Revegetation case study - 2000

Corridor – mixed species across the landscape

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Landscape Goal
Provide adequate habitat within the Wallatin Creek Catchment, by increasing the amount of effective habitat to conserve existing resident flora and fauna in the catchment and improve sustainability of land use.

Nature Conservation
- Create a corridor that connects existing small remnants to the larger york gum jam remnant.
- Linkage to road verge, defined to be of high value to birds

Sustainable Agriculture
- Protect vulnerable sandplain soils from wind erosion.
- To increase water use on the high recharge sandplain soils.

NOT TO SCALE

DEPARTMENT OF Conservation AND LAND MANAGEMENT

Bushcare The National Vegetation Initiative

Site Characteristics

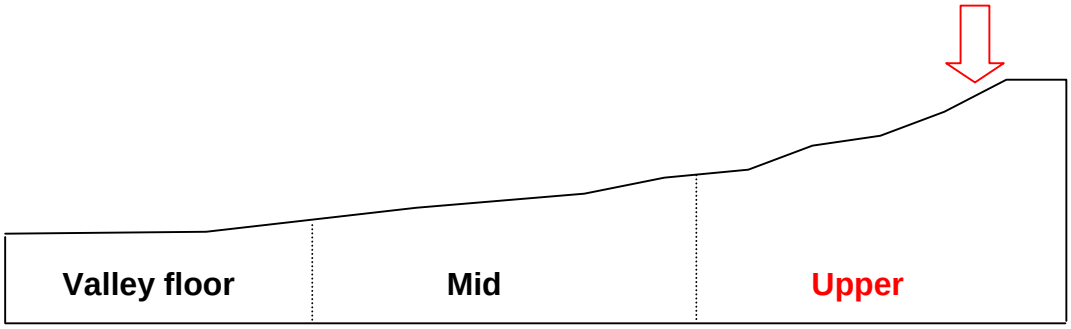


Figure 2. Landscape position of revegetation.

Soil type: Pale sand over loamy sand to gravel.
pH= 9.1 (neutral = 7), soil salinity EC= 20mS/m (non saline = <17 mS/m)

Landform: Ulva landscape unit.

Remnant Vegetation: The corridor connects a 60ha remnant to the road reserve.

Vegetation Association: The road reserve consists of heath vegetation changing into york gum jam woodland.

Potential Recharge: High

Area: Approximately 13 hectares, 1360 metres long by 100 metres wide.

Rainfall: Average annual rainfall is 330mm, the annual rainfall for 2000 was 348 mm with 144mm in the growing season (May to October).

Paddock history: Wheat: Lupin: Wheat: Wheat: Canola

Design of Revegetation

Species Selection

The species selected were from similar soil types, landform and vegetation associations. There are three associations represented in this revegetation site; heath on the pale sand, mallee and whitegum woodland. Note that the white gum associated with this woodland is *Eucalyptus capillosa*, also know as inland wandoo or wheatbelt wandoo.

Table 1. Species selected for revegetation

Genus	*species*	Common name	Fire response	Seedling #	Direct Seed (g)
Heath					
Acacia	*44*			16	
Acacia	*multispicata*	Spiked wattle		15	
Acacia	*rigida*			152	
Allocasuarina	*acutivalvis*	Black tamma	Seeder	333	
Allocasuarina	*campestris*	Tamma	Seeder	360	
Allocasuarina	*huegeliana*	Rock sheoak	Resprouter	120	
Allocasuarina	*humilis*	Dwarf sheoak	Resprouter	500	
Calothamnus	*quadrifidus*	One sided bottlebrush	Resprouter	300	
Eremaea	*pauciflora*			60	70
Eucalyptus	*burracoppinensis*	Burracoppin mallee	Resprouter	720	34
Grevillea	*eriostachya*	Flame grevillea	Resprouter	1	
Hakea	*cygna*	Swan hakea	Seeder	112	
Hakea	*erecta*		Seeder	35	
Hakea	*incrassata*	Marble hakea	Resprouter	38	
Hakea	*platysperma*	Cricket ball hakea	Seeder	120	
Hakea	*scoparia*		Seeder	104	
Hakea	*trifurcata*	Two-leaf hakea	Seeder	60	
Isopogon	*dubious*	Rosy coneflower	Seeder	48	
Melaleuca	*cordata*				24
Melaleuca	*platycalyx*			60	2
Xylomelum	*angustifolium*	Sandplain woody pear		78	
Mallee					
Allocasuarina	*humilis*	Dwarf sheoak	Resprouter	580	
Calothamnus	*quadrifidus*	One sided bottlebrush	Resprouter	419	68
Eucalyptus	*eremophila*	Tall sand mallee	Resprouter	300	530
Eucalyptus	*erythronema*	Red flowered mallee		360	450
Eucalyptus	*sheathiana*	Ribbon bark gum		300	200
Eucalyptus	*leptopoda*	Tammin mallee			22
Whitegum Woodland					
Acacia	*acuaria*		Seeder	152	
Acacia	*acuminata*	Jam wattle	Seeder	300	
Acacia	*lasiocarpa*	Dune mosses	Seeder	17	
Allocasuarina	*campestris*	Tamma	Seeder	120	
Calothamnus	*quadrifidus*	One sided bottlebrush	Resprouter	400	
Eucalyptus	*capillosa*	Inland wandoo or white gum	Seeder and resprouter	2280	60
Eucalyptus	*subangusta*	Black marlock		416	
Eucalyptus	*transcontinentalis*	Redwood		180	228
Melaleuca	*laxiflora*			600	100
Melaleuca	*uncinata*	Broombush	Resprouter	900	

Note: Seeder/Resprouter refers to the main form of regeneration, especially after fire.

Nature Conservation objectives

- **Focal species requirement**

The width of the corridor meets the minimum width for heath and woodland vegetation for dispersal limited species. The total area of the corridor is 13 hectares, an average width of 100 metres. When connected to the larger 60 hectare york gum jam remnant, plus the small one hectare remnants along the corridor it will meet the minimum requirements for area limited species.

- **Natural plant associations**

The area was divided into three different vegetation associations by soil type. Each plant association includes several species from multiple genera to create some diversity. The *Allocasuarina campestris* occurs as a single species thicket on gravelly laterite soils and so have been planted back into similar soils as a single species thicket to resemble its natural form.

- **Provenance protection**

Special permission was granted by Department of Conservation to allow the seed to be collected from the neighbouring three Nature Reserves: Durokoppin, Kodj Kodjin and Burgess Spring in the Kellerberrin Shire. All lie within a 10-15km radius of the revegetation site. This seed was propagated in selected nurseries for planting into specific sites.

- **Vegetation structure**

The average density of the corridor is 1000 stems per hectare, this is to reflect the natural density of the remnants. There is 45% overstorey species consisting of trees and mallees (Eucalypts) and 55% understorey species to give the vegetation structure. Each habitat patch contains a single understorey species and has 120 stems over a 10m by 13m square. These patches occur randomly over the entire site to provide a nesting and feeding substrate for birds. Planting single species patches of understorey (*Calothamnus quadrifidus* or *Allocasuarina humilis*) in the mallee association have created nesting sites for birds. Shelter from predators and the weather is created for birds by the different layers of overstorey and understorey vegetation. Food sources from nectar and pollen will be available for insects and birds. A mix of species was planted randomly and scattered throughout the sites alongside the rip lines to represent clumps and scattered vegetation.

- **Remnant protection**

Part of the corridor borders the small remnants and forms a buffer to protect the remnant from wind, spray drift, nutrient movement and weed seed movement. The remnant will add age structure to the corridor and the provision of a potential source of small fauna eg invertebrates and capturing unique sources of plant and animal genetic material. The corridor starts the linkages between remnants and increases the connectivity in the catchment. It will also increase the size of the remnant to greater than the minimum viable size needed for a corridor.

- **Level of Diversity**

The diversity of plants used reflected the species that were readily accessible and were mature in time for seed collecting and delivery to the nurseries in early December, for propagation in the 2000 planting season. Ten genera and 33 different species of local provenance plants were used in the revegetation design. The diversity also reflects

the success in germinating Acacia species when seed was supplied just after maturity in late December.

- **Threats to revegetation**

Fire is the primary threat to the revegetation. A mix of species that regenerate after fire by seed or resprouting will improve the survival and regeneration after fire.

Agricultural land use objectives

- **Wind erosion**

The placement of the corridor will protect the vulnerable sandplain soils from the prevailing northerly winds. The structure of the corridor will have the height in the overstorey and the density in the understorey.

- **Reduction of surface water run-off**

Lines were surveyed along the contour of the corridor to ensure the rip lines followed the contour. This will encourage contour working along the boundary. A depth of 40cm in the rip line will ensure rainfall easy passage into the soil profile and less run-off into the paddock.

- **Increase water use**

A density of 1000 stems per hectare at 3 metre spacings will assist in water usage and drying the soil profile. This will be particularly effective in this part of the catchment, as it has been defined as high potential recharge area.

- **Stock protection**

The western side of the corridor will be fenced to protect from stock grazing. There is no fence on eastern side as there are already a number of alleys of trees below banks and along fence lines. This paddock will no longer be grazed to protect the revegetation work from stock.

Establishment

➢ Site preparation

The site was ripped using an Agro plough at one metre spacings on the 31 March 2000 to an average depth 30 – 40cm on surveyed contour lines. The gravel pit was ripped at one metre spacings using a grader.

➢ Weed control

The area to be planted with seedlings was sprayed with 1.2 litres per hectare of Roundup® (gylphosate) and 3 litres per hectare of Simazine® on the 28 June 2000. Late and minimal rains delayed herbicide application. The direct seeding site was sprayed with 1.2 litre per hectare of Roundup® mixed with 150 ml per hectare of Le-Mat® (insecticide for red legged earth mite). A second (8 August 2000) application of one litre per hectare of Roundup® was used to control late germination of weeds on the direct seeded site.

➢ Planting design

Vegetation formations were pegged prior to planting, so that the revegetation would represent irregular natural boundaries. A mix of 3-5 different species were planted in clumps. The seedlings were planted with 'potti putki' hand planters to one side of the rip lines on 20 July 2000 and 21 July 2000. Habitat patches were pegged prior to planting at 13m x 10m squares scattered throughout each vegetation formation. These patches were planted at one metre spacings to create a habitat patch.

➢ Direct seeding

Direct seeding areas were seeded on the 14 August 2000, using an air seeder. One part of seed was mixed with 4 parts vermiculite and 2 parts coarse brown sand and 2 parts fine blasting sand as bulking agent in a cement mixer. The species chosen were all fine seed of similar size and flow characteristics from the Myrtacae family. The site was cultivated with the air seeder tines on the day of seeding just before spreading the seed mix. The seed mix was spread across the sites using just the air from the air seeder. After seeding, the site was sprayed with 500ml per 1.5 hectares of Talstar® for 60 days residual control of red legged earth mite.

➢ Implementing the revegetation works

The schedule and description of revegetation works undertaken are summarised below for each area.

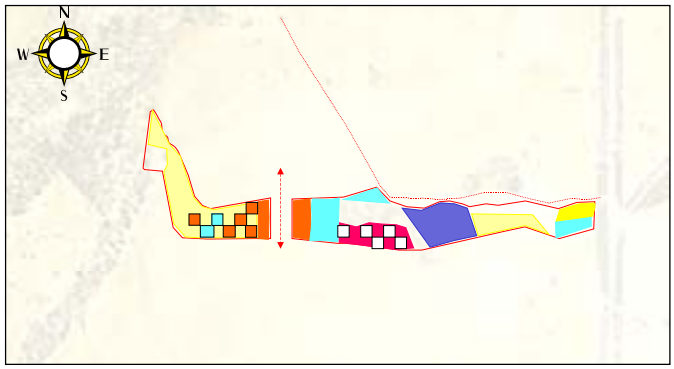
Table 2. Schedule of Works - Seedlings

TASK	ACTION	OUTCOME	COMMENTS
Site preparation	Ripped using agro plough from AGWA 31/3/00 at 1-2m spacings on the contour.	40cm deep rip lines, easy ripping in sandplain soils	Good even depth of rip lines. No need to rip patches as rip lines close together.
Weed control	3L Simazine®, 1.2L Round-up 28/6/00	Late and minimal rains delayed spraying and made weed control less effective. Simazine damage in seedlings in November.	Good weed control despite difficult conditions. After planting late germination of wild radish.
Seedling quality at time of planting	Seedlings kept outside in weather (rain). Loaded the night before planting.	Majority of good quality seedlings. Some seedlings with minimum root development or oversized.	Larger seedlings easier to extract from pot and easy to plant.
Planting	Hand planting using potti putkis 8 people planting seedlings out; Peter W, Prisoners on first day. Peter W, David and Brian on second day.	8am start 3.30pm 8am – 1pm finish 155/8/7 = 2.7 trays/person/hour	Poor quality planting by prisoners in the gravel pit. Good establishment on the western end.

Table 3. Schedule of Works – Direct Seeding

TASK	ACTION	OUTCOME	COMMENTS
Site preparation	Ripped using agro plough from AGWA 31/3/00 at 1-2m spacings on the contour.	40cm deep rip lines, easy ripping in sandplain soils	Good even depth of rip lines.
Weed control	1.2L Round-up, 150ml Le-Mat® 28/6/00. 1L Round-up 8/8/00 prior to direct seeding	Late and minimal rains delayed spraying and made weed control less effective. A second and third application of roundup necessary	Good weed control despite difficult conditions. Late germination after seeding of oats and rye grass.
Method of Direct Seeding	Direct seeding with air seeder (14/8/00) using vermiculite, fine and coarse sand as bulking agent. 12 kilo (1.788kg seed) over 1.5ha Sprayed with 500ml of Talstar (same day)	Even coverage of seed and bulking agent. No signs of insect attack.	Small amounts of rainfall after seeding and soil temperature warming up very quickly may have affected germination.
Germination	Euc spp & Calothamnus germinated 26/10/00		Later germination due to lack of rainfall?

Layout of revegetation



Access track
Revegetation boundary

Mallee
1.5 ha = 1920 seedlings

300 Eucalyptus eremophila
Tall sand mallee
360 E. erythronema
Red flowered mallee
300 E. sheathiana
Ribbon bark gum
240 Allocasuarina humilis
Dwarf sheoak

Patch 13 x 15m (120 / patch)
360 Allocasuarina humilis
3 patches
360 Calothamnus quadrifidus
3 patches

White gum woodland
7.65 ha = 4977 seedlings

2100 Eucalyptus capillosa White gum
240 E. transcontinentalis Redwood
360 E. subangusta Black marlock
100 Acacia acuaria
300 A. acuminata Jam wattle
17 A. lasiocarpa Dune mosses
120 Allocasuarina campestris
Tamma
240 Calothamnus quadrifidus
One sided bottle brush
676 Melaleuca uncinata Broombush
4153

Patch 13 x 10m (120 / patch)
600 Melaleuca laxiflora /5 patches
224 Melaleuca uncinata /2 patches

Heath
2.6 ha = 2657 seedlings

Yellow sandplain heath
16 Acacia 44
138 Acacia rigida
120 Allocasuarina huegeliana
Rock sheoak
240 Allocasuarina humilis
Dwarf sheoak
38 Hakea incrassata
Marble hakea
120 H. platysperma
Cricket ball hakea
60 H. trifurcata
Two leafed hakea
78 Xylomelum angustifolium
Woody pear
810

Gravelly sand heath
15 Acacia multispicata
Spiked wattle
333 Allocasuarina acutivalvis
Black tamma
240 Allocasuarina humilis
Dwarf sheoak
300 Calothamnus quadrifidus
One sided bottle brush
240 Eucalyptus burracoppinensis
Burracoppin mallee
112 Hakea cygna
Swan hakea
35 H. erecta
104 H. scoparia
48 Isopogon dubius
Rosy coneflower
60 Melaleuca platycalyx
1487

360 Thicket 0.2 ha (20m x 60m)
Allocasuarina campestris Tamma

DIRECT SEEDING

Planting Patterns (Trays)

E. capillosa 10, Calothamnus quadrifidus 4, E. subangusta 3 = 17

E.capillosa 7, Melaleuca uncinata 7, E. subangusta 3 = 17

E.capillosa 6, Acacia acuaria 3, A. lasiocarpa 1 Mel. uncinata 5 = 15

E. capillosa 2, Allo. campestris 2 = 4

E.capillosa 10, A. acuminata 7, E. transcontinentalis 4 = 21

Figure 3. Planting pattern for the corridor revegetation design (60 seedlings per tray).

Costs

➢ Cost sharing arrangements

The revegetation design was cost shared on its value to nature conservation (Departmental share) and profitable sustainable agriculture (landholder share). This site had a cost shared ratio of 4:2, four points to nature conservation values and two points to sustainable agriculture.

The nature conservation value was met by using a multiple species planting of local provenance species that provides an important habitat for locally threatened species. Contributes to recharge control, and the corridor is wider than 30 metres on the heathland and 60 metres on the woodland site. The sustainable agricultural value was met by the revegetation contributing to recharge control of the adjacent farmland, mapped as high potential recharge and protects highly erodible soil.

The Bushcare funded, Department of Conservation managed project contributed 40 cents per planted seedling out of a total of 60 cents per planted seedling. The fencing was funded at 85% of the cost of fencing materials as revegetation linked to priority bush areas. For details on cost sharing method see Mullan 2001.

Table 4. Cost of establishment (2000)

Materials and activities	Itemised costs	Total
Rabbits – 1080 poisoned oats	@ $7.72 /km x 4km	30.88
Mixed species seedlings 10 555	@ 34c per seedling	3 588.70
Ripping – Agro plough @ 1m spacings.	@ 10 per planted seedling 10 555	1 055.50
Pre-Planting Weed Control - Seedlings 1st application: 1.2 L/ha glyphosate, 3L/ha Simazine®	@ 9c per planted seedling 10 555	949.95
Hand planting – 8 planters	@ 10c per planted seedling	1 055.50
Direct Seeding Local Provenance seed 1.788kg/1.5ha Bulking agent vermiculite *Weed control* 1st application: 1.2 L /ha glyphosate 2nd application: 1 L/ha glyphosate *Pest control* 1st application: 150ml Le-Mat® 2nd application: 250 mL/ha of Talstar®	 @ $516/ha x 1.5ha @ $16/100L @ $7.5/ha x 1.5ha @ $5/ha x 1.5ha @ $2/ha x 1.5ha @ $22.50/ha x 1.5ha	 774.00 16.00 11.25 7.50 3.00 33.75
Fencing – 7 line hinged joint netting	@ $1150 per km x 1.6 km	1 564.00
TOTAL COST		**$9 090.03**

Monitoring

Monitoring data: 80% survival of seedlings with direct seeding germination patchy. Some very dense germination of seedlings while other areas sparsely covered. Poor survival of understorey species on heath section.

Figure 4. Corridor planting facing west May 01.

Figure 5. Corridor planting facing west May 02.