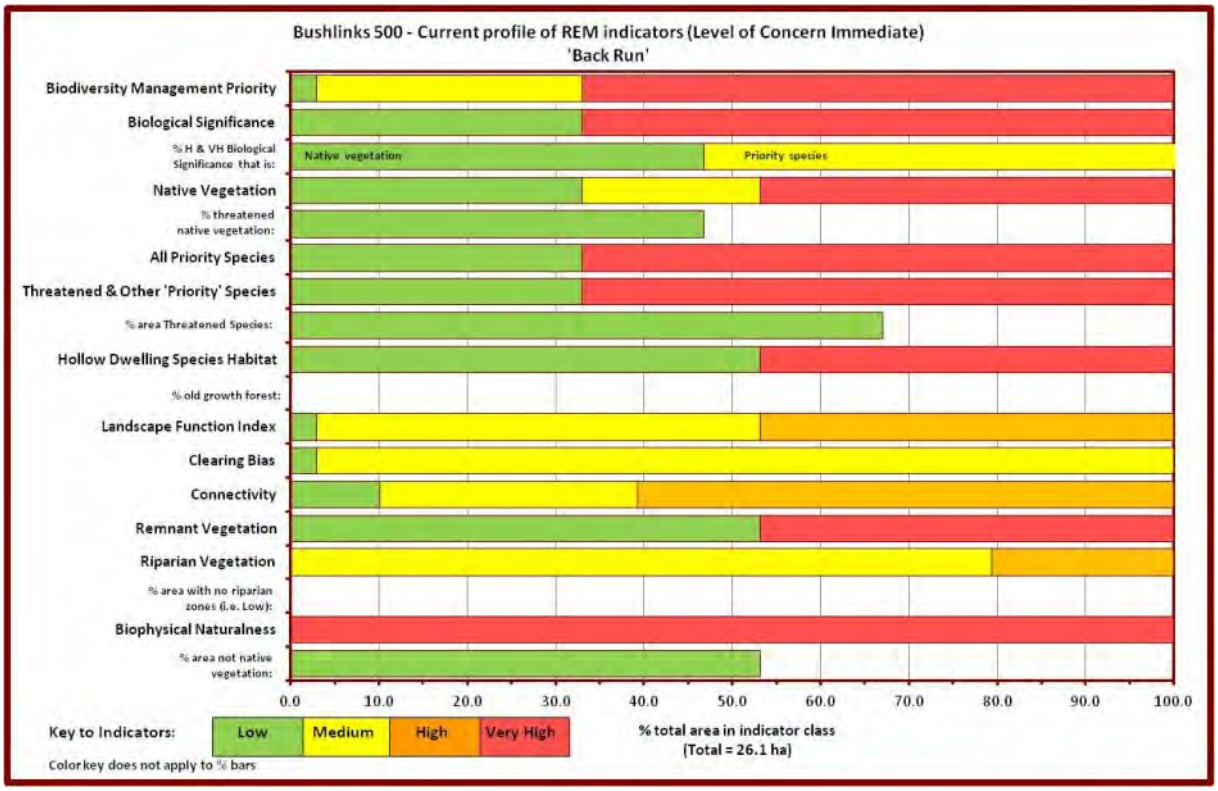


Figure 14: *Remnant restoration and revegetation corridor, 'Back Run'*

Property: Bowsden

Summary of activity: Work undertaken at the site was focused on securing existing remnant vegetation through fencing to exclude stock and allow regeneration, particularly of understorey elements and allow for a new cohort of overstorey species. A number of remnants were connected by revegetation works across an elevated valley. Work on the site was designed to fit with the landowner's broader re-fencing plans to facilitate rotational grazing.

Biological significance: Most of the native vegetation at the site is dry eucalypt forest dominated by *E. dalrympleana* (NRP mapping unit DDA). This community does not nest well within the Tasveg classification and is most similar to its *E. dalrympleana – E. pauciflora* community, which has a limited extent and is poorly reserved in the South East bioregion and of Very High Level of Concern in the REM. The site contains part of a known nest zone of the Wedge-tailed Eagle and also potential breeding habitat for the Masked Owl. Both species are dependent on mature eucalypts for breeding habitat but the REM indicates that over 50% of the forest in the area is of High or Very High level of concern – representing relatively now abundance of mature trees. A total of four listed threatened fauna species and one other priority species have suitable habitat at the site.

Species	EPBC / TSP act status	Notes
Eastern Quoll - habitat	- / -	Species recorded within 2.5 km. Not listed but extinct on mainland Australia.
Masked Owl - breeding habitat	VU / e	
Spotted-tailed Quoll –habitat	VU / r	Species recorded within 2.5 km.
Tussock Skink – habitat	- / v	
Wedge-tailed Eagle – known nest zone	EN / e	

Landscape ecology: Most of the site has been subject to set stocking rates for sheep grazing. Although the site is located in an area of relatively intact landscape characteristics, the vegetation is on the whole in relatively poor condition due to lack of understorey. It is likely to progress to tree decline and loss of hollow dwelling species habitat if not addressed.

Projected outcomes: Fencing and management or remnants at the site is likely to lead to increases in biophysical naturalness and may also help limit loss of mature eucalypts from the area. Enhanced connectivity of remnants may facilitate movement of woodland birds and potentially also of smaller fauna such as the Tussock Skink.

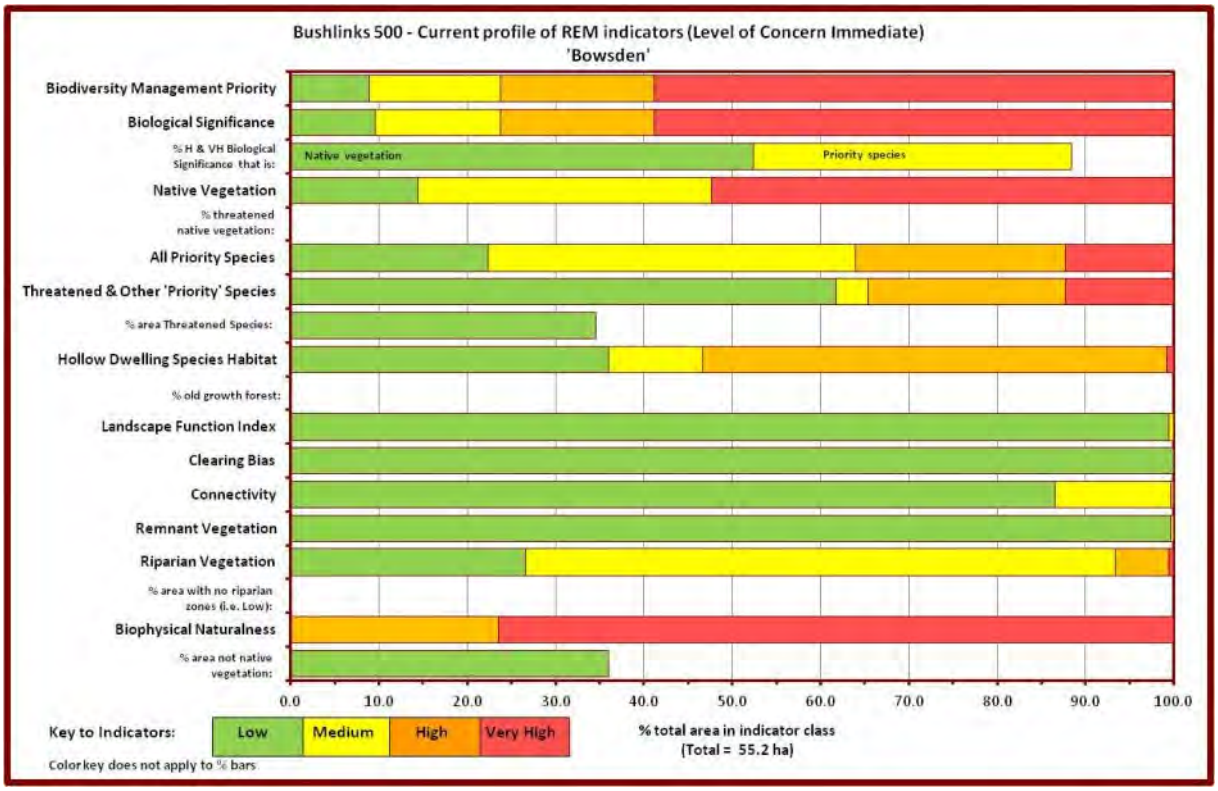


Figure 15: *Revegetation area on 'Bowsden'*

Property: Connorville

Summary of activity: The project site consisted of an area of remnant riparian vegetation on a creek draining across the heavily cleared floodplain of the Lake River. The vegetation of the site was exposed to grazing by cattle and sheep, and also to grazing by fallow deer. Most of the area was fenced to exclude stock and deer; part was fenced only to exclude stock. The existing pasture within the site was replanted with a range of native trees and grasses selected to match the variation in site topography (ranging from relatively wet and swampy to drier sites). Willows and some hawthorn were removed from the site and spraying of thistles that established on disturbed ground was also undertaken.

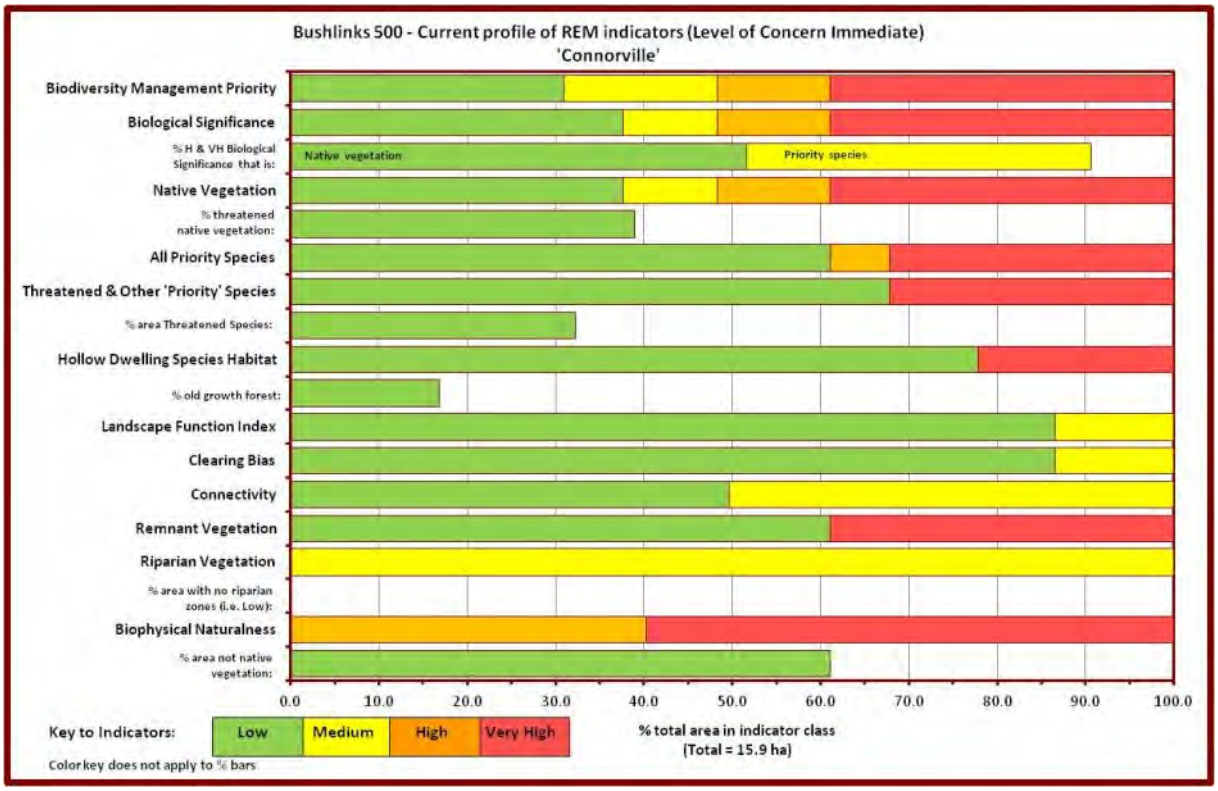
Biological significance: Most of the existing native riparian vegetation at the site was difficult to classify, being a mixture of *E. amygdalina* and *E. viminalis* but with strong mesic elements in the riparian zone of the creek. The site was determined to match the mapping rules for the Tasmanian-listed threatened community *E. amygdalina* inland forest and woodland on Cainozoic sediments (Vulnerable) determined by CARSAG (2004[3]) but it also contains strong elements of a second listed community Riparian Scrub (Vulnerable). Two threatened plant species were confirmed on the site during the project. The REM indicates around a quarter of the site as of Very High concern for hollow dwelling species habitat, reflecting the limited abundance of mature eucalypts at the site and in the vicinity.

Species	EPBC / TSP act status	Notes
Dianella amoena (grassland flaxlily)	EN / r	Confirmed present at site,
Arthropodium strictum (chocolate lily)	- / r	Confirmed present at site,

Landscape ecology: The site has relatively good landscape context; however much of the native vegetation on the Lake River floodplain is degraded so level of concern is also higher than indicated in the REM. Although structurally connected to a larger patch of native vegetation, that on the site is narrow and has a very long edge relative to its size. This factor, combined with continued access by stock and deer, would likely lead to loss of biodiversity values.

Projected outcomes: Fencing at the site has increased the width of protected riparian vegetation at the site by a factor of 2-3 times to around 100 m and should significantly reduce edge effects. Removal of grazing, particularly by deer, is likely to lead to increase natural regeneration. Overall management of the site will lead to increased biophysical naturalness, security of riparian vegetation and enhanced effectiveness of connectivity.

[3] Comprehensive, Adequate & Representative Scientific Advisory Group (2004). Interpretation of the RFA community 'Inland E. amygdalina forest': New community definitions & revised reservation status for E. amygdalina–dominated forest communities across Tasmania. Private Forest Reserves Program, Department of Primary Industries, Water & Environment, Hobart.



Property: Fenton Forest

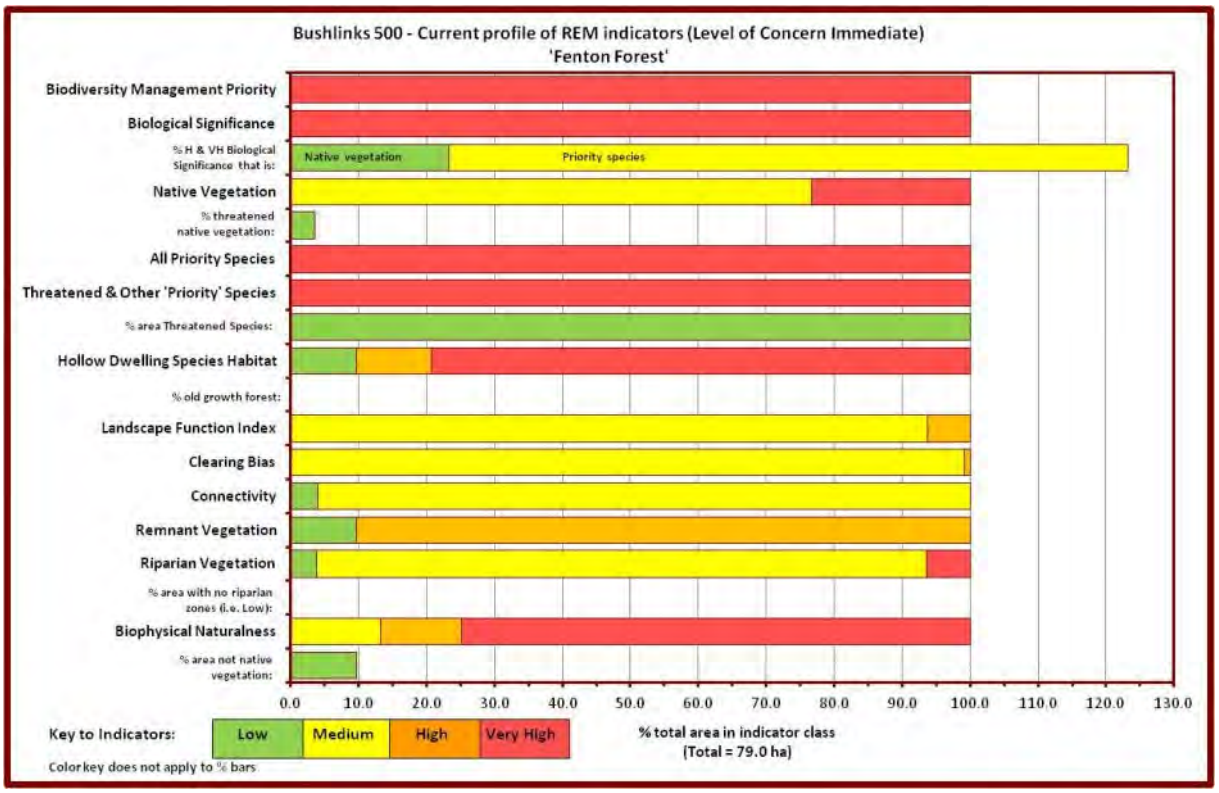
Summary of activity: Project activities at the Fenton Forest property were primarily focused on fencing a large area of remnant bush which had limited regeneration and had been severely burnt in a recent wildfire. A smaller area of riparian vegetation on the Tyenna River was also fenced and part had a restoration planting to effect regeneration.

Biological significance: Forest at the site is dominated by *E. viminalis* forests which are very extensive and of lower conservation priority. The site includes two vegetation communities (*E. pauciflora* forest on sediments and *E. ovata* forest) which are Very High level of concern in the REM. *E. ovata* is also listed as Endangered in Tasmania. Some of the forests at the site are highly degraded and map as lowland grassland complex. The entire site is identified in the REM as of Very High biodiversity management priority, due primarily to the presence of suitable habitat for the Tasmanian Devil across the entire site. One listed threatened species is known from the site and suitable habitat also exists for the Eastern Quoll and Tasmanian Bettong. Concern for hollow dwelling species at the site is High (>90%) due to the almost total absence of mature eucalypts from the site and also the general area.

Species	EPBC / TSP act status	Notes
Austrostipa nodosa (knotty speargrass)	- / r	
Eastern Quoll - habitat	- / -	Species recorded within 2.5 km. Not listed but extinct on mainland Australia.
Tasmanian Bettong – habitat	- / -	Species recorded within 2.5 km. Not listed but extinct on mainland Australia.
Tasmanian Devil – habitat	EN / e	Species recorded within 2.5 km and since 2005.

Landscape ecology: The site is characterised by relatively high level of concern for biophysical naturalness, reflecting the poor condition of the site. The native vegetation consists entirely of remnants less than 200 ha. Connectivity is of moderate concern. Level of concern for landscape ecological function of the site is Medium with a small area (7%) of High concern.

Projected outcomes: Fencing to reduce stock access to the site is intended to assist the establishment of regeneration, which is almost entirely absent due to the effects of fire and possibly grazing history. The restoration planting included in site activities will assist regeneration in the endangered *E. ovata* community. Fencing of the Tyenna River section of the site will protect important riparian vegetation and lead to an overall increase in its condition.



Property: Glenelg

Summary of activity: Project activity on Glenelg occurred in two areas. The first (Steeles Bottom) fenced a large patch of remnant native forest adjoining an existing conservation covenant and provided for management of native grassland that had been induced through loss of trees. The second, fronting the Derwent River near Lake Meadowbank involved fencing existing native forest that had been heavily damaged by wildfire, and also providing for a mixture of planting of copses of trees into pasture that was also to be managed.

Biological significance: Around 77% of the site is of Very High level of concern for its native vegetation. It includes two listed threatened communities – *E. tenuiramis* forest on sediments (Vulnerable) and riparian scrub (Vulnerable). Most of the *E. tenuiramis* forest is habitat for the Tasmanian Bettong, which was confirmed during field assessments. An active den site of the Tasmania Devil was also located during fieldwork, in the Derwent River section of the project. The site also contains some suitable breeding habitat for the Masked Owl in mature eucalypt forests in the Steeles Bottom section of the site. The non-listed Eastern Quoll also has potential habitat within the area.

Species	EPBC / TSP act status	Notes
Masked Owl – breeding habitat	VU / e	
Eastern Quoll - habitat	- / -	Species recorded within 2.5 km. Not listed but extinct on mainland Australia.
Tasmanian Bettong – habitat	- / -	Species recorded within 2.5 km. Not listed but extinct on mainland Australia.
Tasmanian Devil – confirmed den site	EN / e	
Tasmanian Devil – habitat	EN / e	Species recorded within 2.5 km and since 2005.

Landscape ecology: Both parts of the site are dominated by areas of Medium concern for landscape ecological function, with about 9% rated as High. Relatively high proportions of four of the five indicators of landscape function (connectivity, remnant vegetation, riparian vegetation and biophysical naturalness) are of High or Very High level of concern. These indicators are more important on the Meadowbank part of the site, due to fire damage.

Projected outcomes: Management of the site is likely to secure the native vegetation values of the site, the Tasmanian Devil den and breeding habitat for the Masked Owl. Fencing of the Meadowbank site will secure existing post-fire regeneration, which is strong but was also exposed to potential grazing damage. The Steeles Bottom area will enhance an existing but relatively small conservation covenant, and also allow for regeneration of the forest in areas where grazing and fire appear to have limited it.

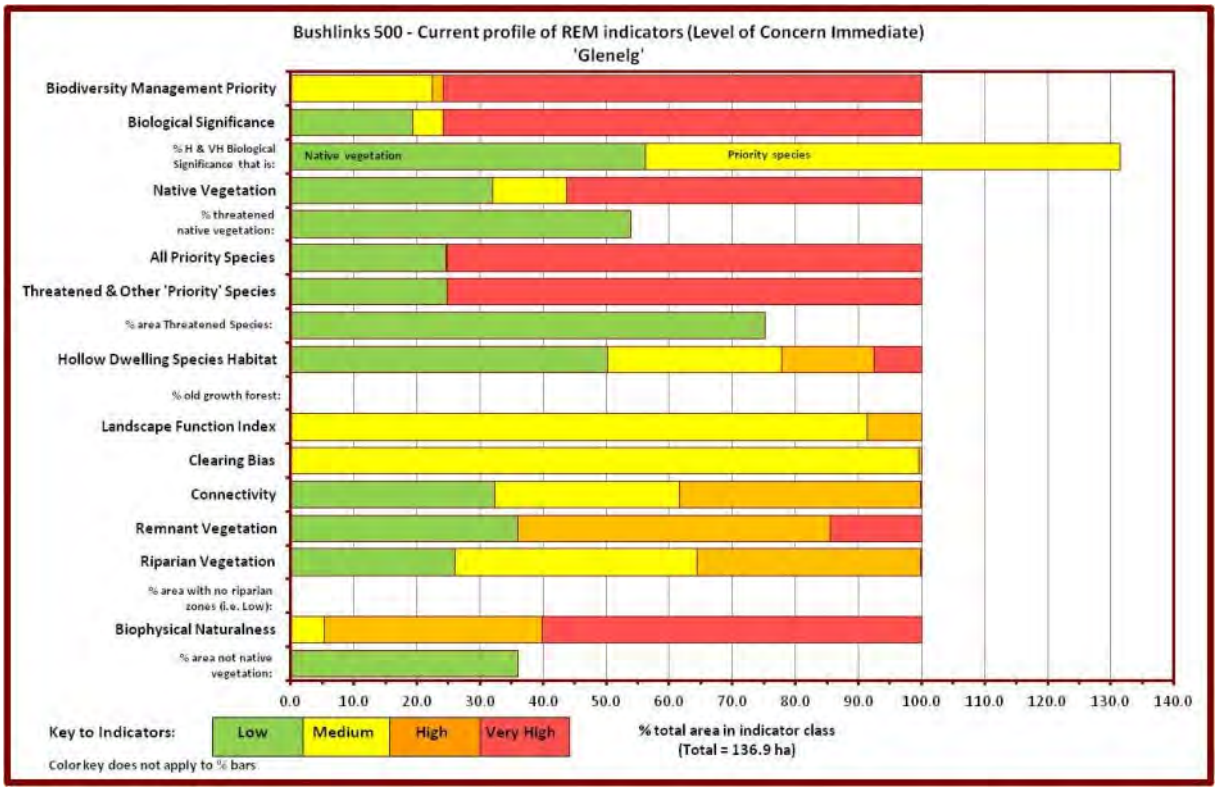


Figure 16: Eucalyptus tenuiramis *forest on 'Glenelg'*

Property: Lanoma

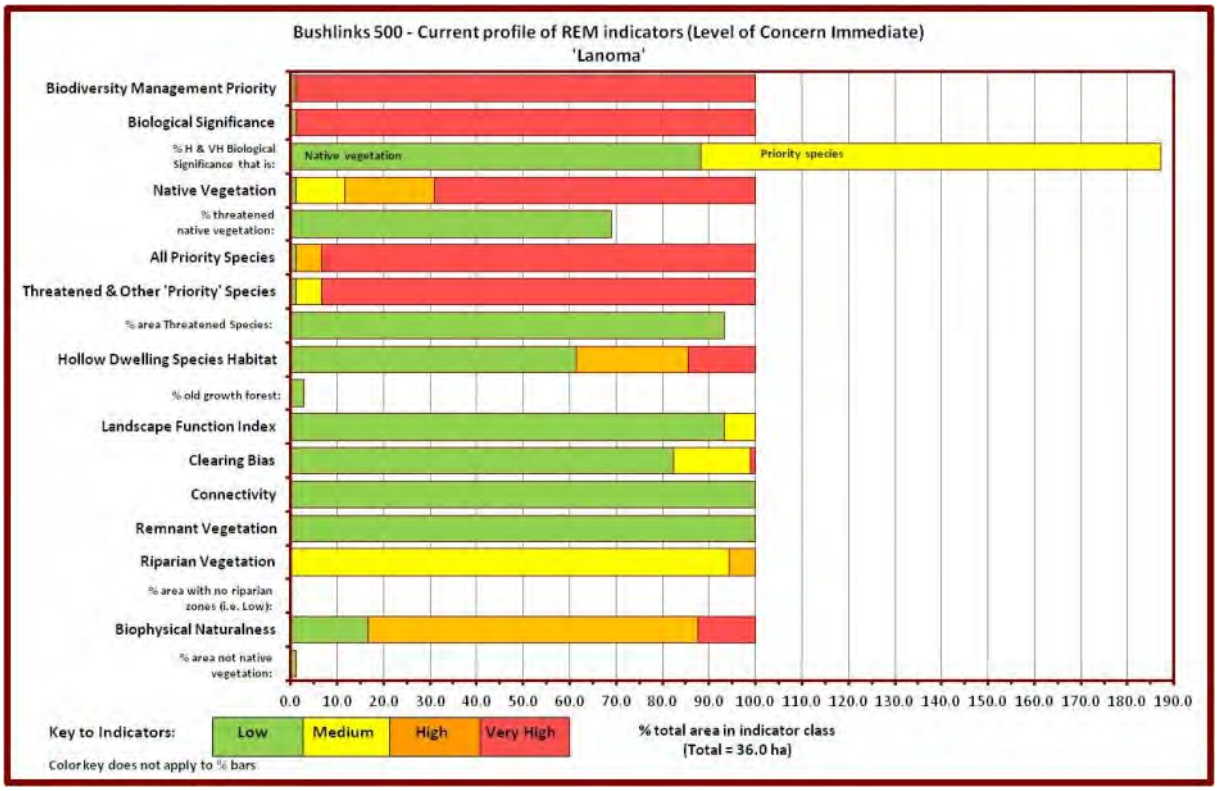
Summary of activity: Project activities on Lanoma primarily involved the fencing of and existing area of native riparian vegetation along the Tyenna River, and also an area of a threatened native vegetation extending further onto the property. The edge of the site adjoins one of the revegetation areas on the Back Run site.

Biological significance: The site is dominated by areas of Very High biological significance, associated with the co-occurrence of threatened species habitat with important native vegetation. Two threatened native vegetation communities occur on the site – *E. tenuiramis* forest on sediments (Vulnerable) and *E. ovata* forest. The site has suitable habitat for three listed threatened species – Masked Owl breeding habitat, Tasmanian Devil and Spotted-tailed Quoll. The latter two species have been recorded in the vicinity of the site. Suitable habitat for two non-listed priority species is also present – Eastern Quoll and Tasmania Bettong.

Species	EPBC / TSP act status	Notes
Masked Owl – breeding habitat	VU / e	
Eastern Quoll - habitat	- / -	Species recorded within 2.5 km. Not listed but extinct on mainland Australia.
Tasmanian Bettong – habitat	- / -	Species recorded within 2.5 km. Not listed but extinct on mainland Australia.
Spotted-tailed Quoll	VU / r	Species recorded within 2.5 km.
Tasmanian Devil – habitat	EN / e	Species recorded within 2.5 km and since 2005.

Landscape ecology: The site has relatively good landscape context. Consequently overall level of concern for landscape function, and for four of the five associated indicators, is relatively low. The main factor affecting landscape function is biophysical naturalness, with over 80% of the site being of High or Very High level of concern. This reflects most of the site having been subject to long term grazing with limited spelling. Further decline would be expected into the future if not managed.

Projected outcomes: The project activity secures the management of areas of important native vegetation and threatened species habitat. The likely direction over the medium term is improvement to the biophysical naturalness of the vegetation as a result of fencing and management of grazing.



Property: Leamington

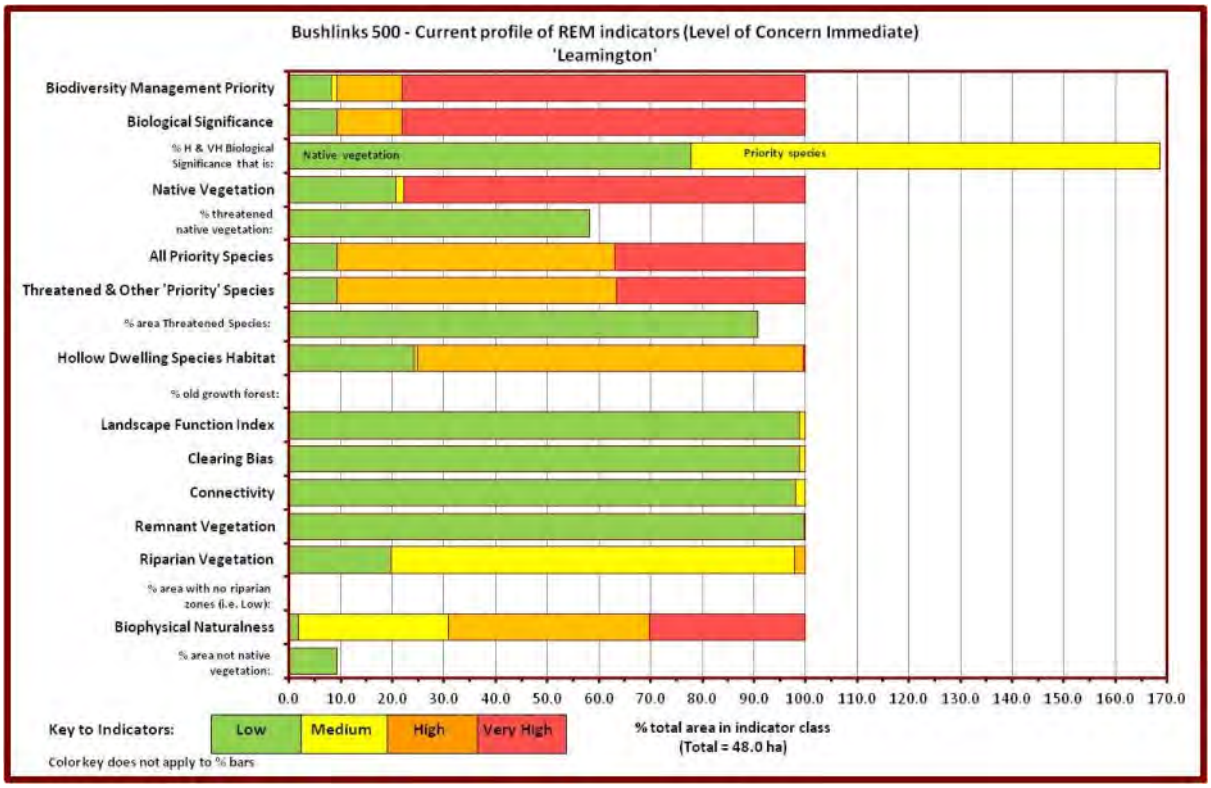
Summary of activity: The focus of activity at the site is protection of a relatively high diversity of native vegetation within a small area. Biodiversity outcomes are to be delivered primarily by fencing to facilitate management of grazing. Some of the area has been subject to intense management to control Gorse. The riparian zone connecting the main part of the site to native vegetation on an adjoining property has been planted with copses of trees and native plants to facilitate connectivity.

Biological significance: The site has a very high proportion of its area – over 90% - identified in the REM as of High or Very High level of concern, including a high co-occurrence of areas important for both native vegetation and priority species. Fifty eight percent of the site is occupied by a variety of listed threatened vegetation communities – *E. amygdalina* forest on sandstone (Vulnerable), *E. globulus* grassy forest (Vulnerable), *E. ovata* forest (Vulnerable) and lowland *Poa labillardieri* grassland (EPBC Critically Endangered). A further 20% of the native vegetation is two forest communities dominated by *E. dalrympleana* and/or *E. pauciflora*, which is identified in the REM as a High level of concern in the South East bioregion due to its limited extent and low levels of reservation. Habitat for three threatened fauna species occurs on the site. The Eastern Quoll has been recorded in the vicinity. The property also includes part of the zone of a known nest of the Wedge-tailed Eagle and is part of the core range of the Ptunarra Brown Butterfly. Habitat of hollow dwelling species is relatively limited, with 76% of the site as of High or Very High concern due to limited mature habitat on the site.

Landscape ecology: The site has relatively good landscape context by virtue of being located in an area of relatively high proportions of native vegetation. Level of concern for biophysical naturalness

at the site is high, with 69% in the High or Very High classes. This figure closely mirrors that for hollow dwelling species habitat and indicates reduction in condition has also strong affected this habitat element. About 79% of the site has a Medium level of concern for native riparian vegetation, indicating a relative absence of intact riparian zones.

Projected outcomes: Management actions at the site are heavily focused on securing its important native vegetation and species values, improving biophysical naturalness, including relatively intensive weed control (Gorse) in part of the area. Copses planted between the main area of the site will increase the proportion of native riparian vegetation in the affected river section catchments and also enhance the function connectivity of bush on the site with other nearby areas.



Property: Lemon Hill

Summary of activity: The Lemon Hill property included the full range of activity types undertaken during the project. Heavily cleared lowland land types were subject to revegetation, pasture/grassland management and copse establishment. Much of the rest of the property included restoration plantings to secure native vegetation with key characteristics in decline due to past management. Compensating for inevitable loss of older eucalypts and securing important vegetation and species areas were priorities on the property.

Biological significance: About 40% of the site is native vegetation with a Very High level of concern. Three listed threatened vegetation communities occupy around 18% of the site – *E. amygdalina* forest on sandstone (Vulnerable), *E. ovata* forest (Endangered) and lowland *Poa labillardierei* grassland (EPBC Critically Endangered). The balance of the Very High concern vegetation is forests dominated by *E. dalrympleana* and/or *E. pauciflora.* The site is extremely important for threatened species. Five species of threatened flora, two species of threatened fauna and one non-listed priority fauna species have either been recorded or have suitable habitat present. The site is also significant for the presence of old growth and mature eucalypt forests. These are relatively rare in this part of the Midlands and, as with elsewhere, are in decline on the property due to lack of recruitment over a long period – a factor most likely associated with a history of set stocking.

Species	EPBC / TSP act status	Notes
Austrostipa nodosa (knotty speargrass)	- / r	
Brachyscome rigidula (cutleaf daisy)	- / v	
Pterostylis ziegleri (grassland greenhood)	VU / v	
Scleranthus diander (tufted knawel)	- / v	
Vittadinia cuneata (fuzzy new holland daisy)	- / r	
Eastern Barred Bandicoot	VU / -	Species recorded within 2 km since 1980.
Eastern Quoll - habitat	- / -	Species observed on property.
Ptunarra Brown Butterfly	EN / v	Population known from property.

Landscape ecology: The site has a relatively high proportion of its area -~40% - identified as of High or Very High concern for landscape ecological function. All five factors contributing to the landscape function indicator are indicated in the High or Very High classes, ranging from 28% through to 97%. These indicate a comprehensive suite of actions is needed to secure ecological functional the site.

Projected outcomes: Project activities are targeted at the improving the landscape function indicators, however the focus for improvement varies across the property. Most of the site is a mixture of fencing and restoration planting and remnant protection. The restoration actions are designed particularly to help slow tree decline and provide more habitat in affected areas. They will not be able to prevent the effects of tree decline, which is a widespread regional problem with many likely impacts particularly on fauna habitat, but may help ameliorate overall impacts on biodiversity. Grazing management is to be used over much of the site to improve biophysical naturalness. Lowland areas targeted for revegetation and copses are designed to increase the amount and diversity of native habitat in otherwise heavily cleared types of land.

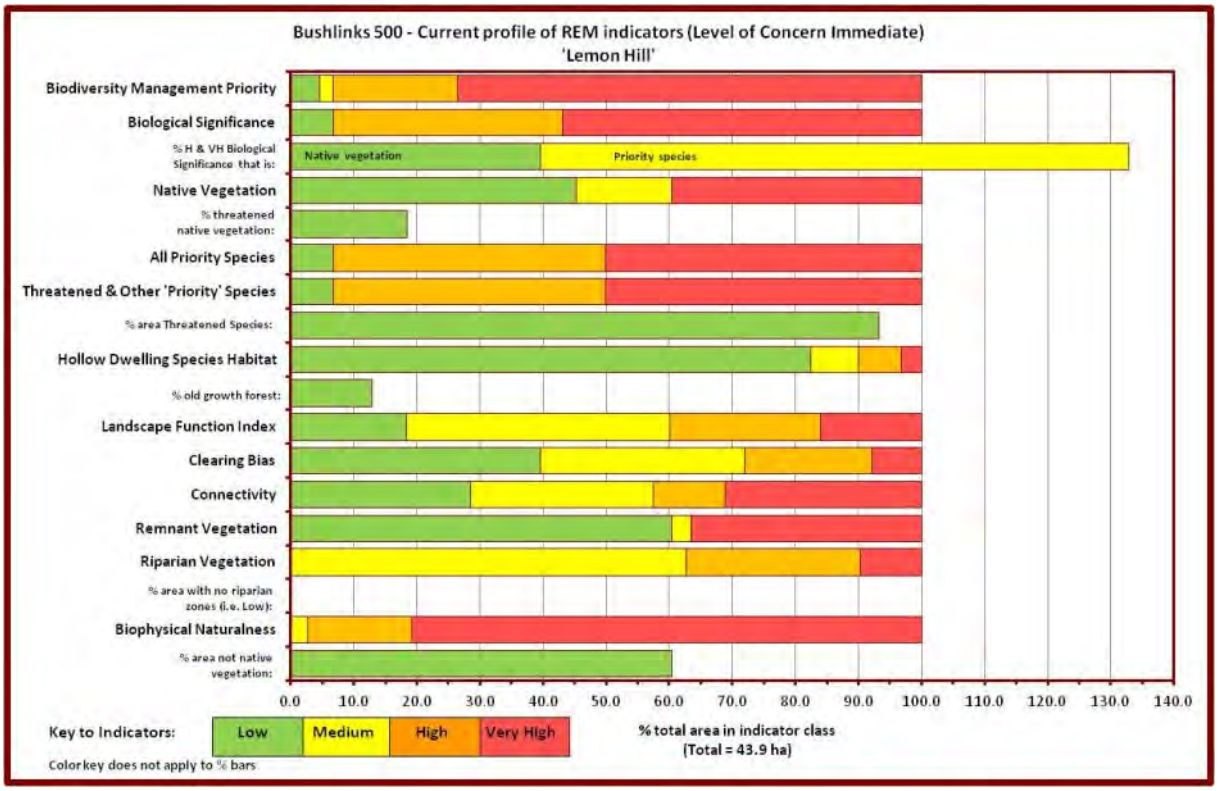


Figure 17: *Remnant woodland and copse planting on 'Lemon Hill'*

Property: Rockville

Summary of activity: The Rockville site was focused on protecting remnant vegetation on land that had otherwise been heavily cleared, and on addressing the associated landscape function. Activities included fencing to secure management of remnant bush, restoration and management of pasture/grassland to promote a perennial system, revegetation to connect remnants and fencing and planting of copses to restore degraded remnants.

Biological significance: 55% of the total area of the site is remnant native vegetation, and about half of this area is native vegetation of High or Very High level of concern. The bulk of the important vegetation is *E. pauciflora* forest on sediments. Although not a listed community, it has been cleared as much as some listed communities, shares other characteristics such as occurring predominantly on private with large areas in poor condition, and consequently has been treated the same as listed Vulnerable communities under the former Private Forest Reserves Program[4] and also the Forest Conservation Fund[5]. One threatened species has been recorded on or near the site.

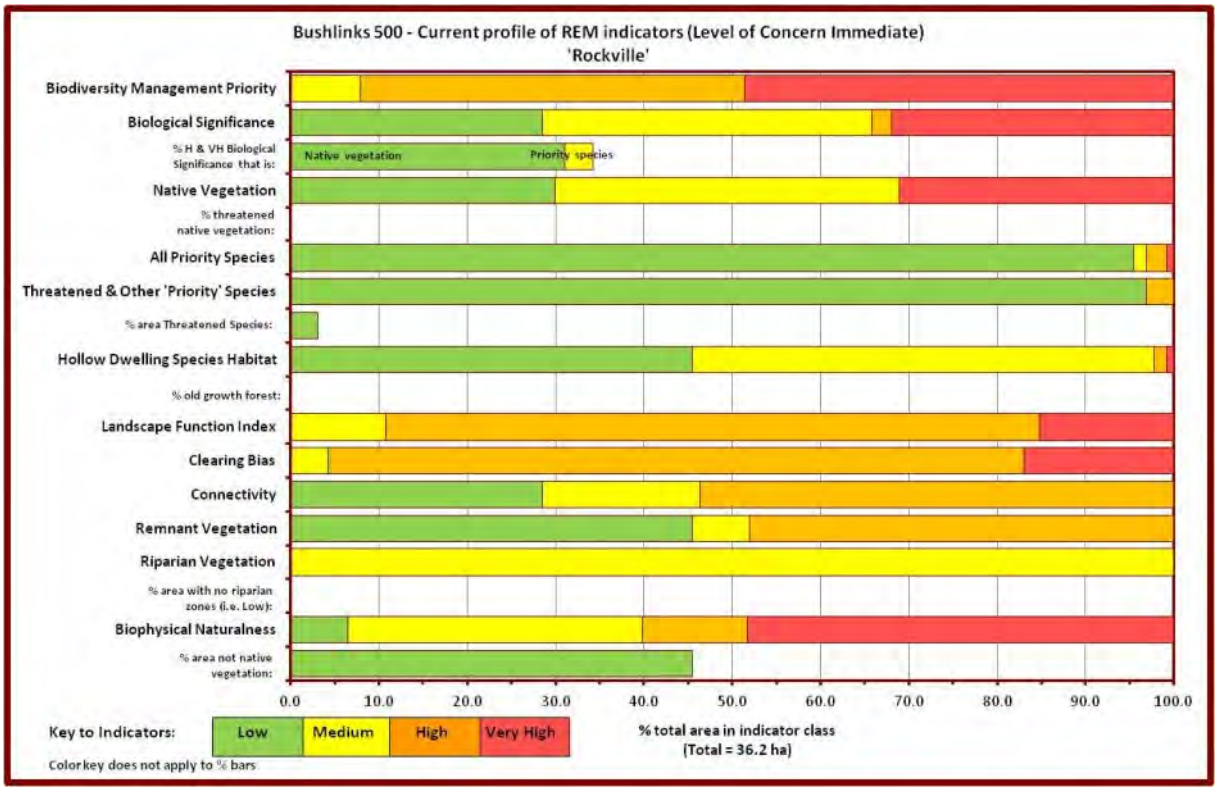
Species	EPBC / TSP act status	Notes
Austrostipa nodosa (knotty speargrass)	- / r	

Landscape ecology: The indicators of landscape ecological function for the site indicate the importance of management interventions. 89% of the site is of High or Very High concern overall for landscape function, which in part reflects that 96% of the area of the underlying land types have been cleared of more than 70% of the native vegetation. Four of the five indicators of landscape function have 48-96% of area in the High or Very High concern classes. Riparian vegetation has been significantly removed and now occupies less than 20% of the riparian zones of associated river section catchments.

Projected outcomes: Fencing to facilitate management of extant biodiversity values will likely lead to an increase in biophysical naturalness. Copses and fencing to restore degraded remnants has introduced a regenerating cohort and may also lead to further natural recruitment. Revegetation at the site has provided structural connectivity across a small but heavily cleared valley, providing a managed corridor 1.6 km in length.

[4] Comprehensive, Adequate & Representative Scientific Advisory Group (2004). Assessing reservation priorities for private forested land in Tasmania. Private Forest Reserves Program, Department of Primary Industries, Water & Environment, Hobart.

[5] Eigenraam, M., Barker, P., Brown, M., Knight, R. & Whitten, S. (2007). Forest Conservation Fund Conservation Value Index technical report. February 2007. Report of the Assessment Method Advisory Panel to the Department of Environment & Water Resources, Canberra. http://www.environment.gov.au/land/forestpolicy/fcf/pubs/fcf-cvi-technical-report.pdf



Property: Rodville

Summary of activity: The project work undertaken at Rodville consisted of fencing to protect an area of important native vegetation including a small part of a threatened species population.

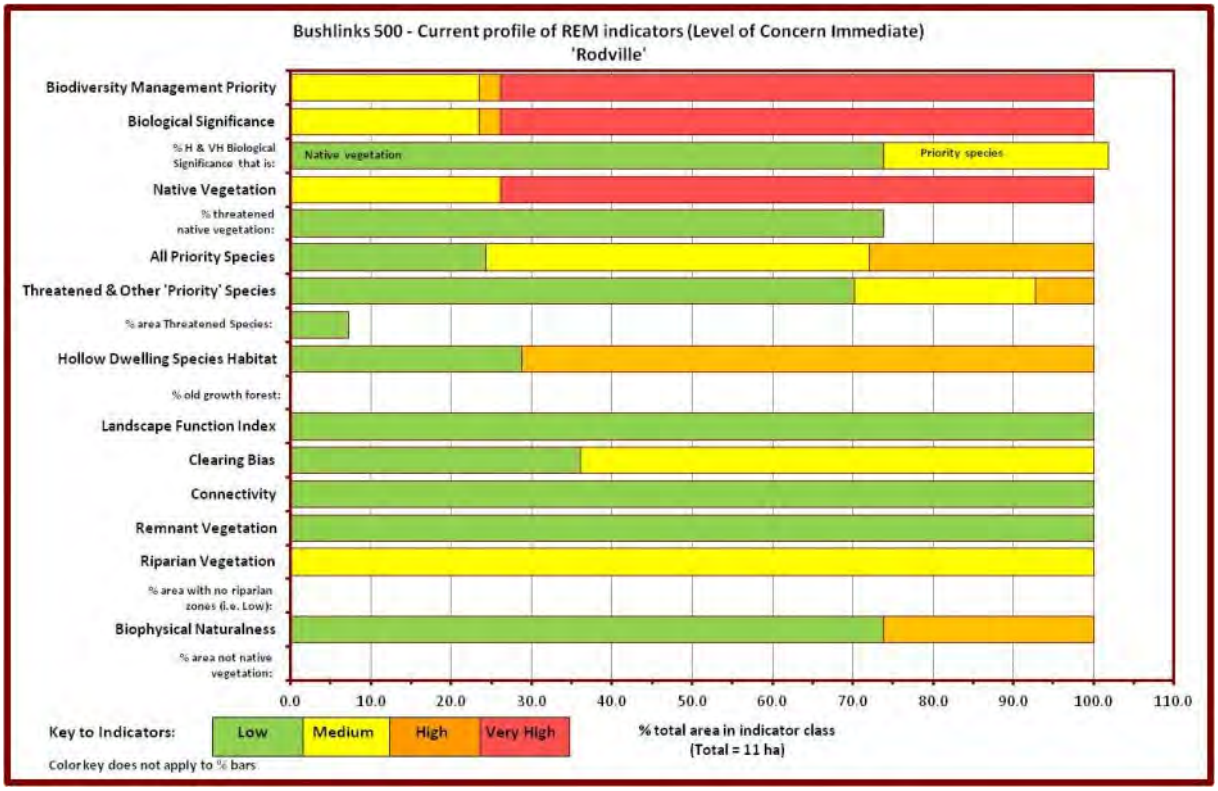
Biological significance: About 75% of the site area supports the threatened vegetation community *E. tenuiramis* on sediments (Vulnerable). The site also includes part of a larger population of the highly restricted threatened plant *E. perriniana.* Two non-listed priority flora species are also present. 72% of the site of High Concern for hollow dwelling species habitat, which has largely been removed from past agricultural and forestry operations.

Species	EPBC / TSP act status	Notes
Eucalyptus perriniana (spinning gum)	- / r	
Leptospermum nitidum (shiny teatree)	- / -	Non-threatened species with limited occurrence in conservation reserves in South East bioregion
Rytidosperma nitens (shiny wallaby grass)	- / -	Non-threatened species with limited occurrence in conservation reserves in South East bioregion

Landscape ecology: The site has good landscape context and is of little concern for overall landscape function.

Projected outcomes: Activity at the site will secure an important area of native vegetation with some values for priority species. Improvement to biophysical naturalness will be facilitated through

fencing and associated grazing management. A longer term outcome will be to provide for the recruitment of mature eucalypts as habitat for hollow dwelling species.



Property: Warringa

Summary of activity: The Warringa site incorporates a range of activities. Fencing and management has been undertaken to secure important remnant vegetation, including on land types that have been heavily cleared. Restoration of remnants in these areas providing connectivity and habitat on plains has been achieved by fencing and planting of copses. An extensive area of Gorse has been controlled. Revegetation has been undertaken to dovetail into existing plantings and a nature conservation covenant to provide a management corridor with high biodiversity values extending over 6 km.

Biological significance: 90% of the site if of High or Very High biological significance. The threatened vegetation communities *E. amygdalina* forest on sandstone (Vulnerable) and *E. ovata* forest (Endangered) occupy 46% of the site. Two threatened plant species have been recorded from the area. The site contains nest of the Endangered Wedge-tailed Eagle and there is also habitat for the Spotted-tailed Quoll and Tussock Skink. A non-threatened priority flora species is also present. The remnant forests have 35% of their area identified as of High or Very High for hollow dwelling species habitat. There are also important areas of mature eucalypts that the project has aimed to secure. The site is also of high importance as it is a relatively rare example of remnant vegetation on floodplains and low lying plains.

Species	EPBC / TSP act status	Notes
Austrostipa nodosa (knotty speargrass)	- / r	
Colobanthus curtisiae (grassland cupflower)	VU / r	
Exocarpos humifusus (mountain native-cherry)	- / -	Non-threatened species with limited occurrence in conservation reserves in the Northern Midlands bioregion
Spotted-tailed Quoll	VU / r	Species recorded within 2.5 km.
Tussock Skink – habitat	- / v	
Wedge-tailed Eagle – known nest zone	EN / e	

Landscape ecology: About 23% of the site is identified as of High or Very High concern for landscape ecological function. The underlying land components over 23% of the site have had more than 70% of their native vegetation cleared. Connectivity characteristics of site remnant are generally not of high concern, with most being located within 250 m of larger vegetation patches. However, the smaller size of the patches, low levels of riparian native vegetation (none more than 20% extant) and High or Very High level of concern for biophysical naturalness over 56% of the area indicate a need for intervention and management to secure ecological function.

Projected outcomes: The project contributes significantly to a continuous corridor of management native vegetation extending over 6 km. Remnants that have been fenced and interplanted with native species are expected to develop improved species and structural diversity. Relief from grazing pressure in these areas may also slow the loss of mature trees. Protected remnants are expected to gain improved biophysical naturalness over time. This has been accelerated in the part of the site that was subject to intensive Gorse control. Revegetated areas are expected to help improve landscape ecological function by providing stepping stones for species movements, including

providing structural connectivity between an existing covenanted area and other important floodplain vegetation.

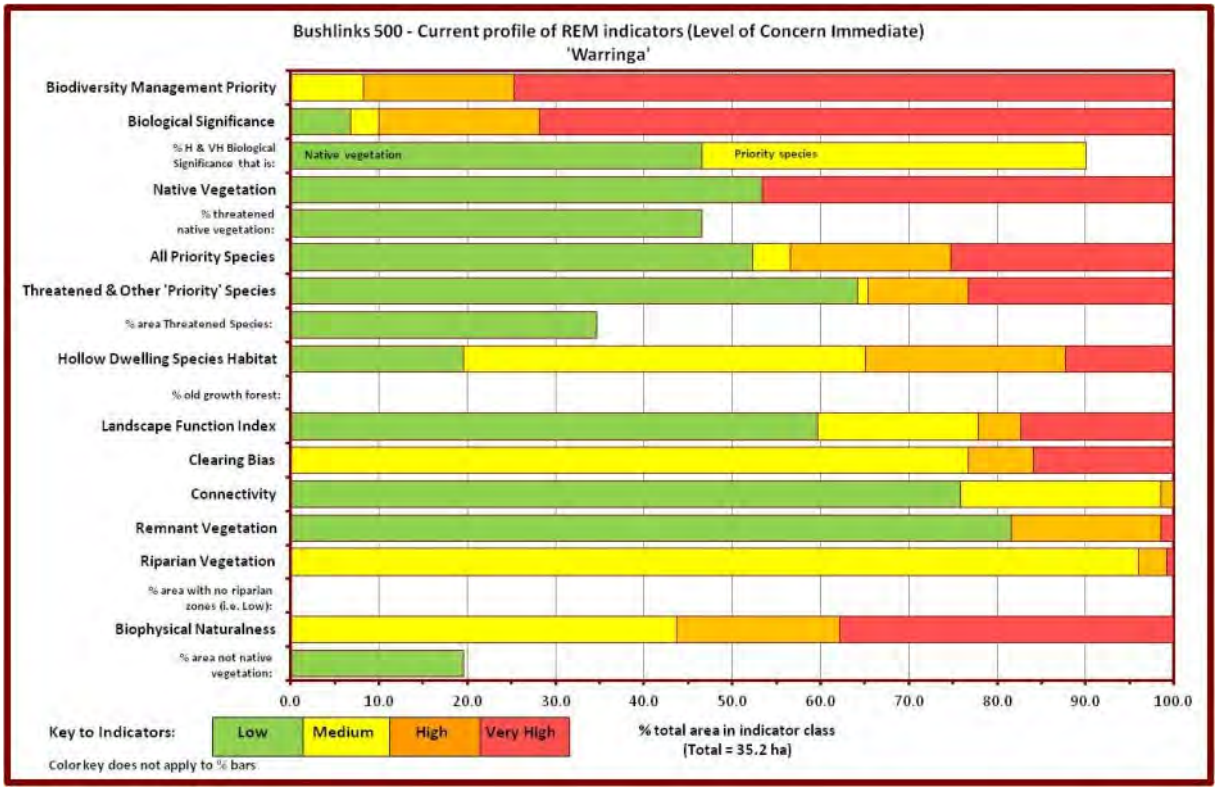


Figure 18: *Remnant* Eucalyptus viminalis *woodland on 'Warringa'*

4.0 Social & Economic Outcomes

Under the Project, economic activity was created in terms of employment and in the supply and/or production of materials – as summarised in Table 8.

Table 8: *Summary social and economic outcomes of the Project*

Employment

Project management	3 organisations (5 people)
Administration and auditing	2 organisations (3 people)
Weed management	2 local contractors (3 people)
Tree planting	4 local contractors (18 people, including 11 indigenous)
Fencing contractors	3 contractors (6 people)
Site preparation (spraying)	3 contractors (4 people)
Site preparation (mound ploughing)	3 contractors (4 people)

Materials

Fencing materials	2 local suppliers
Tree stakes	2 local sawmillers
Horticultural materials (tree guards, mulch mats etc.)	4 suppliers

Plants and seed

Native tree and shrub tube stock	5 local nurseries
Native perennial grass seed	1 supplier

Figure 19: *Fencing contractors at work at 'Connorville'*

Figure 20: *'Pakana Services' crew undertaking revegetation at 'Warringa'*

5.0 Project Evaluation

5.1 Project Effectiveness

In terms of environmental outcomes Bushlinks500 delivered what was intended and exceeded its target of 500 hectares of environmental rehabilitation and protection work by 57 hectares or 11% as described previously in Section 3.1. The overall cost effectiveness of the Project site works inclusive of all revegetation, rehabilitation and bushland protection activities was $1380 per hectare.

Early signs are that survival rates of seedlings established at revegetation sites is very high and that there has been a noticeable regeneration response at some of the bushland protection sites. A good current outcome against project targets and objectives suggests that the Project is likely to be effective against anticipated environmental outcomes, however, this may only be judged by monitoring over a longer timeframe.

The project achieved the desired objective of improving the ecological function at identified sites within the landscape (Section 3.2) by creating a mosaic of grassland and wooded areas between identified important remnants of vegetation hence providing the physical structures needed for habitat in woodland ecosystems.

Other outcomes contributing to overall Project effectiveness were:

- 166 ha of threatened vegetation in the South East and Northern Midlands bioregions was protected by the project under Management Agreements between landowners and NRM South.
- Five farmers not previously engaged in environmental conservation works became involved in environmental rehabilitation projects for the first time through Bushlinks500.
- Spin-off benefits from Project activities included a demonstrated willingness from Project participants to continue conservation works on their properties with their own resources. This may be viewed as an endorsement of, and confidence in, the approach and methodology used in the Project.

Challenges encountered during the project were met through changes to methodology and timetables to account for Project risks that materialised, e.g. dry seasonal conditions and low initial success rates in direct seeding (see Section 5.4.2). This adaptability in methodology meant that Project outcomes were met despite some anticipated Project risks materialising.

One Project outcome that was not as effective as anticipated was the facilitation of supply-chain arrangements and partnerships between farmers and the Understorey Network to ensure ongoing native grass seed supply for future landscape-scale biodiverse plantings. In relation to this objective, Project partners worked closely with one Landholder in the harvesting of native grass seed with the aim of on-sowing to provide a future commercial supply of seed. Problems encountered were:

- Very low seed yield during the trial due to an exceptionally dry season;
- Relative high cost of hiring and running the harvesting machinery;

- Issues in relation to seed 'cleanliness' i.e. difficult to isolate the target seed from non-target seed and contaminants such as thistle;
- Lower than anticipated willingness amongst farmers to utilise native perennial grasses sown on a broad scale in relation to the high cost of the seed; and
- There is current availability of native grass seed from up to 5 suppliers in Tasmania, i.e. there is already enough competition in this market.

In terms of re-introducing native perennial grasses into the landscape in a cost-effective manner - the lessons learned from this approach were:

- There is a high risk involved when native grass seed is utilised for broad-scale direct seeding as the seed is expensive to purchase, expensive to produce and there is a high risk of seasonal conditions leading to poor germination rates;
- It is more cost-effective to plant grass seedlings over small areas (i.e. the copse approach used in Bushlinks500) with the assumption that these seedlings will generate a localised input of seed into the environment with subsequent spread further afield.

It is possible that broad-scale direct seeding may be cost effective if provision is made to repeat sowing in subsequent seasons if initial sowing does not produce satisfactory results. However the risks in this approach would need to be subject to further investigation to compare with that of more intensive planting of seedlings.

5.2 Project Impact

Bushlinks500 has had the following impact:

- The Project has made a contribution to the broader effort to protect and enhance vegetation communities and linkages in the lowland grazing districts of Tasmania, much of which is encompassed by the Midlands Biodiversity Hotspot Area.
- The Project has used sophisticated modelling to determine and optimise the location of all site works so as to obtain the maximum benefit in terms of biodiversity and landscape elements.
- Data collected from field assessments for the project used methods designed to allow its seamless integration into existing Statewide spatial data layers (e.g. vegetation, structural composition, biophysical naturalness), thus making it available for future use such as in environmental accounts.
- The Project has successfully implemented a revegetation program that creates a mosaic of woodland and grassland elements linking identified important vegetation elements in the landscape. To date there has been a greater than 90% survival rate of trees and shrubs at revegetation sites, threats to biodiversity (such as gorse) have been managed at all sites, and regeneration is occurring at bushland protection sites.
- The Project provided a range of local employment opportunities and economic stimuli – refer to Table 8 (Section 4).

- Established well documented site histories that can be revisited over time to evaluate the effectiveness of different revegetation methods.
- The Project has involved and engaged landholders not previously involved in biodiversity conservation projects enabling site works for the first time on Leamington, Rodville, Fenton Forest, Lanoma Estate and The Back Run.
- The Project has generated an enthusiasm or catalyst for some of the landholders involved in Bushlinks500 to continue environmental works in their own capacity.

5.3 Project Efficiency

The Project was delivered in an efficient manner guided by a steering committee, with all project partners bringing complimentary skills and expertise to the Project, for example:

- Natural Resource Planning – expertise in modelling, site assessment, engagement, data collection and analysis, geographic information systems;
- Southern Midlands Council – local knowledge, access to and familiarity with a broad range of landholders in the Project area, experience in delivery of 'best practice' environmental rehabilitation work, geographic information systems, project management;
- NRM South – support, guidance, advice, networks, landholder liaison.

Delivery efficiency was enhanced through Project partners all having worked together on Project management and delivery prior to Bushlinks500.

Other Project efficiency measures were:

- The Project was delivered on budget whilst exceeding targets.
- The Project was delivered 5 months beyond the anticipated completion date, however this was viewed as necessary to account for unseasonally dry conditions at anticipated planting times and subsequent decisions made to delay some site works in order to maximise successful outcomes.

5.4 Project Methodology

The methodology used in the Project was appropriate and effective in a landscape that has low annual rainfall (<550 mm), seasonal variability from year to year, susceptibility to drought, and potential for severe frosts.

Site modelling with the Regional Ecosystem Model, in conjunction with local knowledge and networks, maximised efficiency in site selection and appropriateness for Project activities. This enabled optimal outcomes in terms creating vegetation linkages, enhancing biodiversity prospects, and improvement in landscape function.

'Best practice' methodology was utilised in the planning and implementation of site works – inclusive of selection of quality materials, use of experienced contractors and selection of site-appropriate species for revegetation. Timing of site-works was planned to be appropriate for each site and seasonal conditions. Also, follow-up work e.g. watering or additional weed management, was undertaken where necessary. Nonetheless, some challenges were met where the methodology and approach required adaptation, as discussed below.

5.4.1 Lessons Learned from the Project

Some lessons learned from the Project were:

- Careful site planning and a long lead-time into site works are of key importance in order to enable 'best practice' site preparation and to enable flexibility in light of seasonal conditions.
- Thorough site preparation is crucial to a successful revegetation practice i.e.: spraying-out twice prior to planting (inclusion of a pre-emergent herbicide produced the best results), and mound ploughing using equipment from Private Forests Tasmania specific to preparation for tree planting. On a site where a landholder was unwilling to spray, poor results were achieved due to annual grasses out-competing establishing seedlings.
- Use of experienced local nurseries, local provenance stock and 'frost hardening' of all plants is crucial to achieving high survival rates in seedlings.
- Use of qualified and experienced tree planting contractors is crucial in ensuring high survival rates in seedlings.
- Planting in winter has the advantage of low moisture stress for plants but this is more than offset by the damage done by frosting, cold soil and relative dormancy in the seedlings. Trees appear to be seriously impeded by harsh conditions during the first 2 months of establishment in this region.
- Later plantings (i.e. October and November) achieved a very high survival rate and significantly faster growth rate – however, the importance of watering for later plantings cannot be understated.
- Use of 'Planting gel' (combination of Seasol and water crystal) anecdotally has a very positive effect on plant health and growth rate and provides some level of 'dry proofing' during the establishment phase of the seedlings.
- Site appropriate fencing for exclusion of stock, native animals and fallow deer is crucial.

- Direct seeding of native grass seed (which is very expensive) is fraught with risk when seasonal conditions lead to very low germination.
- Establishment of native perennial grasses is best achieved through selective planting of seedlings in combination with initial 'site-spelling' and ongoing seasonal grazing management (rotational or cell grazing).
- Flexibility in approach is important. Rather than 'a one size fits all' approach - adopt a site-appropriate methodology in terms of plant selection, type of fencing required, watering requirements, and time of planting.
- Adapt based upon initial outcomes – watch and closely monitor the progress at each site such that methodology and approach may be adapted if necessary.

5.4.2 Risk Management

Two identified risks (6 and 7) in the Project Plan came into play (Table 9):

Table 9: *Extract from the Risk Management table from the Bushliks500 Project Plan*

Risk	*Identified Approach to manage risk*
6. Seasonal weather requires rethink of scheduled activities due to potential risk of sowing and planting failure.	Adverse weather conditions for revegetation works in the first planting season of the project can be managed by delaying of works into the second planting year. Adverse weather conditions in the second planting year would likely necessitate a renegotiation of the project timelines.
7. Seasonal conditions post sowing or planting (drought, extreme wind, flood, severe frost) lead to lower than expected germination of seed or survival of seedlings resulting in expectations or targets not being met.	• Detailed preparation work undertaken in regard to sowing technique in order to maximise success. • Use of reputable seed suppliers that guarantee viability (and cleanliness) of seed. • Use of Understorey Network in seedling establishment (core business in ensuring successful establishment of biodiverse plantings).

Management of 'Risk 6'

Under identified Risk 6 (Table 9), significantly drier than normal conditions during the Project's scheduled planting seasons lead to the rescheduling of planting at some sites. The anticipated measure was implemented i.e. a Project extension of 5 months was requested (and granted) to allow the risk to be managed.

Management of 'Risk 7'

In planting season 1 of the Project, an extended dry spell and cold conditions resulted in a very poor germination rate at the Project's initial direct-seeded grassland sites and a higher than expected loss of tree seedlings than anticipated. This risk was not managed as envisaged in the Project Plan, but

through a change in project methodology which was discussed by the Project Steering Committee and then implemented for the remainder of the project:

i. Direct seeding of native grass was changed to hand planting of grass seedlings and grazing management as discussed previously (see Section 5.1).
ii. Trees killed by frost in the winter of 2013 were replaced in the spring of 2013.
iii. All trees planted in season 2 were sourced from different nurseries than those for season 1 and were rigorously 'hardened-off' to build resilience against frosting damage.
iv. For all trees planted in season 2, planting methodology was adapted to maximise success with alternative contractors from season 1 being engaged to undertake the work.
v. For most sites planted in season 2, a later-season planting (September to November) was adopted as a contingency to avoid the dry winter of 2014 (and potential for frosting) and to advantage the actively growing seedlings with warmer spring conditions.

Additionally, an intensive post-planting watering schedule was implemented where necessary to maximise the likelihood of seedling survival in the first few months of their establishment. The high survival rate of trees and shrubs (as at January 2015 – Table 6) planted under the Project indicates that management of Risk 7 has been successful.

6.0 Conclusion

Bushlinks500 has been deemed a great success by the Project partners. In terms of environmental outcomes the Project delivered what was intended and exceeded its target of 500 hectares of environmental rehabilitation and protection work by 11%. Importantly, the project has enhanced the structural connectivity and provided for improvements to vegetation condition needed for habitat in woodland ecosystems by creating a mosaic of grassland and wooded areas between identified important remnants of vegetation.

The adaptive approach to the project methodology combined responsive risk management lead to a greater than 90% survival rate of trees and shrubs at revegetation sites, threats to biodiversity managed at all sites, and regeneration occurring at bushland protection sites.

The Project has made a valuable contribution to the broader effort to protect and enhance vegetation communities and linkages in the lowland grazing districts of Tasmania. The positive Project outcomes are an endorsement of one of the central components of the project design – the Regional Ecosystem Model. This sophisticated model developed by Project partner, Natural Resource Planning, optimised the location of all site works so as to obtain the maximum benefit in terms of biodiversity and landscape elements.

In addition to the positive environmental outcomes, the Project generated economic activity in terms of: employment (providing work for 43 people, 11 of which were indigenous); supply and/or production of materials (8 local suppliers for materials and 5 local nurseries); and engagement of farmers in site works across 11 properties.

The overall cost effectiveness of the Project site works inclusive of all revegetation, rehabilitation and bushland protection activities was $1380 per hectare.

The experience and knowledge gained through the delivery of Bushlinks500 will be transferable to future projects in the region and will assist in the continual learning that is required to deliver environmental outcomes in an efficient, effective and low-risk manner.

The Project partners acknowledge the vision and generous support of the Australian Government in funding Bushlinks500.

Attachment 1:

Summary of the Regional Ecosystem Model

The Regional Ecosystem Model (REM) is a comprehensive system for:

- Integrating spatial data on the distribution of the major components of biodiversity, and the factors affecting them;
- Analysing relationships among the components of biodiversity and the environment; and
- Spatially identifying areas which have immediate or potential conservation concerns, and providing indicators of their relative importance, to inform approaches and priorities for management.

The REM was developed by Natural Resource Planning Pty Ltd using funds from the Australian Government's Caring for Our Country program. The following briefly summarises the REM, which is described in more detail in Knight and Cullen 2009[6], 2010[7].

The REM is based on a comprehensive 'Strategy Review' of both the strategic framework for biodiversity management in Tasmania and of the major themes in the relevant scientific literature. The Strategy Review identifies 'Issues' which the strategic framework identifies as part of the scope of biodiversity management. Issues are in turn organised into 'Assets' and more broadly into 'Asset Classes'. Figure 1 shows the conceptual structure of the classification. Figure 2 shows the Issues which were identified in the Strategy Review.

Issues in the Strategy Review were examined against a range of criteria to determine their suitability for incorporation into the REM. Criteria for the assessment included:

- The ability of each Issue to be stored spatially and analysed in a GIS;
- Whether Issues were confounded, i.e. in combining multiple Issues into one and thus compromising objective assessment of more fundamental Issues; and
- Whether Issues were logically consistent and supported scientific opinion.

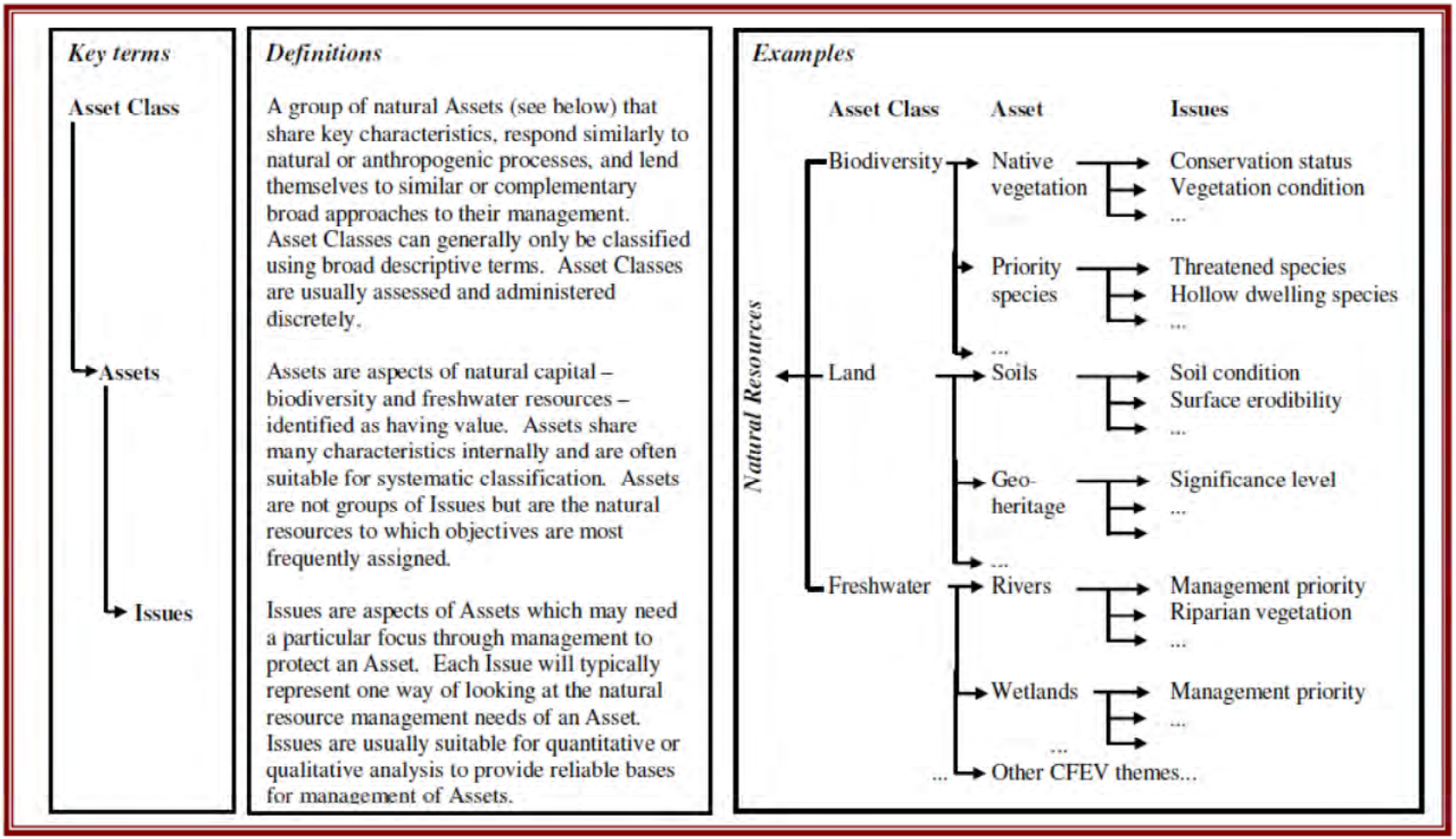
Issues identified as appropriate for inclusion in the REM were examined to identify:

- Indicators which represent critical ways of viewing each Issue;
- Classes within each Issue that indicate relevant ranges of variation and suitable thresholds for categories; and
- A 'Level of Concern' to be assigned to each class to be used as a guide in determining management priorities.

[6] Knight, R.I. & Cullen, P.J. (2009). A review of strategies for planning & management of the natural resources of biodiversity, freshwater, land & soils in the Tasmanian midlands. A report of the Caring for Our Country project 'Using landscape ecology to prioritise property management actions in Tasmania'. Natural Resource Planning, Hobart, Tasmania.

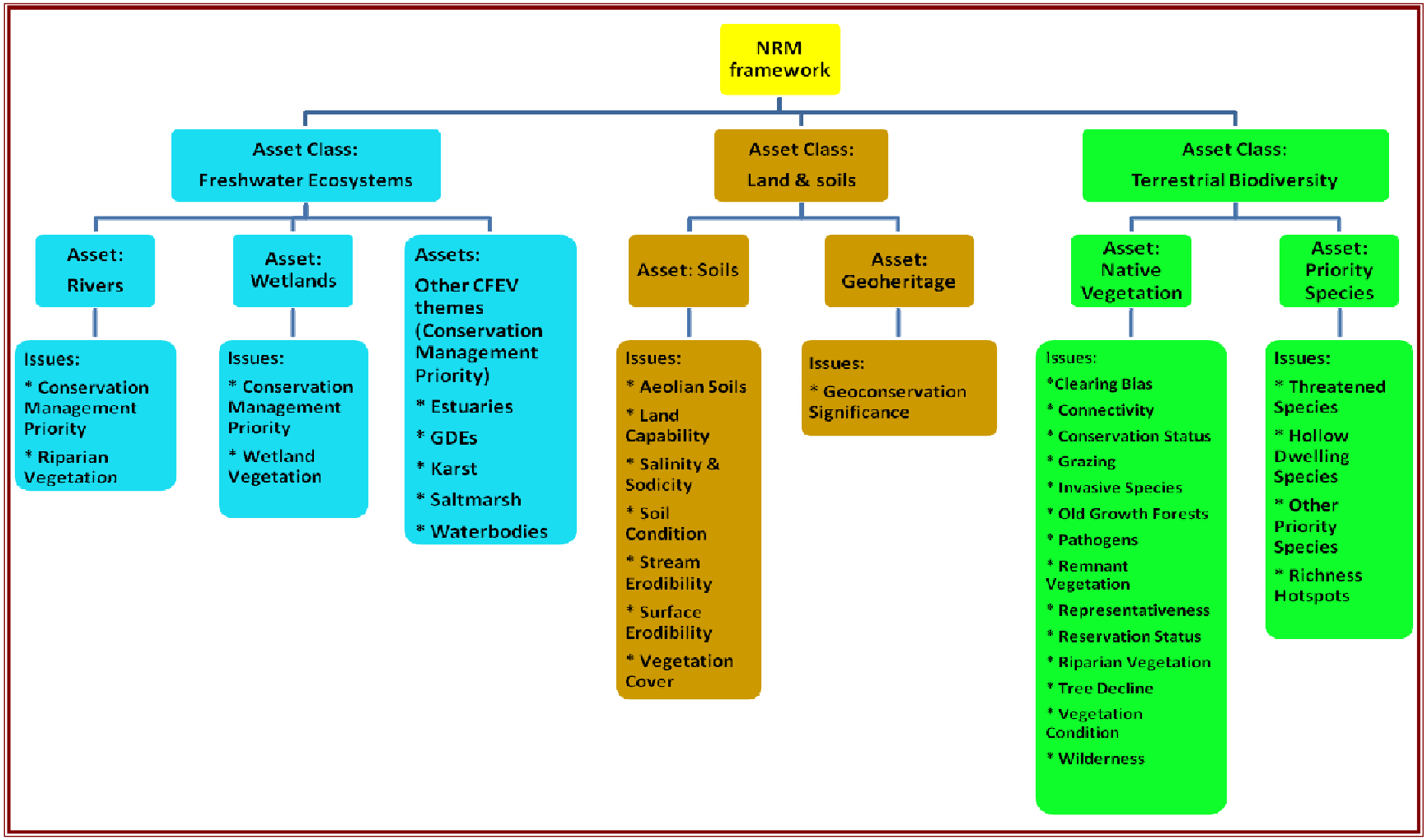
[7] Knight, R.I. & Cullen, P.J. (2010). Specifications for a Regional Ecosystem Model of natural resources in the Tasmanian Midlands. A report of the Caring for Our Country Project 'Using landscape ecology to prioritise property management actions in Tasmania'. Natural Resource Planning, Hobart, Tasmania.

Figure 1. Conceptual structure and key definitions used in the Regional Ecosystem Model[8]



[8] Source: Knight, R.I. & Cullen, P.J. (2009). *op. cit.* p7.

Figure 2. Classification of NRM Asset Classes, Asset and Issues from the Strategy Review



Note: Not all Issues identified in the Strategy Review are included in the REM. See REM specifications for details.

Where possible, classes in each Issue were chosen to reflect thresholds which have been applied elsewhere or identified in the scientific literature. An example of classes within an Issue is shown below.

Example classification: Remnant vegetation (patch size)

Native vegetation patch size (ha)	Concern – Immediate	Concern – Potential
<2ha	M	L
2-20ha	VH	VH
20-200ha	H	VH
>200ha	L	M

The ranges of patch size classes within the indicator reflect first the range of 2-200ha for remnants nominated by Kirkpatrick *et al.* (2007), with patches >2ha generally retaining much higher conservation values than smaller patches. Remnant <2ha are considered to be of little importance to landscape function, while those >200ha are subject to the processes which affect remnants at a significantly diminished intensity and effect. The split in the middle size class in the indicator is based on the RFA assessment of remnant vegetation, which considered patches <20ha, though potentially locally important, as below the threshold for importance in maintaining existing processes or natural systems at the regional scale (Tasmanian Public Land Use Commission 1997).

'Level of Concern' is considered to vary according to the management context and is defined in two ways:

- Immediate – an estimate of the relative priority for immediate management action to address current risk to the natural resource; and
- Potential – an estimate of the relative priority to protect and manage the natural resource from risks which may arise in the future.

The two types of Level of Concern are designed to be consistent with the definitions of Conservation Management Priority in the Conservation of Freshwater Ecosystems Values project (DPIWE 2008[9]), which also uses Immediate and Potential.

Use of Immediate Level of Concern is generally most appropriate where past management may have created a need to improve the condition of an Issue, or where there is continuing landuse which may place the resource at risk if not managed appropriately. For example, native vegetation whose condition has been degraded may need to be improved to help address biodiversity conservation needs.

[9] Department of Primary Industries & Water (2008). Conservation of Freshwater Ecosystems Values (CFEV) project technical report. CFEV program, Department of Primary Industries & Water, Hobart.

Potential Level of Concern is generally appropriate in circumstances where a change in management could reduce the condition of an Issue. An example for native vegetation might be an area where its condition is considered important to maintain to address biodiversity needs, or whose loss would compromise those needs.

Not all Issues have Level of Concern which diverges according to whether they are Immediate or Potential. Threatened species, for example, have statutory recognition that they are likely to become extinct. Thus both Immediate and Potential Level of Concern are considered identical, as the species status applies to the entire taxon. However, for any given species the management response at a given site may be different to that elsewhere.

These considerations point to an important aspect of use of the Level of Concern system:

Level of Concern is an indicator for the relative priority of an Issue to be considered in management, but does not direct what an appropriate management response might be.

Each Issue in the REM has Level of Concern classes assigned in a classification matrix (see remnant vegetation example above). Each matrix is designed to transparently illustrate how the Issue is treated in the REM, to assist interpretation, and to provide a simple method by which the REM parameters can be altered if required (e.g. where new research indicates thresholds in a matrix may need alteration).

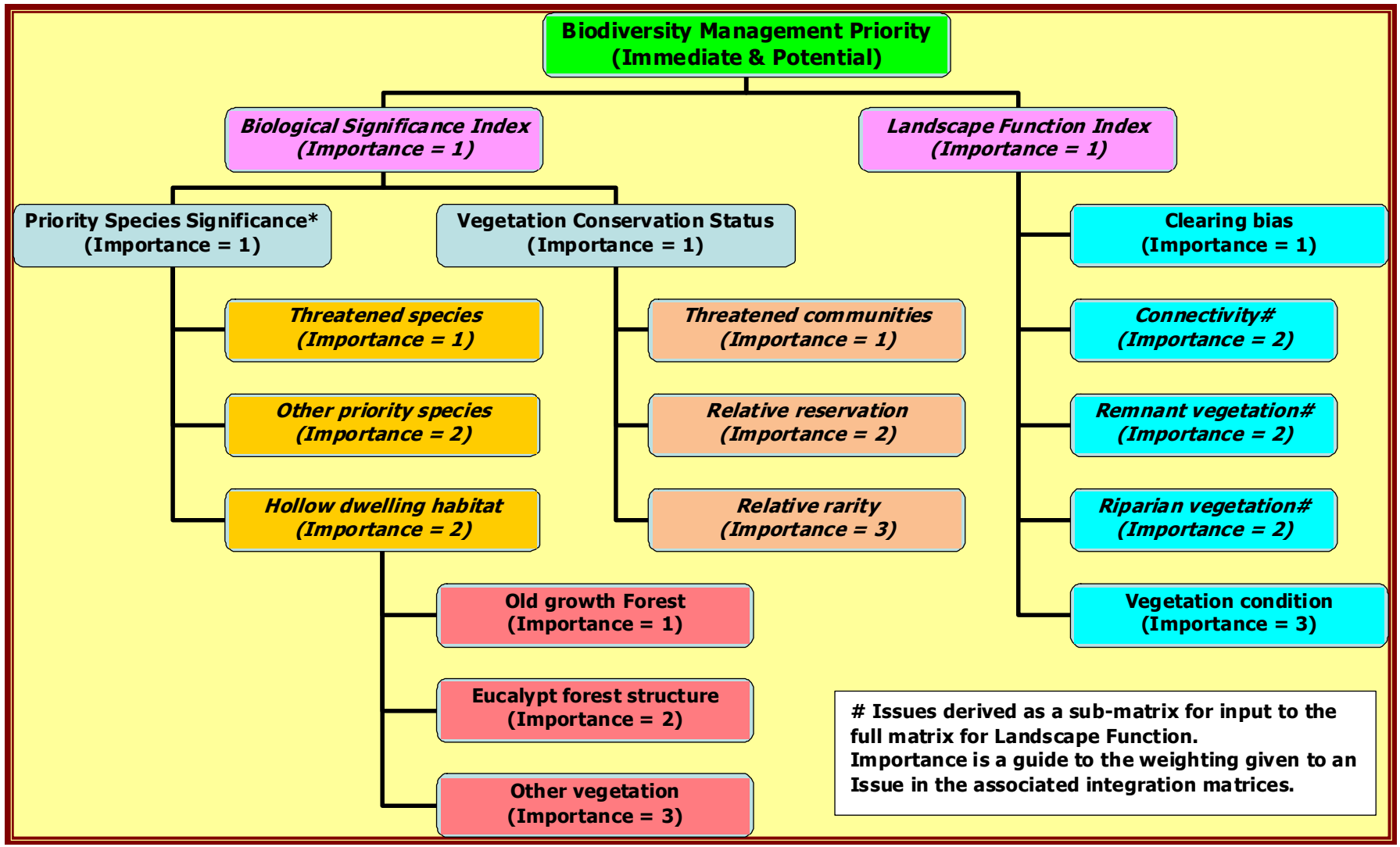
The REM separately assesses each Issue within the Biodiversity Asset Class, but also aims to place them in an overarching ecological context based on the relationships to other Issues. This is achieved through hierarchically integrating each Issue matrix with those for other Issues to form successively higher groups within the REM, such than an overall indicator of Biodiversity Management Priority can be generated. Figure 3 shows how each Issue is integrated to form the full REM. Table 1 (at end) summaries the terms used in the REM. Figure 4 (at end) provides a full illustration of the prioritisation process and relationships in the REM.

The highest level in the REM classification is Biodiversity Management Priority. It is derived through integrating the prioritisation matrices of two contributing themes in biodiversity conservation:

- Biological Significance - the relative importance of the elements of biodiversity and hence their priority to be protected through appropriate management regimes; and
- Landscape Ecological Function - an assessment at multiple scales of the characteristics of the landscape and its ability to maintain the elements of biodiversity it contains.

The matrix which integrates Biological Significance and Landscape Ecological Function is shown below. An important feature of the matrix structure is that it does not dilute a high level of concern for one if the other is low. This approach addresses a known limitation that arises when using additive or averaging indices for conservation purposes and has the further advantage of being simple and transparent.

Figure 3. Assets and Issues in the Biodiversity Asset Class



Integration matrix for Biodiversity Management Priority

	Landscape Function Index			
Biological Significance Index	**VH**	**H**	**M**	**L**
VH	VH	VH	VH	VH
H	VH	VH	H	H
M	VH	H	M	M
L	VH	H	M	L

Similar forms of integration matrices are used at each level of the REM, with some variation according to the issues being addressed and the relative importance of each Issue to the overall index being derived.

Within the Biological Significance component of the REM are two Assets (see Figure 1 for definition) towards which management goals are likely to be directed:

- Native vegetation - composed of vegetation communities with Level of Concern a function of each community's conservation status, bioregional extent and percentage level of reservation; and
- Priority species - the subset of species and species groups identified as requiring consideration in management as a result of them being listed as threatened, otherwise identified as priorities (e.g. Regional Forest Agreement priorities, poorly reserved flora species), or as the habitat for the group of 29 species identified in Tasmania as hollow dwelling (Koch et al. 2009[10]).

The Landscape Ecological Function component of the REM is designed to account for the factors that can affect biodiversity through the presence/absence of critical characteristics of the environment at multiple scales. The REM addresses Landscape Ecological Function by considering Issues at three scales:

- Broad scale habitat loss is a major threat to biodiversity and cause of biodiversity decline, which can continue after habitat loss has ceased due to ecological inertia associated with extinction debt. Habitat loss is characterised by patterns in the types of land from which habitat has been removed. The Issue of Clearing Bias measures these patterns at the landscape scale by assessing the percentage of each land component (land facet is also sometimes used) within Tasmania land systems that exist as native and cleared vegetation. More heavily cleared land components have higher Clearing Bias.
- Medium scale landscape patterns are addressed through the examination of the configuration of three landscape variables. Connectivity characteristics of the

[10] Koch, A.J., Munks, S.A. & Woehler, E.J. (2009). Hollow-using vertebrate fauna of Tasmania: distribution, hollow requirements & conservation status. Australian Journal of Zoology, 56(5):323-349.

landscape are assessed by measuring the relative of isolation of remnants and the permeability of cleared land to species movements. The size of patches of native vegetation is assessed against thresholds for identifying Remnant Vegetation. The proportion of native Riparian Vegetation within each river section catchment provides an indicator of the health of the aquatic environment within each catchment, and its distal effects on biodiversity.

- Local scale landscape processes are assessed through assessing vegetation condition, which is expressed in the REM as Biophysical Naturalness. This assesses the characteristics of native vegetation for perturbation in structure and composition within each patch of native vegetation.

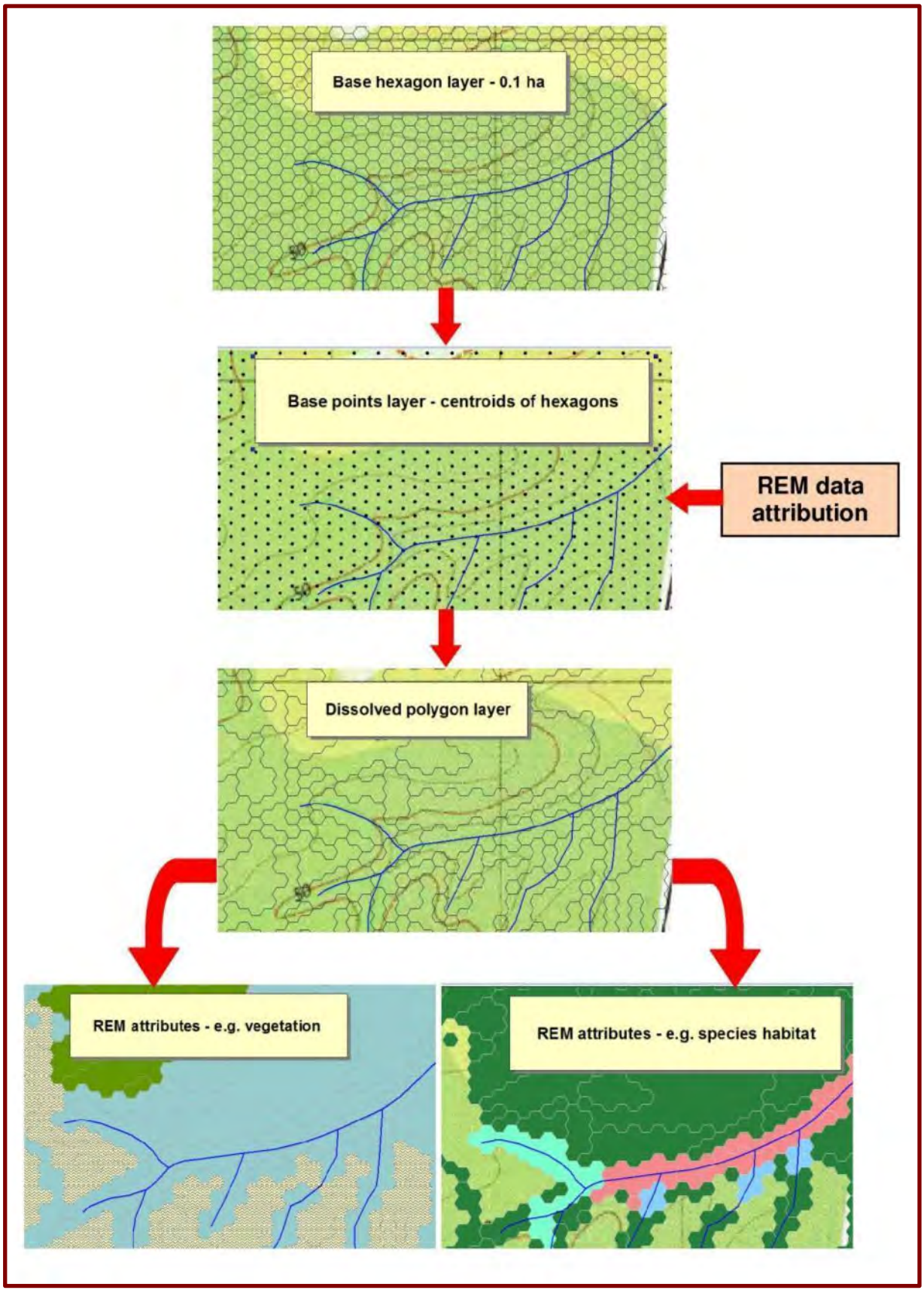
Each element of the REM is underpinned by Statewide spatial data layers. Each data layer has clear rule sets for its use in building the REM. The integrated REM spatial layers contain all the input data from the base layers, including multiple inputs for the same Issue where available (e.g. desktop and field vegetation mapping), and all the derived Level of Concern indicators.

The REM is built on a novel spatial architecture designed to store and process large amounts of spatial data efficiently and at fine scales. It is based on a non-overlapping layer of hexagonal polygons of 0.1 ha size, which approximates to a spacing of about 30 m. The centroids of the polygons are extracted and are used to process the REM and its data. The point format significantly reduces complexity of the spatial geometry and hence increases processing speed. The REM generated in the points layer is then re-attributed to the parent hexagons. A subset of the primary inputs to the REM is then concatenated to a single string, and the resulting layer dissolved on the attribute. Derived attributes are then re-attached to the data and the polygon layer used for multiple purposes. Figure 5 summarises the REM architecture.

The core components of the REM described above are common to all applications. A spreadsheet version of the REM is also available[11] which can be used in the absence of spatial data to generate the full range of REM indicators. This can be used, for example, to determine REM indicators where the input data is wrong or to model the changes in indicators resulting from management actions . A standard output is also a summary REM profile, which display all the indicators as a percentage of the area of interest. Figures 6 and 7 (at end) provide a sample profile. The also serve as a useful tool for modelling change, whether planned or actual, arising from conservation investments and from development.

[11] http://www.naturalresourceplanning.com.au/landscape-ecology-tools/

Figure 5. Simplified REM spatial architecture and process



The REM can further customised for each project and users to deliver outputs and tools that assist meeting their specific needs. Customised add-ons that have been developed include tools to cross tabulate priority species with vegetation types, generate REM summary tables of the characteristics of multiple areas, and additional layers to assist in use of the REM. For example, a urban threat index spatial layer has been developed to assist in local government application, and for property planning the REM can be linked to data on issues such as salinity and erosion risk.

Use of the REM is licensed by NRP to clients for approved purposes, in accordance with the commercialisation provisions of the Australian Government's funding for its development. NRP wishes to establish ongoing partnerships with a wide range of potential users of the REM. Use by both commercial and non-profit organisations is encouraged.

Clients who have used the REM or its components since completion of the original project include:

- Australian Government Biodiversity Fund;
- Clarence Council;
- Forestry Tasmania;
- Gunns Limited;
- Kingborough Council;
- NRM South;
- Norske-Skog;
- PF Olsen Pty Ltd;
- Southern Midlands Council and
- The Understorey Network.

Table 1. Summary of REM assets, indicators and issues

Issue	Definition	Summary	Indicator
Biological Significance	Biological significance measures the relative priority for management of the elements of biodiversity contained within a given area.	Biological significance is one of two arms of the REM and represents a structured classification of biodiversity. It is comprise of Native Vegetation and priority species (see below).	Classes ranked from Low-Very high derived from a matrix of Level of Concern classes for Native Vegetation and Priority Species.
Native Vegetation	Native vegetation communities based on the classification used in Tasveg.	Native vegetation comprises all areas mapped to the Tasveg classification, except for cleared land types ("F" codes), water, (OAQ"), sand and mud (OSM) and rock (ORO). An additional native vegetation mapping unit has been introduced to the REM for areas comprised of native vegetation plantings (DEP).	The REM contains a grouped classification for native vegetation which is used in various parts of its application.
Vegetation conservation status	Native vegetation communities with legislative recognition of being threatened.	na	Vegetation communities listed as threatened under the Tasmanian Nature Conservation Act 2002 or Commonwealth Environment Protection and Biodiversity Conservation Act 1999.
Relative reservation	Reservation status is a measure of the degree to which vegetation communities are included in the Comprehensive, Adequate and Representative (CAR) reserve system	Higher levels of reservation give greater confidence that the species for which vegetation communities are surrogates are likely to be protected, subject to appropriate geographic and biophysical distribution in the landscape.	Percentage bands of reservation of the vegetation communities, utilising the lesser of the Statewide or relevant bioregional reservation level.
Relative rarity	The extent of a native vegetation community in the bioregion being assessed.	Relative rarity is scale to reflect increased importance for vegetation types which are more restricted, and less importance for those which are relatively extensive.	The REM stratifies the extent of each community in each bioregion into bands, which are then form part of the matrix for deriving Level of Concern for native vegetation.
Priority species	Priority species are those that are recognised as threatened and certain classes of other species that are identified as priorities for conservation.	Classification within the group is structured around species listed as threatened and other priority species.	Level of Concern for priority species is classified from Low-Very High through a matrix combining threatened species status, number of threatened species, other priority species and hollow dwelling species habitat.

Issue	Definition	Summary	Indicator
Listed threatened species	Species listed as threatened under the Tasmanian Threatened Species Protection Act (1975) or Commonwealth Environment Protection and Biodiversity Conservation Act (1999)	na	Threat status and number of co-occurring threatened species in an area.
Other priority species	Non-threatened species identified as priorities for attention to conservation and management.	Other priority species comprises non-threatened species identified in the Regional Forest Agreement as Priority Species, including species groups such as hollow dwelling species, and flora species identified as inadequately reserved at the State or bioregional level.	The presence of other priority species (excluding hollow dwelling species habitat) is assigned a single ranking the REM (Medium), above that for no priority species and below that for threatened species.
Hollow dwelling species	Habitat for hollow dwelling species.	Hollow dwelling species comprise a group of 29 species listed in the Regional Forest Agreement as a priority species group.	Hollow dwelling species habitat is classed from Low-Very High depending on the type of vegetation present, eucalypt forest structure, predicted hollow abundance and presence/absence of old growth forest.
Old growth forest	Old growth forest is ecologically mature forest demonstrating the characteristics found in older and/or minimally disturbed forests	na	Old growth forest is classed as Very High Level of Concern (Potential) and as low Level of Concern (Immediate) in the Hollow Dwelling Species component of the REM.
Eucalypt forest structure	Forest structure classes derived from air-photo interpreted vegetation mapping.	Eucalypt forest structure is derived from the published RFA map depicting standard classes as Silviculturally Regeneration, Regrowth, Predominantly Regrowth/Some Mature, Predominantly Mature/Some Regrowth and Mature. This is supplemented with more up to date data where available.	Classes ranked from Low-Very High reflecting higher Immediate Level of Concern where structure is likely to contain fewer hollows and higher Potential Level of Concern where hollows are likely to be more abundant.
Non-eucalypt vegetation.	Vegetation communities in the Tasveg classification that are not recognised as eucalypt forest.	Eucalypt forest classes are identified in Tasveg by the prefixes “W” and “D”.	Non-eucalypt vegetation is ranked Low in the schema for hollow dwelling species habitat due to the absence of eucalypts.
Landscape Function	The ability of the landscape to sustain the elements of biodiversity it contains.	Landscape function integrates five indicators representing successively finer partitioning of the landscape.	Classes ranked from Low-Very High using a 3 way matrix combining the same classes of Clearing Bias, a submatrix combining Connectivity, Remnant Vegetation and Riparian Vegetation, and Biophysical Naturalness.

Issue	Definition	Summary	Indicator
Clearing bias	Clearing bias is a measure of the patterns of habitat loss in a region.	There is potential for ecological collapse at a regional level where >70% of a region has been cleared, and potential localised collapse and stress within the region where lower levels of clearing have occurred due to preferential clearing of certain land types.	The percentage of each land component that has been cleared, stratified spatially into areas now cleared or with extant native vegetation.
Connectivity	Connectivity is the degree to which patches of native vegetation are inter-connected and the extent to which species can move between patches,	Remnant vegetation may suffer loss of species in some taxonomic groups, and loss of ecosystem function, if the distance between remnants and the impermeability of the interstice (e.g. through absence of paddock trees) exceeds that which each organism is capable of crossing.	For remnant vegetation patches, the distance to the nearest non-remnant patch. For cleared land, the distance to the nearest patch of native vegetation.
Remnant vegetation	Remnant vegetation is defined as islands of native vegetation, below a specified size, that are surrounded by cleared land.	In heavily cleared landscapes, patches of remnant vegetation can contribute significantly to the maintenance of ecosystem function, while their loss and decline is a major factor in ecosystem collapse. Their smaller size makes them vulnerable to ongoing degradation through various combinations of anthropogenic and natural ecological processes	The indicator for remnant vegetation is the contiguous extent of each patch of native vegetation communities, stratified into size classes.
Riparian vegetation	Riparian vegetation is the vegetation that adjoins freshwater features (e.g. rivers wetlands) and has ecological characteristics which are influenced by the freshwater environment.	Riparian vegetation has been found to have consistently high biodiversity values relative to its extent and therefore contribute disproportionately to landscape function. Its values are also multi-faceted, providing protection for terrestrial biodiversity, land and soils resources, and freshwater ecosystems, and multi-scale in extending beyond the immediate riparian zone.	The percentage of the local catchment of each of river section and wetland which is under native riparian vegetation, stratified into bands as described for the CFEV project. The indicator applies equally to both the cleared and native vegetation components of the catchment.
Vegetation condition	Vegetation condition is the composition and structure of native vegetation relative to a reference framework for the particular type of vegetation.	Vegetation condition is an indicator of the ability of native vegetation at the local physical and near-temporal scale to maintain and sustain the elements of biodiversity it contains.	Modified biophysical naturalness classes derived from RFA mapping and application of logical consistency rules to Tasveg community attributions and limited condition descriptors.

Figure 4. Tasmanian Regional Ecosystem Model - Indicators, Content & Prioritisation Matrices

Native Vegetation Index	Priority Species Index VH	H	M	L
VH	VH	VH	VH	VH
H	VH	VH	H	H
M	VH	H	M	M
L	VH	H	M	L

Biological Significance Index	Landscape Function Index VH	H	M	L
VH	VH	VH	VH	VH
H	VH	VH	H	H
M	VH	H	M	M
L	VH	H	M	L

Threatened & Other Priority Species		Hollow Dwelling Species Habitat VH	H	M	L
Two or more listed species	**VH**	VH	VH	VH	VH
Endangered, Critically Endangered	**VH**	VH	VH	VH	VH
Vulnerable, Rare	**H**	VH	H	H	H
Other Priority Species	**M**	H	H	M	M
None	**L**	H	M	L	L

Biodiversity Management Priority

Biological Significance Index (Importance = 1)

Landscape Function Index (Importance = 1)

See next page

Component Cleared (%)	Concern – Immediate	Concern – Potential
Cleared		
>90%	VH	L
70-90%	H	L
30-70%	M	L
<30%	L	L
Native veg.		
>90%	VH	VH
70-90%	H	H
30-70%	M	M
<30%	L	L

Priority Species Significance* (Importance = 1)

Vegetation Conservation Status (Importance = 1)

Clearing bias (Importance = 1)

Species category/ attribute	Concern – Immediate	Concern – Potential
Two or more listed species	VH	VH
Endangered, Critically Endangered	VH	VH
Vulnerable, Rare	H	H
Other priority species	M	M
None	L	L

Threatened species (Importance = 1)

Other priority species (Importance = 2)

Hollow dwelling habitat (Importance = 2)

Threatened communities (Importance = 1)

Relative reservation (Importance = 2)

Relative rarity (Importance = 3)

Connectivity# (Importance = 2)

Distance of:	Concern – Immediate	Concern – Potential
Cleared land to native veg.		
<50m	L	L
50-250m	M	L
250-1,000m	H	L
>1,000m	VH	L
Native remnant to non-remnant		
<50m	L	VH
50-250m	M	H
250-1,000m	H	M
>1,000m	VH	L
Non-remnant		
Any	L	L

Remnant vegetation# (Importance = 2)

Riparian vegetation# (Importance = 2)

Vegetation condition (Importance = 3)

Old growth Forest (Importance = 1)

Eucalypt forest structure (Importance = 2)

Other vegetation (Importance = 3)

Status and bioreg. extent	Concern – Immediate & Potential Reservation level (Min. % State/bioreigon) <10%	10-30%	30-60%	>60%
Threatened				
Any	VH	VH	H	H
Not threatened Bioregional extent				
<2,000ha	VH	VH	H	M
2,000-5,500ha	VH	VH	H	M
5,500-15,000ha	VH	H	M	L
15,000-55,000ha	H	M	M	L
>55,000ha	M	M	L	L

Biophysical naturalness category	Concern – Immediate	Concern – Potential
5 (highest)	L	VH
4	L	VH
3	M	H
2	H	M
1 (lowest)	VH	M
0 (non-native)	L	L
-1 (water, sand, mud)	na	na

Descriptor of hollow probability (eucalypt forest only)	Concern – Immediate	Concern – Potential
Old growth forest	L	VH
Mature; Predominantly Mature, Some Regrowth	M	H
Predominantly Regrowth, Some Mature	H	M
Regrowth, Silvicultural Regeneration	VH	L
All other vegetation	L	L

Forest Practices Authority - predicted hollow abundance	Concern – Immediate	Concern – Potential
High	L	VH
Medium	M	H
Low	H	M
Not rated	L	L

Native vegetation patch size (ha)	Concern – Immediate	Concern – Potential
<2ha	M	L
2-20ha	VH	VH
20-200ha	H	VH
>200ha	L	M

River section catchment or wetland riparian vegetation (%)	Concern – Immediate	Concern – Potential
<1	VH	L
1-20%	H	VH
20-80%	M	H
>80%	L	M

Figure 4 (cont). Derivation of Landscape Function Index

Sub-matrix of Connectivity, Remnant Vegetation & Riparian Vegetation (CRR)

Connectivity	Remnant Vegetation	Riparian Vegetation	CRR Index	Rank (1 = highest)
VH	VH	VH	VH	1
H	VH	VH	VH	2
VH	VH	H	VH	3
VH	H	VH	VH	4
M	VH	VH	VH	5
H	VH	H	VH	6
VH	VH	M	VH	7
H	H	VH	VH	8
VH	H	H	VH	9
VH	M	VH	VH	10
L	VH	VH	H	11
M	VH	H	H	12
H	VH	M	H	13
VH	VH	L	H	14
M	H	VH	H	15
VH	H	M	H	16
H	M	VH	H	17
VH	M	H	H	18
VH	L	VH	H	19
L	VH	H	H	20
M	VH	M	H	21
H	VH	L	H	22
L	H	VH	H	23
VH	H	L	H	24
M	M	VH	H	25
VH	M	M	H	26
H	L	VH	H	27
VH	L	H	H	28
L	VH	M	H	29
M	VH	L	H	30
L	M	VH	H	31
VH	M	L	H	32
M	L	VH	H	33
VH	L	M	H	34
H	H	H	H	35
M	H	H	M	36
H	H	M	M	37
H	M	H	M	38
L	VH	L	M	39
L	L	VH	M	40
VH	L	L	M	41
L	H	H	M	42
M	H	M	M	43
H	H	L	M	44
M	M	H	M	45
H	M	M	M	46
H	L	H	M	47
L	H	M	M	48
M	H	L	M	49
L	M	H	M	50
H	M	L	M	51
M	L	H	M	52
H	L	M	M	53
L	H	L	M	54
L	L	H	M	55
H	L	L	M	56
M	M	M	L	57
L	M	M	L	58
M	M	L	L	59
M	L	M	L	60
L	M	L	L	61
L	L	M	L	62
M	L	L	L	63
L	L	L	L	64

Full Landscape Function Index matrix

Clearing Bias	CRR sub-matrix	Condition	Landscape Function Index	Rank (1 = highest)
VH	VH	VH	VH	1
VH	VH	H	VH	2
VH	H	VH	VH	3
VH	VH	M	VH	4
VH	H	H	VH	5
VH	VH	L	VH	6
H	VH	VH	VH	7
VH	M	VH	VH	8
VH	H	M	VH	9
H	VH	H	VH	10
VH	M	H	VH	11
VH	H	L	VH	12
H	H	VH	VH	13
H	VH	M	VH	14
VH	L	VH	VH	15
VH	M	M	VH	16
H	H	H	H	17
H	VH	L	H	18
M	VH	VH	H	19
VH	L	H	H	20
VH	M	L	H	21
H	M	VH	H	22
H	H	M	H	23
M	VH	H	H	24
VH	L	M	H	25
H	M	H	H	26
H	H	L	H	27
M	H	VH	H	28
M	VH	M	H	29
VH	L	L	M	30
H	L	VH	H	31
H	M	M	H	32
M	H	H	M	33
L	VH	VH	M	34
M	VH	L	M	35
H	L	H	M	36
H	M	L	M	37
M	M	VH	M	38
M	H	M	M	39
L	VH	H	M	40
H	L	M	M	41
M	M	H	M	42
M	H	L	M	43
L	H	VH	M	44
L	VH	M	M	45
H	L	L	M	46
M	L	VH	M	47
M	M	M	M	48
L	H	H	L	49
L	VH	L	M	50
M	L	H	L	51
M	M	L	M	52
L	M	VH	L	53
L	H	M	L	54
M	L	M	L	55
L	M	H	L	56
L	H	L	L	57
M	L	L	L	58
L	L	VH	L	59
L	M	M	L	60
L	L	H	L	61
L	M	L	L	62
L	L	M	L	63
L	L	L	L	64

Figure 6. Sample REM profile – Immediate Level of Concern

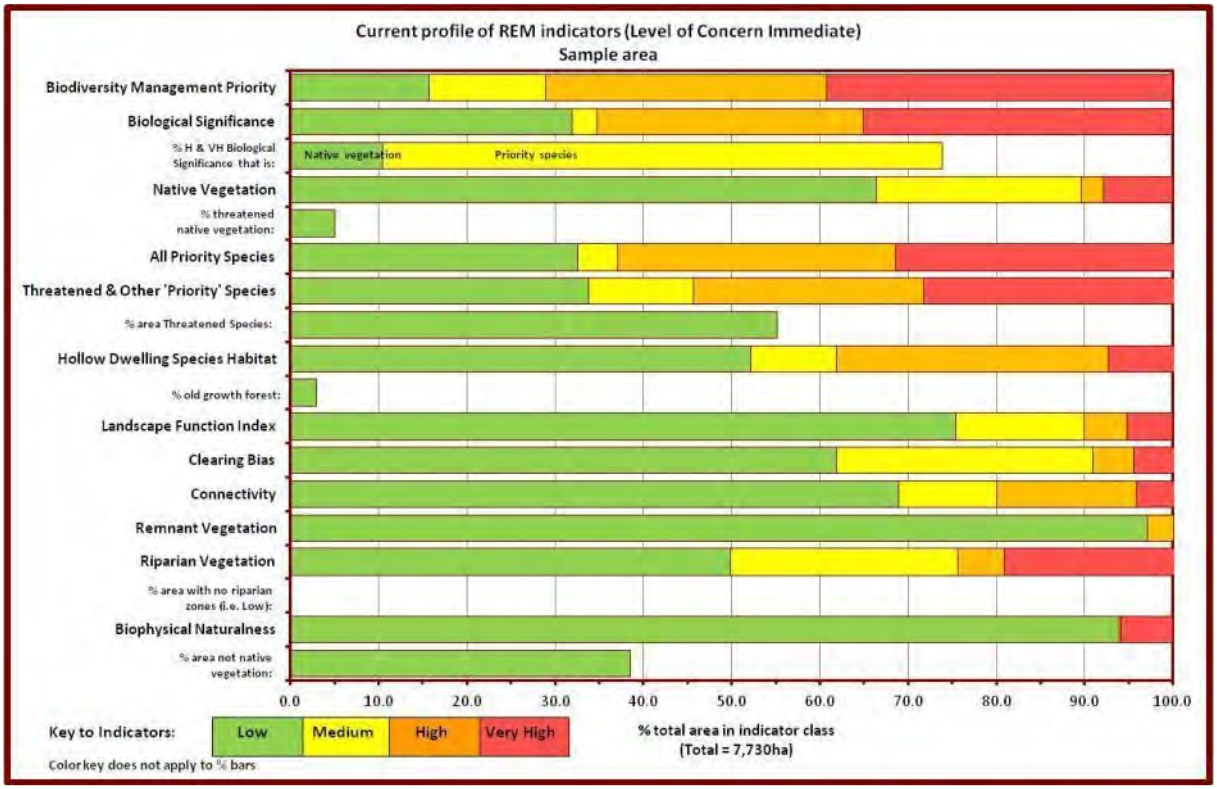
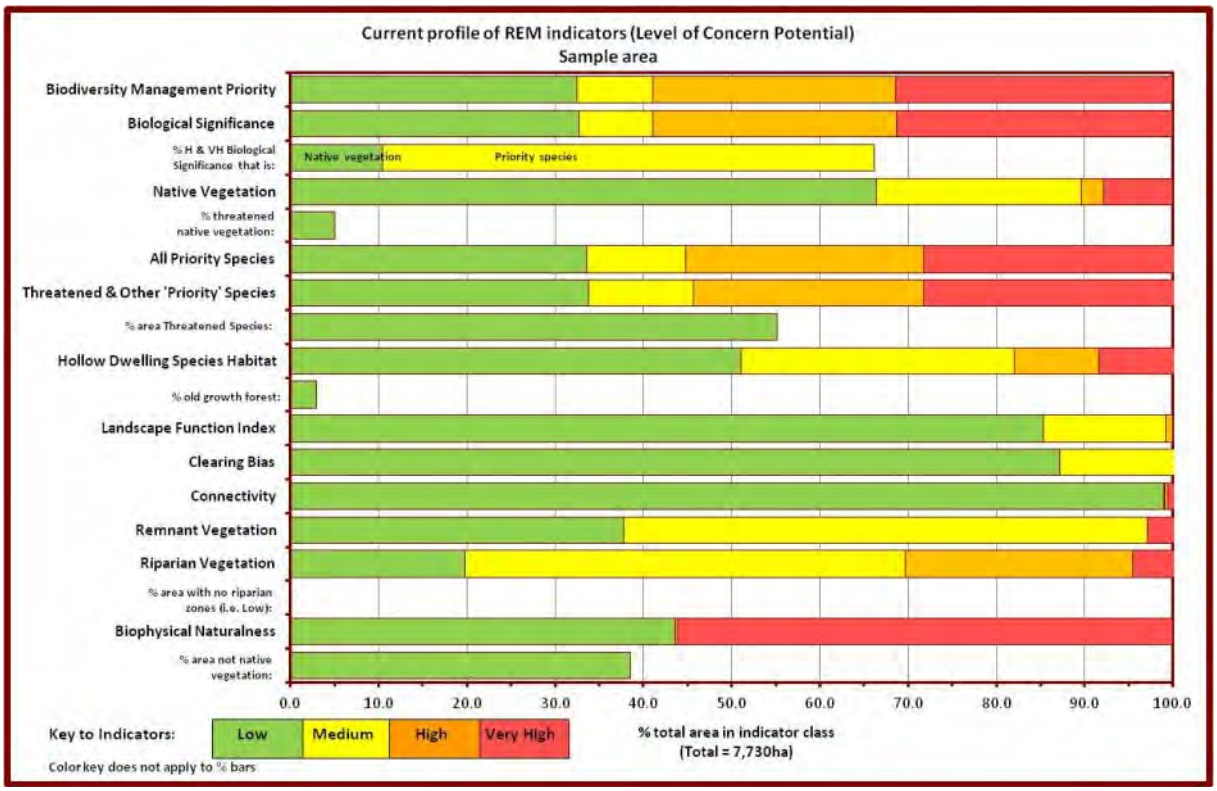


Figure 7. Sample REM profile – Potential Level of Concern



Attachment 2:

Criteria for selection of areas for investment under the Bushlinks 500 project

The Bushlinks 500 project aims to use the Regional Ecosystem Model (REM) for selecting areas for revegetation or restoration that are high priorities for biodiversity conservation, either due to the biological significance of their vegetation and/or priority species habitat, or due to the need to undertake revegetation works through linkages to secure those value.

The criteria for the project have been designed first to define areas which may be eligible for investment under the project, and then to provide clear and defensible criteria for selecting between areas. The project provides for rehabilitation of 400ha or native vegetation and revegetation of an additional 100ha.

A. Eligibily Criteria

1. Proposals may involve areas of native vegetation for rehabilitation or areas of cleared or degraded land[12] for revegetation.

2. These areas need not necessarily be located on a single property but where multiple properties are involved securing agreement of all landowners will be required before any decisions on investment are made.

3. All proposals must include some component which is rated as High or Very High Level of Concern for either Biological Significance or Landscape Ecological Function.

4. Proposals which involve rehabilitation of native vegetation only should be rated as:

   i. High or Very High Immediate Level of Concern for Biological Significance and at least Medium for their native vegetation (i.e. vegetation can be of lower importance where priority species habitat is present) and at least Medium for their Landscape Ecological Function; or
   ii. Very High Level of Concern for their Native Vegetation.

[12] For the current purpose, degraded land is native vegetation considered to have been induced through degradation of the climax native vegetation for the site, e.g. GCL which has been induced through loss of trees from a dry forest or woodland vegetation community.

5. Proposals which involve only revegetation of cleared or degraded land should:

i. be rated as High or Very High Immediate Level of Concern for Landscape Ecological Function and adjoin areas of native vegetation[13] rated at least Medium for Biological Significance; or
ii. be rated as Medium Level of Concern for Landscape Ecological Function and adjoin areas of native vegetation rated at least Medium for Biological Significance and at least High for Landscape Ecological Function.

6. Proposals which include both rehabilitation of native vegetation and revegetation of cleared or degraded land should meet one of the following criteria:

i. Any areas of cleared or degraded land where the revegetation will reduce the Immediate Level of Concern for Landscape Function of adjoining native vegetation rated as High or Very High Level of Concern and where the Native Vegetation rated at least Medium;
ii. Areas of revegetation of cleared or degraded land rated as High or Very High Immediate Level of Concern for Landscape Ecological Function should include a rehabilitation component rated at least Medium Immediate Level of Concern for Native Vegetation.
iii. Areas of revegetation of cleared or degraded land rated as Medium Immediate Level of Concern for Landscape Ecological Function should include a rehabilitation component rated at least High Immediate Level of Concern for Biological Significance and Medium Native Vegetation.

B. Prioritisation Criteria

Proposals which meet the Eligibility Criteria will be further prioritised for investment using the REM schema for ranking various combinations of Biological Significance, Native Vegetation and Landscape Ecological Function. For the current project the schema has been modified to reflect the mix of areas of extant native vegetation and areas proposed for revegetation. The prioritisation schema for eligible proposals is indicated in the attached table on the following page. The key to the table is shown below.

The prioritisation schema will be used as a guide to the prioritisation of proposals. Other considerations such as cost effectiveness will also be used in determining final project approvals. Decisions will also reflect the need for the project to deliver its funded objectives of 100ha of revegetation and 400ha or rehabilitation of existing native vegetation.

[13] Adjoining areas of native vegetation need not be contiguous but should be within approximately 100m of proposed revegetation areas.

Key to the prioritisation table – Bushlinks 500

Table feature	Notes
Highlighted cells	Eligible proposals
Highlighted cells	Ineligible proposals
Biological signficance (native veg)	Biological Significance (Immediate) class for extant native vegetation.
Landscape Function (native veg)	Landscape Ecological Function (Immediate) Level of Concern for extant native vegetation.
Landscape Function (reveg)	Landscape Ecological Function (Immediate) Level of Concern for proposed revegetation area.
Reveg + Rehab	Eligible proposals involve both rehabilitation of native vegetation and revegetation of cleared or degraded areas, subject to eligibility criterion 6.
Rehab	Eligible proposals can be based on rehabilitation of native vegetation only, subject to eligibility criterion 4.
Reveg	Eligible proposals can be based on revegetation of cleared or degraded areas only, subject to eligibility criterion 5.
Investment Priority – rank	Ranked priority class for the combined extant native vegetation and revegetation areas. Used to differentiate among eligible proposals.

Bushlinks 500 – Prioritisation schema for investments

Matrix of REM indicators for eligible proposals and prioritisation for project funding

Biological Significance (native veg.)	Landscape function (native veg.)	Landscape function (reveg areas.)	Reveg+ Rehab.	Rehab.	Reveg.	Investment priority (rank)
VH	VH	VH	Yes	Yes	Yes	64
VH	H	VH	Yes	Yes	Yes	63
H	VH	VH	Yes	Yes	Yes	62
VH	M	VH	Yes	Yes	Yes	61
VH	VH	H	Yes	Yes	Yes	60
VH	L	VH	Yes	Yes	Yes	59
VH	H	H	Yes	Yes	Yes	58
H	H	VH	Yes	Yes	Yes	57
H	VH	H	Yes	Yes	Yes	56
M	VH	VH	Yes	No	Yes	55
VH	M	H	Yes	Yes	Yes	54
H	M	VH	Yes	Yes	Yes	53
VH	L	H	Yes	Yes	Yes	52
H	H	H	Yes	Yes	Yes	51
VH	VH	M	Yes	Yes	Yes	50
VH	H	M	Yes	Yes	Yes	49
M	VH	H	Yes	No	Yes	48
H	VH	M	Yes	Yes	Yes	47
H	L	VH	Yes	No	Yes	46
VH	M	M	Yes	Yes	No	45
H	M	H	Yes	Yes	Yes	44
VH	L	M	Yes	Yes	No	43
M	H	VH	Yes	No	Yes	42
H	H	M	Yes	Yes	Yes	41
H	L	H	Yes	No	Yes	40
M	VH	M	No	No	Yes	39
M	H	H	Yes	No	Yes	38
H	M	M	Yes	Yes	No	37
VH	VH	L	Yes	Yes	No	36
M	M	VH	Yes	No	Yes	35
VH	H	L	Yes	Yes	No	34
H	VH	L	Yes	Yes	No	33
H	L	M	Yes	No	No	32
VH	M	L	No	Yes	No	31
VH	L	L	No	Yes	No	30
M	H	M	Yes	No	Yes	29

Biological Significance (native veg.)	Landscape function (native veg.)	Landscape function (reveg areas.)	Reveg+ Rehab.	Rehab.	Reveg.	Investment priority (rank)
M	M	H	Yes	No	Yes	28
M	L	VH	Yes	No	Yes	27
H	H	L	Yes	Yes	No	26
M	VH	L	Yes	No	No	25
H	M	L	No	Yes	No	24
M	L	H	Yes	No	Yes	23
M	H	L	Yes	No	No	22
L	VH	VH	No	No	No	21
L	VH	H	No	No	No	20
L	H	VH	No	No	No	19
L	VH	M	No	No	No	18
L	H	H	No	No	No	17
L	H	M	No	No	No	16
L	VH	L	No	No	No	15
L	M	VH	No	No	No	14
H	L	L	No	No	No	13
L	M	H	No	No	No	12
L	H	L	No	No	No	11
L	L	VH	No	No	No	10
L	L	H	No	No	No	9
M	M	M	No	No	No	8
M	L	M	No	No	No	7
M	M	L	No	No	No	6
L	M	M	No	No	No	5
M	L	L	No	No	No	4
L	M	L	No	No	No	3
L	L	M	No	No	No	2
L	L	L	No	No	No	1