Local Native Seed Supply Strategy

for the

Young District & Dananbilla-Illunie Range

targeting Box Gum Woodlands

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February 2012

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This seed supply strategy for the *Young District including the Dananbilla-Illunie Range* is one of six strategies developed by Greening Australia. These strategies are part of the 2009-2010 federally funded Caring for our Country *Communities in Landscapes* Project[1]. The other five strategies are for: Little River Landcare Group, (south west of Wellington); Central Tablelands Landcare, (Orange – Bathurst region); Weddin Local Landscape, (Grenfell region); Burra, Royalla and Fernleigh Park Landcare groups, (south of Canberra) and the Kyeamba Valley- Humula – Oberne and Tarcutta Landcare areas (east of Wagga Wagga).

Greening Australia has 30 years experience working with land holders to assess, restore, research and manage native vegetation on private and public land, the organisation was well placed to facilitate this strategy[2].

This document was prepared by Bindi Vanzella with assistance from other staff at Greening Australia, Capital Region.

Disclaimer: The views and opinions in this report have been obtained from a wide range of sources. While reasonable efforts have been made to ensure that the contents of this seed supply strategy are factually correct, Greening Australia nor the *Communities in Landscapes* project partners do not accept responsibility for the accuracy or completeness of the contents, and shall not be liable for any loss or damage that may be occasioned directly or indirectly through the use of, or reliance on, the contents of this document.

[1] Landcare NSW Inc. is the lead agency for *Communities in Landscapes: Working together to integrate conservation and production across Box-Gum Woodlands*. The *Communities in Landscapes* proposal uses the logic that landscape-scale change can be achieved by working with farmers and their communities to identify and advise on management practices that will benefit ecosystem function in Box-Gum Woodlands, have positive outcomes for production, and increase community capacity to carry on these practices beyond the life of the project. The website is http://cil.landcarensw.org.au/

[2] Greening Australia plays a lead role in *Florabank*, a seed knowledge exchange website that has operated since 2008 advising many in plant and seed supply practices. In 2011 Greening Australia (Capital Region) launched its grassy woodland native seed and nursery trading website at http://www.grassywoodlands.org.au.

Combined, these two websites play a pivotal role in delivering the best options available to help restore the health and diversity of natural landscapes and in doing so, the health, wellbeing and pride of our rural and urban communities.

Acknowledgements

People who contributed to this document; helped organise community meetings, freely offered suggestions on what information was required and/or willingly provided technical advice, feedback and information. They are:

- Young Landcare : Heather Williams, Katrina Hudson and Kevin & Marilyn Stemm;
- Lachlan CMA- Fin Martin;
- Greening Australia: Stephen Bruce, Jason Cummings, Melinda Pickup, Susie Wilson, Tatyana Leontjeva, David Freudenberger and Juliette Grimaldi;
- Office Environment & Heritage – Susie Jackson (Ranger), Julie McInness (NPWS Scientific Licensing);
- DnA Environmental: Donna Johnston;
- CSIRO- Plant Industry – Linda Broadhurst and
- Far South Coast Community Seedbank: Karen Walker.

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Introduction

The focus of this strategy is developing the capacity and capability to reliably supply high quality and genetically diverse seed from a broad range of species with varying life history traits for revegetation and land restoration work. It targets landscapes associated with Box-Gum Grassy Woodland but it can be used as a guide for other vegetation associations.

This strategy guides seed collectors and suppliers, nurseries, Landcare, catchment officers, environment networks, education facilities and revegetation investors, consultants and practitioners in best practice native seed supply that will contribute to landscape resilience, diversity and functionality.

Community members and organisations with an interest in native seed in the area contributed to the strategy identifying knowledge and resource gaps and suggested actions to develop a quality and reliable seed supply service. This strategy is therefore viewed as a document that will be reviewed as knowledge and skills improve, networks develop and ideas progress into actions. Additionally, this strategy can be used by individuals and groups in the wider Central West Slopes and Plains of NSW as much of what is documented is relevant and representative across other peri-urban and rural areas.

SECTION A: The Landscape Challenge

1. Landscape snapshot

This seed supply strategy focuses on Landcare groups in the Young district with the inclusion of the Dananbilla-Illunie Range to the east as shown in Figure 1[3]. The areas were chosen to complement existing plans and on-ground work that recognise the need to actively address tree decline, habitat connectivity, soil loss, water quality and salinity in the area.

This area is almost entirely comprised of the Young local government area but the shires of Cootamundra, Weddin, Cowra and Boorowa are also represented. The major water catchments are the upper catchments of Bland, Tyagong, Crowther and Back Creek. All water flows into either the Lake Cowal system or the Lachlan River.

The region is dominated by agricultural production, predominately for cropping and grazing however there is a diverse mix of other intensive enterprises such as orchards (mostly stone fruit and cherries), viticulture, specialist fruit and vegetables, poultry and pigs. Some areas of significant natural vegetation are protected through covenanting agreements with state government especially in the Dananbilla-Illunie Range.

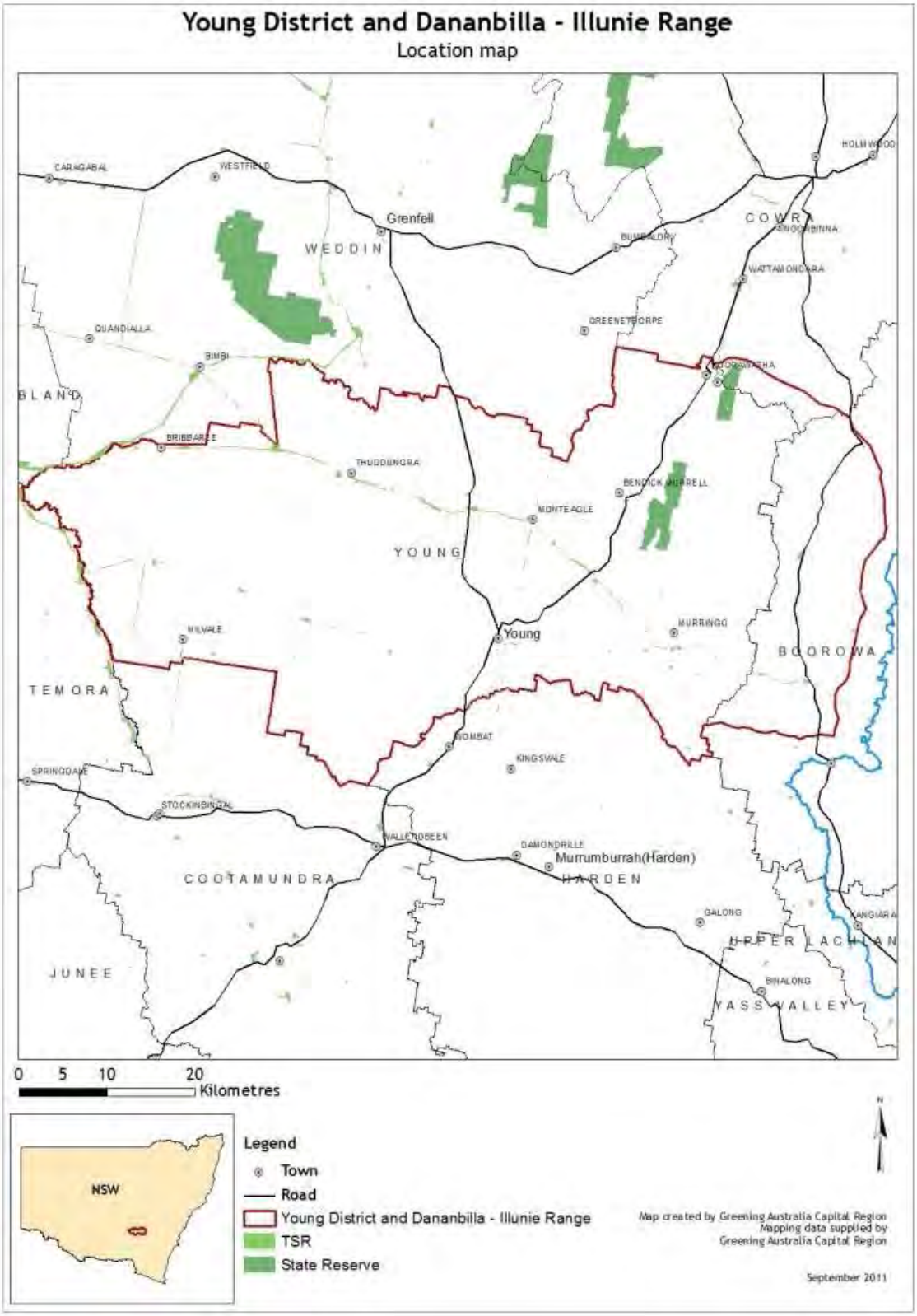
Settlement history, topography, soils and geology determined the extent of native vegetation clearing and modification. Early settlement from the early to mid-1800's encouraged vegetation removal for agricultural and horticultural development on the more fertile soils of undulating hills and alluvial flats. Gold was found in and along the creeks. This still led to extensive soil disturbance and vegetation loss resulting in siltation, erosion and weeds. (Hudson 2001 & Hassall & Associates 2003). Some areas such as the Hervey sandstone otherwise known as the Dananbilla-Illunie Range was cleared for fencing material (such as Ironbark posts) and firewood rather than for agricultural production (Jackson pers. com).

"Approximately 90% of the land area of Young Shire is used for agricultural production and has been largely cleared of native vegetation. The remaining 10% of the shire is comprised of urban areas, road reserves and areas of remnant vegetation on private land. Approximately 5050 hectares in land of the Young Shire occurs in State Forests and Nature Reserves. Areas of remnant vegetation are generally restricted to roadside reserves and land unsuited to agricultural production due to poor soils and topography. The largest areas of remnant vegetation occur on the ranges in the eastern part of the shire including the Crowther, Douglas, Dananbilla and Illunie Ranges". (Hudson 2001)

Positive action by organisations such as the Lachlan CMA, Young Landcare groups, Young Shire Council, Bland Creek Catchment Coordinating Committee, NPWS -Dananbilla Protect Areas Network and individuals continue to invest in fencing, planting and covenanting to link isolated patches of native vegetation, encourage natural regeneration and address the deteriorating understorey from continuing threats from pest animals, weeds, and overgrazing of sensitive native plant species.

[3] It is important to note that the boundaries of this seed supply strategy are changeable. It can easily be altered to capture a wider geographic interest in the region. Therefore, the recommended actions and guidelines should not limited by lines on a map that could otherwise be viewed as excluding wider community participation or limiting funding opportunities.

Figure 1: Location map



2. Restoration and the Importance of Quality Seed

The impact of land clearing and importance to retain, protect and re-establish native vegetation in the area is acknowledged in several documents listed in Table 1. Even though none of the reports capture data for the entire geographic area, collectively they present similar messages and statistics depending on the availability of information of the time. The most recently published documents specifically highlight the critical loss of Box Gum Woodlands as a percentage remaining. Table 1 gives a summary of these findings.

Given the threatened status of Box Gum woodland communities listed below, and the small amount of area retained, restoration is a key tool in their conservation. Strategic investment in the collection and use of diverse local native seed is a pre requisite to protect and conserve the ecological integrity of these plant communities.

Any restoration or revegetation project should consider the benefits of using **provenance** (or local) material. The use of local seed will help minimise risks of revegetation failure, and conserve ecological values from the genetic level to the landscape scale. Geographic distance is not the only consideration of genetic diversity when collecting seed. Seed collectors and users should consider the health of the source population, and its ability to provide genetically diverse seed, as well as its geographical location.

When selecting seed for a revegetation project consider taxonomy, habitat adaptation, physical and genetic quality, and proximity relative to the surrounding native vegetation, revegetation technique, condition of the site and project objectives. These considerations will help answer the question, “where should I collect or source seed for my revegetation project”. Additional information about provenance is in Section B: 7.

Table 1: Regional reports acknowledging the need for land restoration with supporting evidence

Report	Restoration comment / action	Vegetation type & estimated % remaining
Reconstructed and Extant Distribution of Native Vegetation in the Lachlan Catchment (2006)	"The aim of this project is to provide information regarding vegetation distribution in the Lachlan catchment. This information is intended to act as a foundation from which strategic investment into vegetation and biodiversity management at a whole of catchment level may be guided". *Page 1*	< 10% remaining - Blakely's Red Gum & Yellow Box open woodland - Yellow Box woodland on flats & alluvial terraces of the slopes - White Box- Cypress Pine Woodland - White Box Kurrajong woodland - Inland Grey Box Woodland
Lachlan Catchment Action Plan (2006)	"By 2016 there is an increase of 145 000 hectares of terrestrial native vegetation that is being actively managed for biodiversity conservation. *Page 21* "Identify areas of suitable seed source on a sub catchment basis and establish seed collection programs in partnership with relevant organisations; Establish areas managed for seed banks for revegetation." *Page 38* "Supply of suitable endemic species and quantities not reliable." *Page 39*	Appendix 4, Table 3 lists *Very High Regional Significant vegetation types within the catchment* that have less than 10% extant remaining. These are as listed above.
***Young District Natural Resources Management Plan* (2003)**	Vegetation and Biodiversity Strategy: - Conserve and enhance existing remnant native woody vegetation -Increase coverage of the districts by native vegetation - Improved weed control across the district *Page 69-72*	'Timber' in district zones defined as remnant, disturbed forest &/ or woodland 1.Bribbaree, Balabla, Weedalion, & Lower Burrangong = 1% (5000ha) 2. Memagong, Tumbleton & Berthong = 1% (5,500ha) 3. Cudgell creek = 1% (550 ha) 4. Bulla & mid Burrangong = 1% (960ha) 5. Upper Burrangong=1% (2300ha) 6. Crowther creek = 24% (13,300ha) 7. Murringo & Wambanumba= 7% (13,600ha)
Upper Burrangong Catchment Management Plan (2001)	"-To encourage maintenance and regeneration of native species across the Upper Burrangong catchment wherever possible - To revegetate 3147ha of the catchment to native trees by 2050 - To have 80% of streambanks revegetated with native species by 2050". *Page 6-2*	Total Upper Burrangong catchment tree cover = 3.4%. No specific data provided for vegetation type.

Young Shire Remnant Vegetation Survey and Management Guidelines (2001)	"In the majority of cases indigenous or local species should be used in revegetation. The greatest value to wildlife is achieved by using those species which occur naturally in the district. Propagation of seedlings from local seed in strongly recommended as these are adapted to the local conditions and should establish well. Some exemptions occur where the site is so modified that the original species will no longer grow in the area……species should be matched to soil type, topography and aspect of the site". *Page 23*	No specific data provided for vegetation communities however the roadside survey conservation ratings for 830km of road was 26% high; 40% medium and 34% low
Identification of priority local landscapes for conservation planning in the South west slopes bio-region (2009)	"The Dananbilla Local Landscape contains some very large native vegetation remnants, including large areas of relatively intact grassy woodlands, some of the best examples of lowland grassy woodlands that remain in the South West Slopes Bio-region…….The key challenge for conservation planning is to formalise the Conservation Planning already undertaken as part of the Protected Areas Network, and to continue implementation, particularly in and adjacent to the Murringo landscape". *Page 53*	% Mapped extant tree cover 14.76% (11,497 ha). No specific data provided for vegetation type.
Stage 2: Bland Creek Catchment Action Plan & Sub catchment Work Plans (2002)	"Identifying priority areas for conservation, restoration and enhancement; and the threats to native vegetation and biodiversity are the key research actions ….Further actions require planting at the property and catchment levels, with education and on-ground actions being strong on practical applications." *Summary Page*	No native vegetation data was accessible to the project to allow a detailed analysis of vegetation decline in the Bland creek catchment. *Page 21*
Mid Lachlan Regional Vegetation Management Plan (1998)	"… the development of this regional plan reflects a growing recognition within the rural community of the impacts of past management practices on the natural environment. It also reflects a growing willingness to embrace opportunities and benefits provided by integrating healthy and sustainable native vegetation into a sustainable and productive agricultural landscape." *Page 3*	No data provided

3. Key Steps for Developing a Seed Supply Strategy

Steps	Priority Actions	Guidance
Community engagement	• Select a lead person or group • Generate community interest through participatory activities where they are valued, are making a difference in the landscape and contributing to their own health and well-being as well as others	Section B:5
What seed is needed	• Stocktake provenance seed for current and upcoming projects and plant propagation • Identify seed supply gaps and target field collections or establish seed production areas • Scope and initiate new projects needing seed. • Identify funding sources and partnerships	Section B:6and 10
Plan for seed collection	• Develop a seed collection action plan • Appoint a harvest co-ordinator • Identify seed harvest capacity and capability -build a network of skilled, well-resourced seed collectors who are adequately equipped	Section B:7 and 8
Seed harvest	• Manage seasonal seed collections across the region to maximise efficiencies	Section B:7& 8
Develop a seed supply service	• Scope the need and viability for a community seedbank in the region • Develop a seedbank business and operational plan	Section B:9& 10

SECTION B: Seed supply guidance

1. Box Gum Woodland and other Native Vegetation Associations

Species are not necessarily restricted to a specific vegetation type such as Box Gum Woodlands (Refer to Section B:2). This benefits revegetation and restoration activities across different landscapes and demonstrates the flexibility of species to cope with soil, altitude, aspect, rainfall and temperature variability.

Native plant communities covered by this document are diverse. This is reflected in Figure 2 showing 17 different vegetation communities. This detailed data comes from the *Reconstructed and Extant Distribution of Native Vegetation in the Lachlan catchment* (DEC 2006). This document and four other references are of particular use to the local seed collector and/or land carer working in box gum woodlands. Even though plant community descriptions are broader in the publications listed below they will support any seed supply activity in the following ways:

1. *Young Shire Remnant Vegetation Survey and Management Guidelines* (Hudson 2001). This report covers most of the seed supply area identifying broad vegetation types and areas of significant remnant vegetation including a roadside species inventory with a conservation rating for 830km of road.

2. *A Practical Guide to Revegetation in the mid Lachlan Region.* (Sydes et al 2003). This publication describes plant community types with distribution maps (capturing the northern end of (this seed supply strategy), species descriptions and revegetation guidelines.

3. *Mid Lachlan Regional Vegetation Management,* (Land & Water Conservation 1998) This document includes landscape and vegetation profiles based on districts such as Young Hills and Rises and Tyagong Creek. The profiles include geology and soil type.

4. *The Native Vegetation of Boorowa Shire* (Priday et al 2002) captures the eastern section of this seed supply strategy with a map showing the extant of remaining vegetation and plant community descriptions with species associations.

Of the 17 plant communities identified by DEC (2006) for this area, 4 are listed as an Endangered Ecological Community (EEC). They are all box woodlands and are listed with both the Commonwealth and/or State. They are:

I. *NSW Threatened Species Conservation Act 1995* (TSCA) and
II. *Commonwealth Environmental Protection and Biodiversity Conservation Act*, 1999 (EPBC)

Table 2 lists vegetation types as classified DEC (2006). Figure 2 shows the remaining distribution of these different vegetation types.

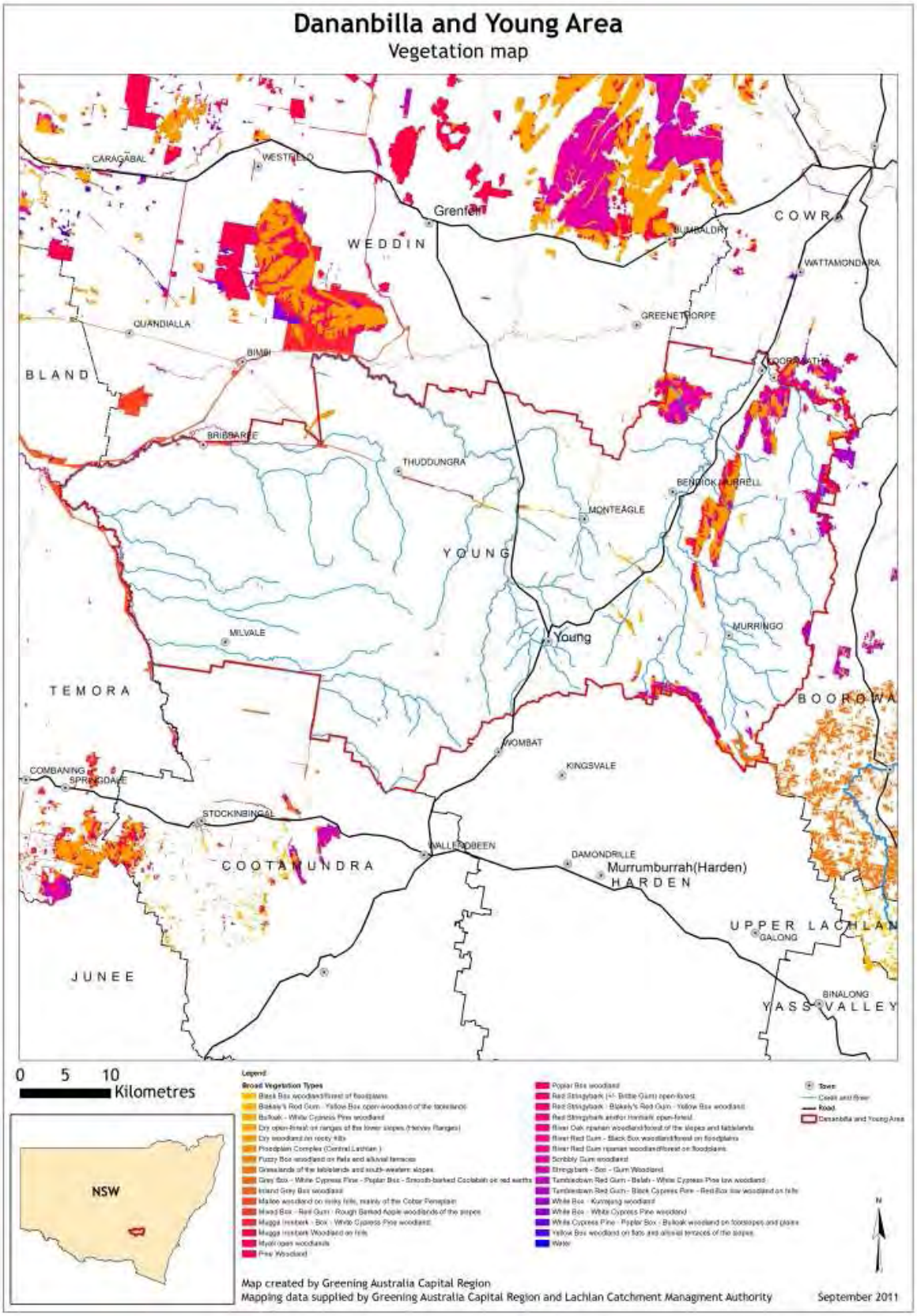
Table 2: Broad Vegetation Types (BVT) in the Young District & Dananbilla – Illunie Range

Vegetation Type & Description	Listing
BVT 46 Blakely's Red Gum - Yellow Box open-woodland of the tablelands Dominant species *E. blakelyi* (Blakely's red gum), *E. melliodora* (yellow box), *E. bridgesiana* (apple box), +/-*E. albens* (white box). Listed in NSW as a '*White Box-Yellow Box-Blakely's Red Gum (box-gum) woodland*' EEC and with the Australian Government as a *Box Gum Grassy Woodland* EEC.	Yes
BVT 78 White Box - Kurrajong woodland This BVT is widely distributed on the western slopes on a variety of substrates. White box has usually been heavily thinned where the country is used for grazing, or cleared for cultivation. Often only the kurrajong are left, as the foliage is palatable to stock. Listed in NSW as a '*White Box-Yellow Box-Blakely's Red Gum (box-gum) woodland*' EEC and with the Australian Government as a *Box Gum Grassy Woodland* EEC.	yes
BVT 70 Yellow Box woodland on flats and alluvial terraces of the slopes This unit has a very extensive distribution on the slopes and plains. Yellow box grows on fertile sites, ideally suited to agriculture. Consequently little remains of the pre-clearing extent. Often the only remnants are isolated paddock trees and roadside vegetation. The understorey is typically very weedy. Most of this unit within Brigalow Belt South and the South West Slopes Bioregions would be listed in NSW as a '*White Box-Yellow Box-Blakely's Red Gum (box-gum) woodland*' EEC and with the Australian Government as a *Box Gum Grassy Woodland* EEC.	yes
BVT 74 Inland Grey Box woodland Widely distributed throughout the central west and northern slopes, primarily around Temora, Forbes, Tullamore with scattered occurrences north to Coonabarabran where *E. pilligaensis* (Pilliga box) becomes dominant on similar country. Listed in NSW as *'Inland Grey Box Woodland in the Riverina, NSW South Western Slopes, Cobar Peneplain, Nandewar and Brigalow Belt South Bioregions*' EEC and listed with the Australian Government as a *'Grassy Woodlands and Derived Native Grasslands of South-eastern Australia'* EEC	yes
BVT 5 Red Stringybark (+/- Brittle Gum) open-forest-Typical remnants of Red Stringybark open-forest with a grassy understorey grow on relatively steep sheltered slopes	
BVT 6 Inland Scribbly Gum woodland some sizeable stands on ranges and hills west of Cowra.	
BVT 8 Dry open-forest on ranges of the lower slopes (Hervey Ranges) **Dominant species**	
BVT 12 Red Stringybark and/or Ironbark open-forest The group is broad, principally due to difficulties defining the boundaries of a finer classification. It is essentially characterised by dominance of either *E. crebra* (narrow-leaved ironbark), *E. macrorhyncha* (red stringybark) or *C. endlicheri* (black cypress pine).	
BVT 13 Mugga Ironbark - Box - White Cypress Pine woodland	
BVT 14 Mugga Ironbark Woodland on hills This broad vegetation type occurs on rocky ranges of the slopes and plains. It is characterised by mugga ironbark with black cypress pine, but without species usually found on country of lower relief, such as grey box	
BVT 15 Pine Woodland This broad vegetation type is characterised by large stands of pure cypress pine	
BVT 18 Mixed Box - Red Gum - Rough Barked Apple woodlands of the slopes It occurs in similar situations to BVT 46 'Blakely's Red Gum - Yellow Box open-woodland of the tablelands', with a similar suite of box eucalypts, but can be differentiated by its restriction to the slopes and the absence of *E. bridgesiana* (apple box).	

BVT 30 River Red Gum riparian woodland/forest on floodplains Grows along major watercourses on the slopes and plains and floodplains that receive sufficient flooding for an extended period. Floristic composition of this BVT at its eastern-most extent differs markedly to that growing on the western alluvial plains.	
BVT 42 Tumbledown Red Gum - Black Cypress Pine - Red Box low woodland on Hills Tumbledown Red Gum – Black Cypress Pine – Red Box low woodland on hills' is defined by the presence of *E. dealbata* (tumbledown red gum).	
BVT 45 Red Stringybark - Blakely's Red Gum - Yellow Box woodland Transitional vegetation type indicated by the presence of *E. macrorhyncha* (red stringybark) in combination with box and gum species that typically grow in low, moist and fertile parts of the landscape	
BVT 49 Dry woodland on rocky hills Occurs on rocky hills, usually on siliceous substrates of sedimentary origin. Dominant species *E. dwyeri* (Dwyer's red gum), *C. glaucophylla* (white cypress pine), *C. endlicheri* (black cypress pine), *Acacia doratoxylon* (currawang), *E. sideroxylon* (mugga ironbark)	
BVT 77 White Box - White Cypress Pine woodland Woodland with a grassy understorey, rarely sparse shrubs. Dominant species **:** *E. albens* (white box), *C. glaucophylla* (white cypress pine)	

Source: *Reconstructed and extant distribution of native vegetation in the Lachlan catchment*. DEC (2006)

Figure 2: Extant of Vegetation Communities remaining in the Young district and Dananbilla- Illunie Range



2. Box Gum Woodlands

Yellow Box Blakely's Red Gum Woodland and White Box Woodland are plant communities characterized by a species-rich understorey of native tussock grasses, herbs and scattered shrubs, and the dominance, or prior dominance, of openly spaced trees including White Box (*Eucalyptus albens*), Yellow Box (*E. melliodora*) and / or Blakely's red gum (*E. blakelyi*). They typically occur on fertile clay or loamy soils on alluvial plains, lower slopes, creek flats, slopes and drainage lines.

The ground layer is dominated mostly by perennial grass tussocks. There may be many species of grass such as Kangaroo Grass (*Themeda australis)*, Red-leg grass (*Bothriochloa macra*), Wallaby Grass (*Austrodanthonia* sp.), Tussock Grass (*Poa labillardierei*), Weeping Meadow Grass (*Microlaena stipoides*) and Spear Grass (*Austrostipa sp*). The diversity of herbs such as lilies, orchids, scramblers and daises is higher in Box-Gum woodlands in good condition.

For a comprehensive list of species found in the White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland plant communities refer to the *Environment Protection and Biodiversity Conservation Act (1999)* official listing. http://www.gbwcmn.net.au/sites/default/files/bgw-flora-profile.pdf or the Grassy Box Woodland Conservation Management Network website http://www.gbwcmn.net.au/sites/default/files/bgw-flora-profile2011.pdf

Table 3 lists some of the species associated with Box Gum woodlands in the Young District and Dananbilla- Illunie Range. It draws on vegetation lists from *Young Shire Remnant Vegetation Survey and Management Guidelines* (Hudson 2001), *The Native Vegetation of Boorowa Shire* (Priday et al 2002), *Native Vegetation Resource Package for the Mid Lachlan Region* (DLWC 2001) and *Reconstructed and Extant Distribution of Native Vegetation in the Lachlan catchment* (DEC 2006) to provide a diverse list on which to prioritise seed collecting in the area. The healthier[4] the site to be revegetated the greater diversity of local species that can be used. More resilient species will need to be used on the highly disturbed and degraded sites to survive competition from weeds or dominating native grasses associated with higher soil fertility. For more information refer to Appendix 1 *Revegetation considerations before seed collecting and planting.*

[4] Close to original condition prior to European disturbance.

Table 3: Some plant species associated with Box Gum Grassy Woodlands in the Young District & Dananbilla- Illunie Range

Tree species	
Eucalyptus albens **White Box**	*Eucalyptus goniocalyx* **Long Leaf Box**
Eucalyptus melliodora **Yellow Box**	*Eucalyptus polyanthemons* **Red Box**
Eucalyptus blakelyi **Blakely's red gum**	*Eucalyptus micropcarpa* **Grey Box**
Eucalyptus bridgesiana **Apple Box**	*Brachychiton populneus subsp. populneus* **Kurrajong**
Eucalyptus dealbata **Tumbledown Red Gum**	
Mid-storey species	
Acacia implexa **Hickory Wattle / Lightwood**	*Acacia mearnsii* **Late Black Wattle**
Acacia décora **Western Golden Wattle**	*Dodonaea viscosa subsp. angustifolia* **Narrow Leaf Hop Bush**
Acacia verniciflua **Varnish Wattle**	*Pultenea procumbens* **Bush pea**
Acacia acinacea **Gold Dust wattle**	*Leptosermum divaricatum* **Hill Tea Tree**
Acacia genistifolia **Early / Spreading Wattle**	*Lissanthe strigosa* **Peach Heath**
Acacia leucoclada **Northern Silver Wattle**	*Styphelia triflora* **Five Corners**
Acacia deanei **Deanes Wattle**	
Ground layer species	
Ajuga australis **Austral Bugle**	*Gonocarpus tetragynus* **Raspwort**
Aristida ramosa **Purple Wire grass**	*Goodenia hederacea* **Ivy Goodenia**
Arthropodium minus **Small Vanilla Lily**	*Hardenbergia violacea* **Native Sarsaparilla**
Austrodanthonia racemosa **Wallaby Grass**	*Hibbertia obtusifolia* **Grey Guinea Flower**
Austrodanthonia eriantha **Wallaby Grass**	*Hydrocotyle laxiflora* **Stinking Pennywort**
Austrodanthonia caespitosa **Ringed Wallaby Grass**	*Hypericum gramineum* **Native St. Johns Wort**
Austrodanthonia linkii **Wallaby Grass**	*Laxmannia gracilis* **Slender Wire Lily**
Austrodantonia setacea **Wallaby Grass**	*Leptorhynchos squamatus* **Scaly Buttons**
Austrostipa scabra subsp. scabra **Speargrass**	*Lomandra filiformis subsp. coriacea* **Wattle Mat Rush**
Bothriochloa macra **Redleg Grass**	*Lomandra longifolia* **Long-Leaved Mat-rush**
Bracteantha viscosa **Sticky Everlasting**	*Lomandra multiflora* **Many-Flowered Mat-rush**
Bulbine bulbosa **Bulbine lily**	*Microlaena stipoides var. stipoides* **Weeping Meadow Grass**
Burchardia umbellata **Milkmaids**	*Microseris lanceolata* **Yam Daisy**
Carex inversa **Knob Sedge**	*Oxalis perennans* **Native Oxalis**
Chrysocephalum apiculatum **Common Everlasting Daisy**	*Plantago varia* **Native Plantain**
Craspedia variabilis **Common Billy Buttons**	*Poa sieberiana var. sieberiana* **Snow Grass**
Cymbonotus lawsonianus **Bear ears**	*Podolepis jaceoides* **Showy Copper-wire Daisy**
Cynoglossum suaveolans **Sweet Hounds Tongue**	*Ranunculus lappaceus* **Common Butter cup**
Convolvulus erubescens **Bindweed**	*Solenogyne dominii* **Smooth Solenogyne**
Desmodium varians **Slender Tick Trefoil**	*Stackhousia monogyna* **Creamy Candles**
Dianella revoluta **Spreading Flax Lilly**	*Themeda australis* **Kangaroo Grass**
Dianella longifolia **Flax Lilly**	*Tricoryne elatoir* **Yellow Rush Lily**
Dicondra repens- **Kidney weed**	*Vittadinia cuneata* **Fuzzweed**
Dichopogon strictus **Chocolate Lily**	*Vittadinia gracilis-* **Woolly New Holland Daisy**
Einadia nutans **Climbing Saltbush**	*Viola betonicifolia* **Purple violet**
Elymus scaber **Common Wheatgrass**	*Wahlenbergia communis* **Tufted Bluebell**
Geranium solanderi **Native Geranium**	*Wahlenbergia luteola* **Yellowish Bluebell**
Glycine clandestine **Twining Glycine**	*Wahlenbergia stricta* **Tall Bluebell**
Glycine tabacina **Native Soya Bean**	*Wurmbea dioica* **Early Nancy**

3. Benefits of a Seed Supply Strategy

Benefits derived from a coordinated approach to seed supply between groups such as collectors, nurseries, Landcare, CMA, TAFE, Greening Australia, Universities include ecological, financial and social rewards. They include:

- Improved access to genetically diverse local seed where:
    - Seed suppliers (including nurseries) are aware of local demand for species and can meet it including the supply of hard to source species;
    - Seed spotters can increase collection locations minimising negative inbreeding effects from over collection at popular sites or from small plant populations with limited genetic diversity;
    - Seed users are aware of stock availability and can plan properly and inform of supply gaps;
    - Seed production areas can be established to manage supply gaps in specific species and promote efficiencies;
- Improved results on ground from contributing to:
    - Resilient landscapes with long term habitat complexity and evolutionary adaptation to changing environments;
    - Enhanced diversity of native perennial pasture species available for low intensity grazing opportunities;
    - Increased choice of species to plant or direct seed rather than substituting with non-local or "easy" to collect and grow species that may otherwise simplify species composition of a site;
    - Reduced replacement expenses –using good seed is a small cost relative to the overall cost of revegetation;
- Increased community engagement across all ages and localities through knowledge exchange and practical activities that create new learning opportunities, offer social inclusion and have meaningful outputs such as seed collecting, plant propagation and planting;
- Stimulated local economy through employment and income prospects;
- Enhanced biodiversity across the landscape that will improve resilience to changes in weather patterns and
- Improved long term productivity in agricultural enterprises.

4. State of seed supply in the area

In land restoration and revegetation[5], seed is used to either propagate seedlings for planting, for hand broadcasting or direct seeding using machinery. The origin of seed is critical to the principles of using local provenance species to minimise restoration risks and maximise conservation outcomes; local quality seed usually best establishes and survives.

Drought conditions in NSW over the last decade and the closure of Greening Australia's Cowra's seedbank in 2003 saw a decline in access to diverse regional seed collections and seed collection knowledge. The few nurseries and revegetation companies that did support the use of local seed for revegetation work either used up current stocks, collected small quantities of seed for their own use, found alternate sources even if seed was not locally collected, or substituted species. As a result a provenance seed supply service became fragmented and unreliable.

Enquires about local seed suppliers or nurseries propagating local plant species became more difficult, especially for understorey species. Restoration activities funded through Landcare and the Lachlan CMA principally left the acquisition of seed for seedlings and direct seeding up to the landholder or the preferred supplier to source.

The following seed supply issues were first raised by Windsor (2003) and are still pertinent eight years later with many of the points recently raised again by community groups and individuals.

- There is difficulty obtaining local provenance seed, particularly suitable understorey and groundstorey species.
- There are limited qualified native seed collectors in the region capable of servicing the demands for diverse local provenance seed.
- There are insufficient quantities of provenance seed stored or collected "on spec". Collection is mostly dependent on funding and predetermined orders. This leaves many projects in a precarious situation as seed is not available all year round nor is it available every year.
- As seed is not always readily available, there can be a tendency to use either non-local provenance stock or even non- local native species as a substitution to meet project deadlines.
- Timing and duration of government funding has in the past not allowed sufficient time for the collection of a diverse range and sufficient quantity of seed, then the treatment and propagation of seedlings in tune with the species requirements. Generally it is a two year period from seed collection to planting.

[5] Restoration is the return of a degraded habitat to its original species composition, structure and function. Revegetation is to provide a habitat with vegetation; may not necessarily include original provenance or species composition (Offord, C.A. Meagher, P.F. 2009).

- There is limited coordination of seed demand and supply. Presently there is no formalised network of seed collectors throughout the catchment. This makes obtaining high quality, local provenance seed difficult to locate. The informal seed collecting network may also result in the over servicing of some areas, or limited to no servicing in others areas.

- A lot of time is spent travelling to suitable locations for seed collection, especially when local provenance seed is now a requirement. This increases the costs for seed collectors which are usually not reflected in the sale price of seed. Extensive travel costs may also result in closer and more readily accessible remnants being over collected.

- There is a supply shortage of the more obscure and lesser known species, especially understorey and groundstorey species needed to satisfy biodiversity and conservation objectives. This may be due to the shortage of experienced seed collectors, insufficient funds and low recognition of the costs associated with the collection of these types of species. It is also related to the insufficient knowledge in their propagation (especially more western species). These factors may result in non-endemic or non-native plants being used as substitutes or the incorrect structural components of vegetation communities being planted.

- Plants presently supplied are usually species, which are readily collected and easily propagated which may have implications for biodiversity outcomes. Alternatively, less popular plants such as those that may be prickly, short lived (especially wattles), less showy species and harder to propagate are not often used in revegetation projects. This may have consequences for biodiversity outcomes and long-term ecological integrity.

- The lack of propagation notice leaves many nursery providers estimating stock numbers and species. Surplus stock may mean wastage while shortfalls cause clients to seek plants from elsewhere. Both outcomes having financial and ecological implications

- There is limited quality assurance for high quality seed and seedlings, e.g. collection, storage and propagation in line with Florabank guidelines. There is limited germination viability testing being undertaken.

- Some landholders are still reluctant to incorporate shrubs, particularly wattles, in their revegetation projects.

- Planting season often coincides with peak farming time especially in cropping areas resulting in the planting of tubestock in less than optimum conditions.

- Direct seeding is a bit of an unknown because results vary so much. It is not suitable for all areas or species but can be very cost efficient.

- Limited specialist machinery is available for different terrain and soil, particularly for site preparation and maintenance (rippers, mounders, rotary hoes, specialist spray equipment etc.).

5. Building community knowledge and skill in Native Seed Supply

Building the knowledge and skills in the community to partake in seed supply activities will help achieve sustainable revegetation targets and help stimulate local investment, innovation, networking and empowerment.

It is important to create opportunities for people where they can make a difference and contribute to their own health and well-being.

First identify who in the community is interested in seed collecting, assess their skills, training requirements and what they expect from the arrangement, e.g. payment, volunteer or barter. Improved plant knowledge will provide confidence and encourage a wider group in the community to contribute to a seed supply activities such as seed spotting and spontaneous or targeted collections. Collected seed can be donated, bartered or purchased at market prices.

Plant knowledge is a prerequisite to any seed collection activity. Plant identification training is frequently requested by community from introductory to advanced training. There are always people in the community who are willing to share their knowledge or offer their property as a study site and throw in the odd barbeque or two!

There are many formal training options available to learn more about plants, seed and the local environment. Indigenous cultural values, plant use and landscape knowledge is often over looked and should be considered as part of training events. Where possible encompass the integration of farming systems, the urban environment and cultural values/interests.

Practical training can offer:

- **I day introductory courses** that can be tailored to your area or needs. These are offered by Greening Australia as well as other organisations or training providers (see Section B:11)
- **5 day *Florabank* professional course** coordinated by Greening Australia
- **Conservation & Land Management training** packages. Certificate 1 through to Diploma offered through TAFE NSW Western Institute and TAFE Riverina Institute. These are nationally accredited.
- **Paddock Plants –** Dept. Primary Industries (Profarm course). 1 day training in plant identification.

Other ways the community can be involved in seed supply activities are:

- Start a herbarium of local species for plant identification- colour photocopies of plants in flower and fruit work well and can be located at an easily accessible place such as the local community centre, school or hall;
- Volunteer or financially support the development of a community seed bank;
- Establish community Seed Production Areas that can produce species suitable to be grown in polystyrene boxes, raised wooden beds or in the ground. These plants (lilies, herbs, grasses and grass like plants) can be cared for by individuals, retirees or schools. Refer to Section B:10

6. Creating new projects and calculating seed demand

Revegetation occurs across all landscape types and tenure such as on farms and mines. Forecasting seed requirements can be difficult especially with the future unknowns of vegetation offsets and carbon farming. At present demand is highly influenced by:

- land manager interest e.g. farm improvements
- the availability of environmental funding- state, regional and local
- catchment priorities e.g. Lachlan Catchment Action Plan and
- legal obligations andstatutory planning conditions .

Do you need seed?

Before planning to collect seed

1. Question whether seed needs to be collected (or not) based on stock availability. There may already be adequate volumes of the desired species in stock. Unnecessary collections could lead to seed wastage and affect natural regeneration.

   Poor provenance and species availability may open income or volunteer opportunities for people interested in growing, harvesting and using local native seed. Refer to Section 11 for seed suppliers.

2. Investigate if it may be preferable or easier to grow a specific species from cuttings or plant division. Plant division is where a plant, particularly tussock grasses or similar, can be is split into two or more pieces all of which have roots attached. Cuttings and divided plant material should be collected from a wide selection of parent plants in the area following similar guidelines to seed collecting.

Scoping project opportunities needing seed

Cross Property Boundary Corridor Project

In the Dananbilla – Illunie Range continue to implement property plans initiated as part of the *Communities in Landscapes* project co-ordinated by Susie Jackson at NPWS. Continuing this work will complement activities undertaken as part of the:

- NPWS Dananbilla Protected Areas Network. This has involved voluntary Conservation agreements to enhance connectivity between the several small conservation reserves in the landscape, and to create large viable 'core areas' of habitat.
- The Lachlan CMA' focus landscapes project designed to protect, enhance and increase the amount of native vegetation through educational events, fencing incentives, revegetation and establishment of paddock tree clusters. http://www.lachlan.cma.nsw.gov.au/ourprojects/pages/focuslandscapesproject.aspx
- The Lachlan CMA squirrel glider project focusing on education and improved habitat. Activities include nest box instalments, removal of life threatening barb wire, planting of appropriate trees and shrubs for feeding and breeding and control of pest animals.
- Birds Australia *Birdlife IBA* (Important Bird Area) recommendations to conserve sites of global importance of which the south west slopes is one of 62 in NSW. http://www.birdata.com.au/iba.vm

The Dananbilla- Illunie landscape contains some very large native vegetation remnants, including large areas of relatively intact grassy woodlands, some of the best examples of lowland grassy woodlands that remain in the South West Slopes Bio-region. (Jones et al 2009)

Reversing paddock tree decline

In 2011 Greening Australia received funding from the Australia Government's *Caring for our Country* program to fund revegetation works in the upper and mid Murrumbidgee Catchments until 2013.

The *Whole of Paddock Rehabilitation* (WOPR) project, developed by Greening Australia, addresses land restoration at the paddock scale. It requires approximately 12 different tree and shrub species seeded at the rate of ~260g/km using a single furrow. More information about the WOPR model and funding is available by phoning (02) 6253 3035 or at http://www.greeningaustralia.org.au/uploads/Our%20Resources%20-%20pdfs/ACT_WOPR09.pdf.

Corridor Linkages

Travelling stock reserves and routes in the Young district exhibit some of the best examples of quality box gum woodlands left. While Hudson (2001) identified their importance in the landscape for habitat linkages, Zelnik (2010) detailed why through plant diversity, vegetation type and other values such as cultural importance, size and corridor linkages. It is from this data that Young Landcare is keen to develop a project in partnership with several stakeholders. Although in the concept stage it is envisaged that the Quamby Road / Monteagle stock route become an environmental hub for learning and doing. Activities likened to Wirraminna Environment Education centre at Burrumbuttock have been proposed as it too had it origins as a stock reserve. Creek and woodland revegetation, plant propagation, water bug surveys, walking trails and a learning/ meeting centre are among the possibilities. It is here that the Young seedbank would be established and develop a strong relationship with the *Weddin Community Wild Plant Nursery,* given its relatively close proximity.

Burrangong Creek

The Burrangong creek flows through the town of Young but, like many urban waterways has been subjected to significant modifications as a result of early settlement and town development. The floods of 2010 saw significant infrastructure and bank stability damage to the already degraded system affected by over 100 years of weed infestation, variable water quality and lack of native vegetation. The opportunity exists for Young Landcare to partner with Young Council and other stakeholders to progress improvements beyond the capabilities of council's current works program.

The strategic reintroduction of local native species along the riparian zone and on the upper slopes and banks (that would have been representative of box gum woodland), will "*Protect and enhance the natural environment and provide a proactive approach to environmental management of air, land, water & biodiversity*". This target is identified in Young Shire Council Community Strategic Plan 2011-2021 and supported by similar catchment plan recommendations such as the Upper Burrangong Catchment Management Plan (2001).

Understorey species

Herbs, lilies and daises, otherwise known as wildflowers, are a fundamental component of Box Gum Woodland structure and function. Diversifying seed and plant availability beyond common tree and shrub species will improve species selection when revegetating, create new project opportunities and raise the profile of these plants.

Groundcover plants are aesthetically pleasing, offering scope to promote and use in both rural and urban environments e.g. Water- wise gardening. Their diversity, colour, texture, form and beauty does capture ones attention. School children and their families, retirees and aged care groups could grow plants for seed related projects. For instance a Grassy Box Woodland wildflower community garden could be established in a high profile area such Young township or one of the smaller towns and villages such as Bribbaree, Thuddungra, Tubbul, Monteagle, Bendick Murrell, Murringo, Koorawatha, Maimuru and Milvale.

Research: There are opportunities for the Landcare groups to actively engage with Greening Australia as part of its BBUD program. *Bringing Back Understorey Diversity* aims to raise the profile and use of groundcover species that are not commonly available for revegetation work. Project opportunities that could be explored include establishment trials (e.g. seed versus seedling application, ground preparation especially in weedy sites) germination cues, locating and collecting new seed and plant material and intensive seed production for small plants and even translocation of threatened species.

Indigenous engagement

Plants found in Box Gum Woodland were used by indigenous groups for a wide range of purposes. Whilst most promotion is about plants as food (or bush tucker), plant parts were used for multiple purposes such as medicine, implements, weapons, fibre, shelter, water supply, fire, trade, burials and ceremonial purposes. *Wiradjuri Plant Use in The Murrumbidgee Catchment* (Williams & Sides 2008) has helped raise the significance and cultural value of plants including species found in box gum woodland.

Exploring the use of local plants in the landscape with local indigenous groups presents cross cultural training opportunities, enhance recognition of indigenous knowledge in landscape management. It also demonstrates the value of local native plants to address sustainability, climate change, promote plant conservation and business opportunities.

Project opportunities should be explored with the Lachlan Aboriginal Natural Resource Management Group (LANRMG), established by the Lachlan Regional Aboriginal Reference Group and Lachlan CMA. LANRMG aims to create healthy and sustainable environments by identifying and supporting Aboriginal communities and their leaders through Natural Resource Management (NRM) activities and training. A focus is healthier river systems and landscapes.

Collaborating project ideas with partners

- Use local & state prepared biodiversity and vegetation action plans as a partnership and planning guide e.g.
  - *Lachlan Catchment Action Plan 2006*;
  - *Mid Lachlan Regional Vegetation Management Plan* (RVMP 1998);
  - *Young District Natural Resources Management Plan* (Hassall & Associates 2003)
  - *Upper Burrangong Catchment Management Plan* (Williams 2001)
  - *Stage2:Bland Creek Catchment Action Plan and sub catchment works plan* (GRC et al 2002)
  - Young Shire Council Community Strategic Plan 2011-2021 (YSC 2011)

- Liaise with local advisory and interest groups to share ideas, network and co-invest in seed supply operations and infrastructure. Consider how best to work with these groups even though there may be established links with other activities. The Young Shire Council website has a community page that may inspire some new contacts and project ideas (http://www.young.nsw.gov.au/opening_page.htm). Groups such as Young Landcare, Young Shire Council, farmer groups, garden clubs, local progress association, Greening Australia, Grassy Box Woodland Conservation Management Network, Conservation Volunteers Australia, GreenCorps, local plant enthusiasts and the Lachlan CMA are among potential stakeholders who can support activities.
- Cultivate links between local nurseries, revegetation contractors and other seedbanks.
- Work with Greening Australia to ensure provenance seed and plant material is available for revegetation e.g. trading portal http://www.grassywoodlands.org.au/SeedPlants/AccessingDatabase.aspx.

Calculating seed demand

Before calculating how much seed is needed for a project, a decision needs to be made on what revegetation technique will be used. There are three techniques that are commonly used for revegetation: tubestock planting, direct seeding and natural or assisted regeneration.

The selection of a technique or a combination should be predetermined by several elements such as existing site conditions, area to be revegetated, input required, funds available to implement and manage, species availability and future land use, e.g. windbreaks, controlled grazing, salinity abatement and/or habitat corridors. Appendix 1 provides information about revegetation considerations. Table 4 provides some useful contacts to ask about best revegetation options for a site but also consider other local land managers who have already done revegetation work.

Table 4: Example of calculating revegetation seed requirements

Landcare Group				
Objective:	Promote the conservation and protection of grassy woodland ecosystems in our Catchment through restoration actions			
Action:	Restore a grassy woodland ecosystem to 1,000 ha of existing native pasture, improved pasture country, or degraded areas			
Buffer:	Assume 10% risk of failure, thus target 1,100 ha for intervention and improvement or plan for resowing/ or replacement planting over 1000ha).			
Techniques Available:	Assisted regeneration with hand-broadcast of native seed	Direct seeding of windbreaks / shelterbelts	Direct seeding of paddocks (*Whole of Paddock Rehabilitation)	Planting tubestock of trees / shrubs / grass species
Assumptions:	Site in good condition with tree regeneration (e.g. fenced remnant with key species missing) Reintroduce key species from mid- or groundstorey	Windbreaks / shelter belts at least 15 m wide with 5 rows of trees and shrubs of target species Limited focus on restoring groundstorey diversity Appropriate site preparation and follow-up	Paddocks' average size 20 ha Direct seeding on contour with 4 rows 5 m apart Limited focus on restoring groundstorey diversity (select sites that are predominately native pasture) Appropriate site preparation and stock exclusion, follow-up by 20 ha paddock seeded at a density of 750 lineal metres/ha to target the development of a woodland community structure	Planting density at 500 stems / ha Appropriate site preparation and follow-up
Areas Treated:	10% of target total = 110 ha	15% of target total = 165 ha	45% of target total = 495 ha	30% of target total = 330 ha
Input Required:	1 kg/ha (large seeds) 5-10 kg/ha (grasses) 0.25 kg/ha (groundstorey forbs & herbs)	330 km direct seeding 200 g/km fine seed species 60 g /km large seed species	Using 195 g/ha: 150 g ha fine seed species 45 g/ha large seed species	165,000 tubestock Using a ratio of 15:45:40 for grasses:shrubs:trees
Example of Indicative Seed Requirements to restore 1,000 ha with a balanced approach	110 kg for large seed (diverse shrubs) 28 kg small seeds (high-value groundstorey) 5 kg grasses	66 kg fine seed (eucalypt) species 20 kg large seeds (shrub) species	74 kg fine seed (eucalypt) species 22 kg large seeds (shrub) species	2 kg fine seed (eucalypt) species 3 kg large seeds (shrub) species 5 kg grasses
TOTAL to restore 1,000 ha	**Groundstorey Forbs and Herbs: 28 kg** **Grasses: 10 kg** **Shrubs: 158 kg** **Eucalypts: 142 kg**			
Annual requirement over 20 years, treating 55 ha / year	**Groundstorey Forbs and Herbs: 1.4 kg** **Grasses: 500 kg** **Shrubs: 8 kg** **Eucalypts: 7 kg**			

7. Seed collection planning: places, permits and provenance

Coordinating seed collection

Before any seed is collected a harvest plan will help direct energy and maximise efficiencies. It will need to:

- Identify a co-ordinating body
- Name a target list of species to collect or externally source over the course of the seasons
- Encourage pre ordering and consignment of seed in advance of need. A guaranteed purchase or use will enable seed collectors to plan ahead and invest in seed collection
- Start a seed spotters network to locate and record on a database suitable seed collection sites on private and public land. Enlist the help of farmers, Livestock Health & Pest Authority Rangers, CMA staff, and vegetation clearing personnel/contractors such as Council workers who can observe plant flowering, good seeding populations seeding and seed ripeness.
- Develop a local seed collection ripeness calendar – Refer to Appendix 6 for guidance
- Investigate which species need to be established in Seed Production Areas (SPAs) and develop these on private or public land. Visit other SPAs in operation especially in the Royalla area.
- Source relevant seed harvest permits and licenses.
- Produce vegetation profiles across the landscape and cross reference with soil type to help guide best species selection when revegetating. Refer to Appendix 2 and any existing roadside or travelling stock reserve vegetation surveys.

Permits & permission

Before entering any site to assess for seed harvest opportunities or to collect seed consider the following:

- Ownership /accessibility
- Permit requirements. A summary of permissions and licences is summarised in Appendix 3 noting in particular that seed collected from Threatened Ecological Communities or specific threatened species will require a licence from the NSW Office of Environment & Heritage. Threatened plant collections require a specific request with specific conditions attached regarding use and end point of the material
- Who may already be collecting from the site? This will minimise over-collection of particular genetic traits in plants or targeted locations. Some people can also be protective of their collection site.

Locating good seed collection sites

There are many resources available to help locate and track suitable seed harvesting sites. References include vegetation maps, species lists and local knowledge. Table 5 below lists some useful local contacts and Appendix 5 lists useful plant and seed references.

Table 5: Contacts to help locate and record suitable seed harvesting sites

Contact	Assistance
Lachlan Catchment Management Authority	- Catchment officers have plant knowledge and may be able to help locate seed collection sites - Have good access to species lists and maps. - Website: http://www.cma.nsw.gov.au
Greening Australia Capital Region	- Good plant and revegetation knowledge of the local area Useful seed contacts: Stephen Bruce. - Facilities that provide seed training and volunteer opportunities - Can help identify and manage landscape seed supply
Lachlan Livestock Health and Pest Authority	- Rangers in the Lachlan district are very familiar with the vegetative condition of their travelling stock reserve. They can advise on site access and seed collection permits. Useful contacts- Ron Duggan
Local Government (Young, Cootamundra, Weddin, Cowra and Boorowa)	- Weed officers & environmental staff have good knowledge of plant localities. - Roadside vegetation surveys for Young Shire and the Olympic Highway
Office of Environment & Heritage (National Parks and Wildlife Service)	- Have good knowledge of plant identification localities and potential localities to collect seed - Species lists and vegetation and soil maps - Approve seed collection licenses
Local Landcare Group or individuals	- Plant identification/seed collecting – local land managers and plant enthusiasts - Landcare facilitator/coordinator can help organise training & events
Murrumbidgee Field Naturalists:	- Branches in Leeton, Griffith, Coleambally and Narrandera. Contact details at http://www.mfn.org.au/contacts.htm - Regular field trips to places of interest
Lake Cowal Conservation Centre	- Facility that provides environmental education and field work opportunities for students, teachers and communities in the Bland Catchment http://www.lakecowalfoundation.org.au/
Dept. Primary Industry	- Agronomists have good native plant knowledge particularly weeds and pasture species associated with grazing
Charles Sturt University	- Lecturers who are involved with field work have a good knowledge of plant locations. Helpful contacts: - Faculty of Agricultural & Wine Sciences - Geoff Burrows or Jim Virgona (Wagga) - School of Environmental Sciences, Thurgoona - Ian Lunt or roadside vegetation specialist, Peter Spooner.
Riverina Environmental Education Centre	- Facility that provides environmental education and field work opportunities for students, teachers and communities in the Riverina Website: www.reec.nsw.edu.au/2002/teachers/texttch/reecinf.htm - Excellent Box Gum Woodland teaching material
Atlas of Living Australia	- The ALA has a facility called 'explore your area' that lists all knows plant and animal species in a 5 km or 10 km radius of any town or map coordinate. For many of the species records it will show a GPS location on a Google earth image http://www.ala.org.au/

How to identify a good seed collection site

Many plants only set fruit annually and drop seed within a few days or weeks of ripening over the summer months. Miss the season and the wait is another year! Knowing where to collect seed in advance of the season will save lots of time and disappointment.

Native seed is generally harvested from wild populations or bushland remnants. Usually these are easy to access locations; roadsides, crown land (including Travelling Stock Reserves), private property and to a lesser extent National Parks and Reserves.

When identifying potential seed collection sites, local plant adaptation and distribution needs to be factored. Plants adapt to survive, germinate, grow and reproduce depending on the local temperature, soil, moisture, altitude and landscape position. It's these principal environmental factors that constitutes genetic diversity within a species and is the driver of healthy seed, plant vigour and the evolutionary material that enables plants to adapt to change over time. Appendix 2 gives an example of a good referencing tool for practitioners taken from the South West Slopes Revegetation Guide.

Research indicates that the following site collection details should be considered when planning to harvest seed:

- Priority should be given to bush remnants with a minimum of 200 plants per species within the local area and preferably connected to other vegetation in the landscape. These kinds of sites are likely to be healthier sites (i.e. fewer weeds using valuable resources) and contain more genetic diversity. Larger remnants are also more attractive to pollinators who will move pollen between plants and remnants, maintaining gene flow and helping to prevent inbreeding. Increased genetic diversity is also important to ensure there is plenty of evolutionary potential to help plants adapt to change. Larger populations also reduce the risk of overharvesting and possibly impacting on animals that need seed to survive.

- It is preferable to travel further (10s km not 100s km) to collect from a healthier stand of at least 20 fruiting plants rather than risk poor seed quality from a smaller unhealthy site closer to the restoration site. Try not to collect from a site that is very different to where you want to plant, e.g. don't collect from a very wet area to plant in an area that's usually dry. Aim to collect less seed from more plants than more seed from just a few or individual plants. Where possible harvest evenly across the population. No single plant should represent more than 30% of the total seed collected in a batch.

- Seed may be collected from several small populations to provide a single seedlot from at least 50 individuals. This may suit neighbouring farmers who can mix seed collected from within close proximity. Guidelines for deciding which populations to collect from can be found in the Florabank Species Navigator under *Navigate Seed Collection Advice.* (http://www.florabank.org.au/default.asp?V_DOC_ID=924

- Correctly identify the plants to the lowest taxonomic level possible (subspecies, variety, forma and sub specific taxa). Updated plant names can found at *What's its Name?* http://www.anbg.gov.au/win/index.html. Good local plant information can also be found at the Atlas of Living Australia, http://www.ala.org.au.

- If the origin (or provenance) of a species is unknown such as a suspect planting it is best not to collect or clearly record this.

Provenance and seed quality issues

Fundamental to the establishment of resilient, self-sustaining revegetation and restoration work is the use of:

1. provenance plant material and
2. high genetic quality seed sourced from large populations.
3. and sustainable seed harvesting.

Benefits are:

- Plants are genetically adapted to local environments
- Able to adapt to changing environmental conditions
- Increased plant survival
- Improved landscape function including interdependence with local fauna and fungi
- Fertile and vigorous progeny
- Decreased risk of "polluting" the local flora gene pool

Risks from using poor quality seed, collected from small populations with low genetic diversity include:

- compromised genetic integrity of a species
- Reduced ability to thrive in local conditions
- Reduced seed set, which is especially critical for species that cannot self-pollinate
- Reduced growth, vigor or production of less fit progeny. Occasionally, different provenances of the same species cannot interbreed, so mixing them will reduce restoration success
- Limited evolutionary potential to help plants adapt to environmental change

Understanding provenance

1. Provenance is based on the idea that local plants are genetically adapted to local environmental conditions
2. Provenance is difficult to predict across different species. This means seed should always be sourced from a large, healthy population even if this means sourcing seed from a larger population that is further away but from a similar environment.
3. More information about provenance can be read on the Florabank website http://www.florabank.org.au/default.asp?V_DOC_ID=891

Greening Australia makes every effort to ensure that collections are followed in accordance to the scientific recommendations. These can be accessed at http://www.florabank.org.au.

Selecting provenance seed for revegetation

Revegetation is a process of artificially re-introducing native plant species into a degraded or altered site by planting or direct seeding. In any revegetation project there are many variables that will influence successful plant growth such as past use and management of the area, site preparation, species selection, correct revegetation techniques and on-going care.

It is important to match the environmental conditions of where the seed was sourced from to where it is going. Matching soil type (texture and geology), slope position, aspect, altitude and rainfall gives the best chance of survival. Environmental similarities between sites are a much better predictor of provenance than geographic distance but collecting from within 10s km rather than 100s km should be factored as part of the "matching" process.

Matching the aims of your revegetation project and its site condition or conservation value will help determine how precise a provenance range needs to be. Refer to Table 6.

Table 6: How precise a provenance range needs to be when revegetating

Site condition for revegetation	Provenance type
Natural vegetation largely intact but does show some signs of disturbance. Will benefit from the re-introduction of local native species that have not and are unlikely to naturally regenerate. Often understorey species that are less resilient to minor disturbances. e.g. A bush block that has been periodically grazed	Seed should be used from a similar vegetation community, soil type and altitude within 10s km rather than 100s km. Seed for each species should be collected from at least 20 fruiting plants from a healthy stand with a population size of at least 200 plants.
Vegetation is degraded but still has reasonable natural species diversity, especially trees and shrubs and resilient ground layer that can cope with regular grazing, weeds and altered nutrient levels.	Seed should be used from a similar vegetation community, soil type and altitude within the local region or sub catchment. Seed should be sourced from a number of plants (>20) from large populations (>200 plants).
Natural vegetation has been extensively cleared, revegetation goals include soil conservation, erosion control and creating windbreaks and woodlots	Seed should be used from a similar vegetation community, soil type and altitude within the broader region (e.g. IBRA Bio region) or catchment. Seed should be sourced from a number of plants (>20) from large populations (>200 plants).

Provenance and soils

The adaptive relationship of local native vegetation to soils can guide provenance zones for seed collection. *The Mid Lachlan Regional Vegetation Management Plan (RVMP 1998)* broadly profiles the relationship between vegetation and soil type however this may not be detailed enough. A good example is *The South West Slopes Revegetation Guide* (Stelling 1998) which profiles the relationship between vegetation and soil type based on catchments and sub-catchments as shown in Appendix 2. It is recommended that the Young district and Dananbilla – Illunie range consider a similar profiling of the region to guide not only provenance collections but plant selection for revegetation.

Jackson (pers.com) has provided some insight into the relationship between species, locality and lithology. Table 7 summarises her observations from driving and mapping all the roadsides in the Young district concentrating on wattles and uncommon species.

Other useful soil references applicable to area covered by this seed supply strategy are the The *Young District Natural Resources Management Plan* (Hassall & Associates 2003) and the *Bland Creek Catchment Action Plan Stage 1: Natural Resource Data Entry* (GRC 2002). Both reports classify and map soils with text focusing on soil health impacts such as acidity, erosion, sodicity and salinity rather than vegetation type relationships. They are however still useful for seed collectors defining provenance. Soil landscape maps are available from the Young office of the Lachlan Catchment Management Authority.

Links to further information about provenance and adaptive relationships are provided in Appendix 5.

Table 7: Species associations with lithology in the Young district and Dananbilla – Illunie Range

Lithology	Locality examples	Species and comments
Cainozoic Alluvium -Deep Alluvial soils	Back creek	Dominant tree species are *Eucalyptus melliodora* (Yellow Box) and *Eucalyptus blakelyi* (Blakely's Red Gum). The only wattles found were *A. dealbata* (Silver Wattle), and very rarely *Acacia verniciflua* (Varnish Wattle) and *A. decora* (Western Silver Wattle). *Callistemon sieberi* (River Bottlebrush) fringe creeks.
Cainozoic Alluvium & Aeolian sands Deep alluvial soils	Back creek, and Morongla and Jindalee areas	*Eucalyptus microcarpa* (Grey Box). This is a highly diverse system, and commonly included *Acacia lanigera* (Woolly Wattle) , A. hakeoides (Hakea Wattle) , A. spectabilis (Mudgee wattle), *A. acinacea* (Gold Dust Wattle) , *Dodonea viscosa ssp. cuneata* (Wedge leaf Hop Bush), *Senna artemesioides* (Cassia) , Myoporum acuminatum (Waterbush) , *Maireana sp.* and *Clematis sp*. Very rare observations include *Eremophila longifolia* (Emu Bush) , *Indigofera adesmiifolia* (Tick Indigo). *Melaleuca erubescens* (Honey Myrtle) occurs in areas once subject to flooding.
Devonian undifferentiated sediments	Willawong Valley -east of Black Range	*Eucalyptus melliodora* (Yellow Box), *E.blakelyi* (Blakely's Red Gum*), E. albens* (White Box), *Acacia implexa* (Hickory Wattle), *Acacia verniciflua* (Varnish Wattle), *A. decora* (Western Silver Wattle), *A. genistifolia* (Early Wattle) and *Cassinia arcuata* (Drooping Cassinia).
Silurian Devonian granites/ Young granites	Extensive around Young area – Moppitty road & small pocket around Murringo	*Eucalyptus melliodora* (Yellow Box), *E. blakelyi* (Blakely's Red Gum), *E. albens* (White Box) on rolling hills. *Acacia implexa* (Hickory Wattle) and *A. decora* (Western Silver Wattle) mostly on crests. In general *A. verniciflua* (Varnish Wattle), *A. dealbata* (Silver Wattle), *Indigofera adesmiifolia* (Tick Indigo) and *Lissanthe strigosa* (Peach Heath)
Devonian Volcanics	Pipeclay road, upper Karoopa lane, Fernhill Rd	*Eucalyptus sideroxylon* (Ironbark) *E. albens* (White Box), *E. blakelyi* (Blakely's Red Gum), Acacia doratoxylon (Currawang) , *Acacia implexa* (Hickory Wattle) , *A. vestita* (Hairy Wattle), *A. verniciflua* (Varnish Wattle), *Dodonea viscosa ssp. cuneata* (Wedge leaf Hop Bush), *Cassinia arcuata* (Drooping Cassinia), *Daviesia ulicifolia* (Gorse Bitter Pea), *Lissanthe strigosa* (Peach Heath), and *Melichrus urceolatus* (Urn Heath)
Silurian Volcanics	Boorowa - Lachlan Valley Way until Woolpack - Illunie, Gungewalla	*Acacia implexa* (Hickory Wattle),), *A. verniciflua* (Varnish Wattle), *Acacia dealbata* (Silver Wattle), *Daviesia leptophylla* (Slender Bitter Pea), *Dillwynia sericea* (Showy Parrot Pea), Gompholobium huegeli (Pale wedge Pea), *Lissanthe strigosa* (Peach Heath), *Melichrus urceolatus* (Urn Heath) and *Styphelia triflora* (Five Corners).
General observations	• *Acacia implexa* (Hickory Wattle) and *A. decora* (Western Silver Wattle) are essentially only on granites. • *Acacia dealbata* (Silver Wattle) widespread. • *Acacia genistifolia* (Spreading Wattle) is linked with poorer soils • *Eucalyptus microcarpa* (Grey Box) and *E. sideroxylon* (Ironbark) have quite a different suite of associated species to that of box gum woodlands.	

8. Collecting local seed

Revegetation success is dependent on many variables such as technical skill and experience, site condition, recent weather patterns and commitment to manage. Many land managers underestimate the importance of the availability of desired species (as seed and seedlings). **It can take up to 2 years to plant seedlings from the time seed is first collected.**

Where to collect seed, based on knowing when and how, requires a blend of local knowledge and standard practices especially when dealing with multiple species. The Florabank Guidelines represent best practice in seed collection, handling, storage and deployment. It should form the basis for any seed collection activity and policy. These guidelines can be freely downloaded from the Florabank website at http://www.florabank.org.au.
or for a summary of best practice seed collecting refer to Table 7.

To assist local collectors, Appendix 6 of this strategy provides a guide to the collection of seed for several native species found in Grassy Box Gum woodland. Noting: all these species occur in other plant communities to some degree. The table will assist seed collectors on the best time to harvest seed for specific plant species, and also provide seed users with a range of performance considerations such as:

- habit and form;
- collection time and harvest method;
- germination pre-treatment, days to germinate, & optimum germination temperature; direct seeding suitability and
- number seeds per gram (range)

Most of the species listed in Appendix 6 are "orthodox" seed[6] (such as wattle and eucalypt) so species can be stored for long periods of time provided that it is dried to around 10% moisture capacity and stored properly in low humidity (between 4-8%) and without fluctuating temperatures. Standard refrigerators are not the preferred method as they can be too moist, especially older models, but sometimes it is the best option available.

Targeted collections and good storage of seed helps during the poor seasons when frost, predation, grazing, unseasonal weather conditions, plant death, poor seed set and fungi attack may affect seed quality and harvest conditions. The rate of deterioration of seed quality depends on storage temperature, relative humidity and seed moisture content, length of storage, and initial seed quality. More information about seed storage is available from:

- Florabank - http://www.florabank.org.au or
- Plant germplasm Conservation in Australia: Strategies and Guidelines for developing, managing and utilising ex- situ collections (Offord et al 2009).

Appendix 4 is a user friendly field data recording template that can be used to record collections and is accepted by Greening Australia.

[6] Seeds which retain their viability after drying. Noting however, some species are more sensitive than others to this procedure and may not store for long periods.

Seed collection best practice

Table 8: Summary of best practice for seed collection, handling, storage and deployment.

Adapted from Carr et al (2010) and Broadhurst pers.com.

Action	Comment
Training / advice	Eg. Greening Australia, TAFE course, Florabank website
Get the plant identification correct	Taxonomy recognises significant variation among plants as subspecies, varieties and races. Keep up with recent taxonomic revisions. Keep these variations in a species separate as you would for provenances.
Get the maximum genetic quality and diversity	Collect from a healthy stand of at least 20 fruiting plants, preferably from 50-100 healthy plants. Collect no more than 20% total seed crop from plants in natural populations.
	Collect from plants at least 3 plant-heights apart
	Only collect from large populations or pool multiple collections from smaller populations.
Match the site conditions at the collection site to those at the planting site.	If genetic diversity and quality can be achieved, collect from similar sites that are close to the planting site (see Florabank Guideline 10.)
	Altitude – collect from sites with altitude +/- 200m of the planting site.
	Soil – similar texture and depth. Salinity and extreme pH are also important.
	Rainfall – Total rainfall and seasonal distribution varies across broad latitudinal and longitudinal gradients. Collecting seed from sites within the same bioregion as the planting site will ensure rainfall is similar.
	Aspect – in hilly landscapes collect from same aspect as planting site (north or south).
	Slope position – In hilly landscapes collect from same slope position as planting site to account for adaptation to soil depth and frost (upper, mid or lower).
Store seed under best conditions possible from collection through to use	Free from pests and disease. Use air-tight containers. Store below 5°C (fridge) for storage > 5 years. For seed to be used within 1 or 2 years, store below 20°C (air-conditioned room).
	Store orthodox seed at 4-8 % relative humidity. (One instrument used to measure relative humidity is the whirling or aspirated hygrometer, also called psychrometer. Two thermometers, a wet bulb and a dry bulb, are used to measure the temperature and calculate the humidity
	Label the seed correctly from collection through to use.
Record/Catalogue seed collected	Record seed collected for future reference e.g. track its collection location and despatch, calculate quantities of seed harvested and number of species. Field recording sheets and database systems are available via Greening Australia.

Helpful tips for group seed collecting

- Nominate a coordinator
- Make sure there are adequate resources of trained person power, equipment and materials to collect seed, dry, clean and store correctly. Noting that the bulk of species are usually ready to harvest for a short duration from November to January - the Christmas/ New Year period when many people are away or busy. Conservation volunteers can be contracted to help during peak periods
- Provide seed collection tools on a hire or loan basis to collectors. It is unlikely that a single seed collector will be able to afford all items.
- In year 1 collect the easier to source desired species to gauge input requirements (e.g. Wattle) with a longer term vision to supplying a more diverse mix of species.
- Ensure best seed collection practices are followed with available advice and quality assurance checks on hand e.g. correct plant identification; collection data sheets completed properly and risk assessments.
- Explore mentoring activities to leverage capacity and develop experience.
- Review seed collection action plan in accordance to newly acquired skills, experience and knowledge, e.g. revising seed collection maps and update seed collection calendar.
- Promote and share seed collecting stories to get people involved.
- Apply current state and commonwealth Workplace Health and Safety practices.

Helpful tips for seed processing

Seed is rarely dry and clean enough for immediate storage. Most collections require drying, seed extraction from the fruit, cleaning of impurities and fumigation.

Prior to any processing, material collected should be placed where it can immediately start to dry, either out doors in the shade or artificially, and preferably to 4-8% moisture content. If the moisture content of the seed remains high, it will soon start to sweat, mould and loose viability. Be aware that ants will take seed drying out doors but often they will take grubs first so they can work to your advantage.

The techniques applied to cleaning seed after it has dried are many and varied. Techniques applied will depend on the type of fruit, seed and equipment available. Care must be taken to avoid damage to the seed and it maintains identity details during seed cleaning. The cleaning steps involved are:

- Separate the seed from the fruit
- Clean the seed of small impurities (such as insects and leaf fragments) and damaged seed, (eg. shrivelled or predated). Methods include sieving, blowing, winnowing, floatation and imbibing the seed followed by gravity separation.

Once clean and dry, and before storage, seed should be treated with $C0^2$ to kill insect eggs and larvae and the seed tested for viability and germinability.

Seed is best stored in labelled air tight containers in the dark. This will minimise exchange of gas, change in moisture content and temperature fluctuations, all factors affecting long term viability. Upon storing seed ii is recommended that seed details are recorded digitally. It can be as easy as an excel worksheet or a specific software package.

Home based seed storage considerations

Individuals often collect seed for their own use (short or long term) or collect for a larger seedbank or collective such as a Landcare group. Often seed is stored without the benefits of facilities offered by better equipped seedbanks. Purchasing equipment can be expensive and space filling.

Here a few questions and answers to help the home seed collectors store seed to prolong seed health

Question 1: **Killing the bugs.** The use of CO^2 is not practical, so what is possible without those facilities? Can the seed be refrigerated instead? Using Paradichlorobenzene or naphthalene blocks (Urinal deodorizer blocks) is not good. Is there something else that the average householder can use?

Answer: *Inspect the cleaned and dried seed for any signs of insect infestation, if not evident, seed can be stored normally without CO^2 Most insects die once seed is dried or placed out into the open to dry. Most insects will die, leave of their own accord or if ants nearby carry off for a protein banquet!*

The fridge *does slow down most insects from feeding and they will not breed once in a fridge but moisture can be an issue especially with fridges that freeze up a lot or generally are moist, During months of high humidity (especially if a home is not air-conditioned), it is normal for some sweat or moisture to build inside the refrigerator when the room air is humid so a dehumidified fridge is far preferable.*

Overnight in the freezer *is a possibility to kill bugs, but there is the risk that the seed would be damaged if the seed moisture content is not low enough and it freezes.*

Naphthalene flakes *as mothballs and blocks are not recommended because of health concerns and you are no longer able to purchase flakes from the supermarkets until further notice http://www.apvma.gov.au/news_media/media_releases/2011/mr2011-02.php*

Talcum powder and other natural mineral powders *is another option. There are suitable products used in organic grain silos to treat insects. One of these products is called* ***Diatomaceous earth,*** *an amorphous silica. The fine powder absorbs lipids from the waxy outer layer of insects' exoskeletons, causing them to dehydrate. In wheat, it is effective in killing adult weevils, but less effective with larvae in the grain. Most effective at higher temperature and lower humidity.*

Question 2: ***What sort of storage containers?*** I initially use old envelopes to store seed of small plants when out in the field. It's easy to write the name of the plant, date and location. I know not to use plastic bags but what about plastic containers with lids for longer term storage?

Answer: *Food grade containers are best, something that is totally airtight (medicine jars, plastic containers, biscuits tins, camping containers with rubber ring on lid). Could be left in envelope and placed into sealed container once seed is dry.*

Question 3**: *Keeping humidity stable***. Do silicon beads work, or are there other methods to use?

Answer: Keep seed inside your house or workplace where the temperature generally remains stable, not the tin garden shed with extreme temperature fluctuations.

Silicon beads are supposed to work to a point and would be good when packing seed in humid weather. Airtight containers and drying and packing the seed in a dry weather (low humidity) period would be best practice.

Question 4: **What is a simple method to test for seed viability** at home and even when collecting seed

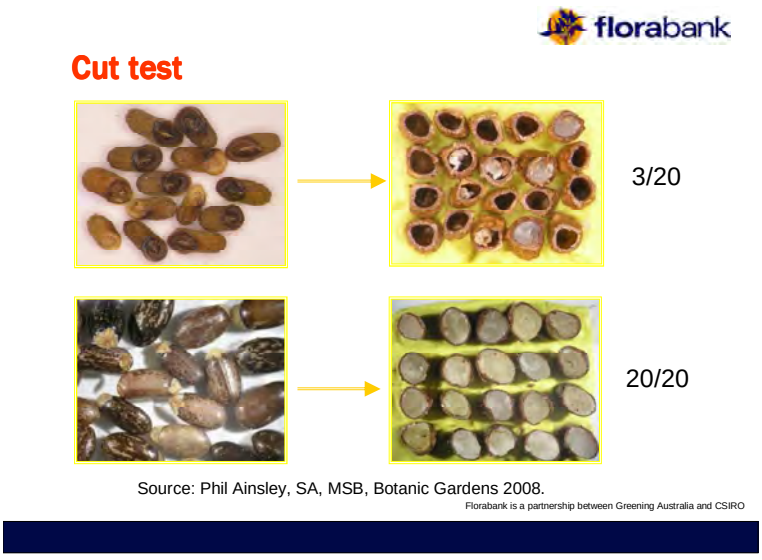
Answer Use the cut test. You cut the seed in half using a nail clipper. Look for intact and healthy embryo, and the endosperm must be clean and firm- see image below. For small seed use a magnifying glass. Eucalypts can be soaked overnight and squished between tweezers of fingernails and should be soft and easy to break. Hard ones are not viable.

To check if the seed will germinate, sow a tray of the seed and see how much comes up. Larger seed could be counted and (25 or 30 seed of each species and replicate 3 times in different trays) and germination averages % worked out from this.

Question 5: **How soon does the seed need to be used**?

Answer Every species is different. Each seed lot will be affected or influenced by localised variables such as how well the seed was dried and storage (humidity and temperature). Refer to Appendix 6 for some species specific guidance.

Figure 3: Viable seed testing results



9. Developing a Native Seed Supply Service

At present there is no community seedbank in the Young area offering collection, processing, storage, coordination, trade/donation, distribution or training services. The nearby town of Grenfell is establishing a seedbank through the *Weddin Community Wild Plant Nursery* and as such collaborative opportunities should be explored. Known seed collection in the Young and Dananbilla- Illunie area is minor, mostly for personal use. The following aims to guide a successful seed supply business and assist individual collectors in the area who harvest for personal use or for commercial purposes.

Starting a Seedbank- There is no definitive business model for establishing and managing a seedbank. Whether a community or commercial seedbank they all vary according to resourcing, partnerships, client base and aims.

To help ascertain the need and viability for a community seedbank in the region consider the following:

- Visit an operating seedbank to see what it looks like, how it is setup and what is involved in managing. Examples can be found at Greening Australia, Australian National Botanic Gardens, CSIRO Australian Tree Seed Centre, Murray CMA- Deniliquin and TAFE NSW Western Institute.
- Scope the need for a "formal" seed banking facility. This will avoid poor storage on farms and in homes can provide a nucleus for regional seed supply and coordination
- Develop a seedbank business and operational plan to:
    - Define market and capabilities[7]
    - Identify location and infrastructure needs
    - Develop operation and logistic procedures- seed acquisition, sales, site management and training.
    - Determine personnel required to manage and operate the seedbank facility, e.g. hours of operation, staff (permanent, contract or seasonal)
    - Availability of skilled staff able to do the work when required
    - Identify purchasing needs and ongoing costs, e.g. what materials would need to be purchased (or shared with other collectors in the region- agriculture seed cleaning equipment can be useful).
    - Explore employment of a seedbank coordinator and under what terms and conditions/ roles and responsibilities
    - Scope funding, partnership or co-investment to establish and manage.
    - Consult Greening Australia, TAFE teachers or other experienced seed collectors to mentor in all aspects of seed supply operations from training and seed banking services to community engagement.

[7] There are potentially 100's of native species to collect seed from. For a "beginner" seedbank target easier to handle species commonly used in revegetation such as eucalypts and wattles. The longer term vision should aim to supply some of the in demand, harder to acquire species. These tend to be difficult to collect seed from for various reasons and/or fiddly to clean such as the bush peas and lilies. Harvesting native grass in bulk is a specialty area requiring expensive harvest equipment and there are businesses already operating who can do this. Ultimately, collect or trade seed according to the need of local projects and interests as the objective is to turnover stock, not keep it in perpetuity.

Seedbank establishment equipment and costs

All native seed banks are setup differently depending upon the scale of operations. Like plant nurseries, seed banks can operate at a small scale with minimal cost as long as the basic requirements are covered. Inputs required will vary according to the availability of existing resources and level of commitment to invest in the operation. Seedbanks have excellent ways to reduce costs and maximise efficiencies such as resource sharing and seed exchange.

Table 8 and 9 list suggested resources and costs needed to operate a medium sized seedbank[8].

Field Equipment, Seed Bank & Office Facilities

The inclusion (or omission) of an item, organisation or business listed below is not necessarily an endorsement (or rejection) of a product or service.

Table 9: Equipment and infrastructure needed if establishing a medium sized seedbank

Equipment and materials	Considerations
Workplace Health & Safety equipment e.g. gloves, vests, First Aid Kit, road signs, masks, hat, boots, mobile phone.	Ensure work cover requirements are met e.g. risk assessments and training.
Office – desk, computer with internet/ GIS, database, field guides, maps, transaction items, photocopier. Plant identification books.	Explore options to share with existing facilities e.g. Landcare, Local Govt. or CMA.
Vehicle (& trailer). Preferably 4WD with a canopy.	Purchase, lease, share or donation.
Shed -drying & processing space (minimum equivalent to 4 car spaces) of dry ventilated space, vermin proof with a hard surface floor such as concrete.	Scope vacant farm sheds or industrial sheds – hire or free for community. Also, consider well ventilated polyhouse or glasshouse if available.
Cool storage seed room. 5-10m^3 or well insulated building to store seed (stable temperature).	Commercial cool room suppliers.
Basic collection and drying equipment – wool packs & buckets, secateurs, labels, bags, drying tarps or racks , pole pruners, plant identification books, access permits and collection licences etc.	Forestry Tools, Prospectors Supplies, Suregro, Treemax (Aluminum sieves), Arborgreen Landscape Systems.
High value cleaning purchase – vacuum separator, Multi-thresher, Kimseed Cleaner.	Kimseed International Pty Ltd.
Seed packaging – CO_2 hire, vacuum packing equipment and heat sealer, scales, storage drums.	Venus impulse Heat sealer, Helix Sealers, Wedderburn scales (annual calibration needed if selling seed).
Seed Supply Database	Use existing databases; Greening Australia Seed Supply System or Murray CMA
Viability and/or germination testing	Outsource options *Seed Solutions*, Botanic Gardens or Greening Australia

[8] There is no recognised definition for a medium sized seedbank. However, based on current operations in Australia it would likely have the capacity to store up to 500kg of seed for at least 20 species, and have the capacity to revegetate anywhere between 500 ha to 15,000 ha depending on direct seeding rate and/or planting density adopted. Influencing factors that will affect the operational scale and importance of a seedbank include: location; rarity and difficulty of species to collect, process, store and use; seed purity (e.g. grass species are mostly collected with florets thus will weigh more but with less seed); seed quality, turnover of stock and whether community or commercially operated..

Seedbank establishment costs

Table 10: Cost example to establish a seedbank

Item	Rate / supply option	Total ($)
Seedbank coordinator position		
* Project Coordination –salary	1 FTE – trained in seedbank operations	$55,000-$70,000
* On costs - Super, insurance etc….	Approximately 12% of salary	-
Seedbank infrastructure		
* 4WD Vehicle for field work	Lease, purchase, donation or in-kind contributions	variable
* Seed bank office	Lease, purchase, donation or in-kind contributions	variable
* Office fit out-Furniture, computer, camera, GPS, internet, phone etc….	Lease, purchase, donation or in-kind contributions	variable
* Seed shed	Lease, purchase, donation or in-kind contributions	variable
Seed bank facilities - seed storage room, drying trolley, separator, thrasher, air con/ dehumidifier, scales	Assumes shed space already available. Purchasing will depend on what is needed and what is already available.	$30,000
* Seedbank operating costs & consumables eg. seed bags, WH&S gear, harvest licences, phone and internet access, electricity, rent, vehicle fuel etc….	Cost highly influenced by in-kind contributions	variable
* Community Training workshops	Room hire, travel and accommodation for guest speakers, catering, training resources, promotions.	$15,000
Seed float – to commence trade		$10,000

***Factor in Annual Budget**

Seedbank Coordinator role and responsibilities

A coordinators employment tenure and work schedule will be influenced by the size of the seedbank, turnover of stock, level of community volunteering and incorporation of other responsibilities and seasonal demands that include:

Summer- Peak seed harvest & drying;
Autumn – Seed processing & storage;
Winter - Data entry, mapping, potential seed site inspections;
Spring – Seed check prior to collection, harvest.
All year- training, business development, promotions, seed trade (spring peak), woody fruit collection, e.g. eucalypts

Salary range $55,000-$70,000 fulltime

Seedbank Coordinator duties:

- Establish an operational community seedbank facility e.g. Source equipment, venue, vehicle
- Install effective systems for tracking seed collected and dispatched
- Prioritise seed supply demands- distinguishing between "bread and butter" and specialty species
- Identify, record and map seed collection sites
- Develop partnerships and networks with stakeholders including nurseries, direct seeders, contract collectors, indigenous community and plant interest groups
- Deliver community seed collection training days
- Provide opportunities for community volunteerism in seed services
- Work closely with the community and government bodies such as the CMA to identify collection areas, seed demand and distribution
- Co-ordinate the sales and purchase of seed including calculate seed prices per species

Funding and grants

There is no known direct funding source to help establish and maintain a native seedbank. Examples of current commonwealth and state environmental grant programs that may fund a seed supply project include the NSW Environmental Trust (available every year) and the Clean Energy Future Biodiversity Fund (available from 2012 to 2017).

The best assistance available to help locate and advise of all funding opportunities is:

- LachLandcare Inc. (Regional Landcare Facilitator) currently Leanne Leihn 02 6385 6285 lfenterprises@boorowa.net
- Young District Landcare Support Officer- Heather Williams 02 6382-5833 /0449568512 landcareyng@live.com.au
- Lachlan Catchment Management Authority www.lachlan.cma.nsw.gov.au

Seedbank risks

In any business, whether community or commercial, there are always risks especially when influenced by seasonal weather patterns and variable demand. Table 10 lists some of the risks associated with operating a seedbank. With good planning and management risk is minimised or dispelled.

Table 11: Seedbank risks

SEEDBANK RISKS			
Major Risk	**Description of Risk**	**Likelihood and impact**	**Strategies to minimise risks**
Funding & Partners	Unable to source adequate partnership to invest in project	Possible: loss of partnership investment redirected to non-project related issues and long term survival of project jeopardised	Keep partners informed of progress and benefit of co-investment thorough regular contact and updates
Community Capacity	Unable to engage community groups, seed collectors, land managers	Unlikely, but will require coordination and liaison with various groups to ensure commitment	Coordinators will ensure adequate consultation, liaison and engagement of all stakeholders
Seasonal / Climatic conditions	Climatic conditions can affect seed production, seed quality and rate of maturation	Likely, will require regular monitoring of seed collection areas	A seed bank coordinator will enable regular monitoring of seed collection sites to notify collectors. Establish seed production areas to have greater influence over seed produced.
Seed supply services	Insufficient seed collected of required species, quantities and provenance for on- ground works. Expectation that seed of any species is available any time of year in quantities required Inadequate data management affect dispatch & tracking of seed	Possible, but impact minimised through forward planning, coordination and liaison with various groups. And, supported by good data management.	A seed bank coordinator will ensure all required seed is available and dispatched to selected on ground work projects
Seed Storage	Inadequate phytosanitary conditions and climate control will shorten the life of seed viability and germinability	Possible seed not stored to *Florabank* recommendations will have poor germination rates, predation, excess moisture and premature dormancy break.	A seed bank coordinator appointed to ensure seed is stored to Florabank standards
Climatic conditions	The risk of unseasonal weather may result in ground works requiring seed such as direct seeding being delayed	Possible: Delay in seed use.	Ensure available space for seed to be stored for a longer period of time.

10: Seed Production Areas- a solution for difficult to source seed

Some species are difficult to collect from wild populations. Carr et al (2010) identify these as:

- the species does not hold its ripe seed for very long[9];
- the species produces small quantities of seed per plant;
- existing populations are rare or are in poor condition;
- populations are not accessible for seed collection because of legislative restrictions; access is not granted (public and private land) or because of site factors;
- plants and populations have a scattered distribution;
- seed is produced sporadically, usually in response to rare, optimal climatic conditions; or
- seeds ripen differentially on an individual plant or within a population.

A solution to collecting difficult seed is the establishment of seed production areas (or SPAs). SPAs allow seed to be produced as a crop so the immediate environment can be manipulated to improve the quality and volume of seed produced. Timing of seed fall can be closely monitored, there is little or no travel involved assessing ripeness, and growing conditions can be manipulated through irrigation, pest animal control and fertiliser application, and all seed can be harvested from a plant instead of the *Florabank* recommendation of 10% -15% from wild stands.

The development of SPAs is still in its infancy but growing in momentum for trees, shrubs and understorey species. It has been shown to be produce larger and more consistent volumes of seed for restoration and cost recovery. With proper planning and design SPAs will improve access to reliable sources of high quality and genetically diverse seed from a broad range of species with varying life history traits.

SPAs are a long term investment, particularly for tree species that may take up to 15 years to produce seed. Returns on most shrubs and understorey are quicker because they usually have annual reproductive cycles. Some understorey (or groundcover) species are short lived whether they are annual, biennial or perennial necessitating forward planning to replace or replenish stock.

The following SPA establishment recommendation should be applied to minimise the risk of poor quality or sterile seed production. Tree and shrub SPAs need to have at least 200 foundation plants per species, collected from a minimum of 20 parent plants (more if possible – up to 50 parents is preferable). For understorey plants such as herbs, lilies and grasses it is preferable to have a population of 5000 foundation plants per species collected from 80-100 parent plants (Broadhurst et al 2012).

More information about SPAs can be found on the Florabank website http://www.florabank.org.au. It includes references such as *the Florabank Guideline 7: Seed Production Areas for Woody Native Plants* and *Introducing Seed Production Areas: An Answer to Native Seed Shortages*.

[9] One solution to overcome this problem is catching seed in an air circulating bag tied to the branch. Cloth bags such as bird banding bags or stockings are durable enough to tolerate different weather conditions for a few weeks. They also exclude seed eaters such as ants.

11: Seed suppliers and propagation service directory

Table 12 lists suppliers in the NSW districts of South West Slopes, Central West Slopes and Plains, Central Tablelands, Eastern Riverina and parts of The Southern Tablelands (including ACT). It is not intended to be a complete list. The inclusion (or omission) of an individual, organisation or business is not necessarily an endorsement (or rejection) of their product or service. Some organisations and businesses service beyond their local district.

Table 12: Seed suppliers and propagation services

X = service provided

District Location	Names of suppliers	Contacts	Seed	Tubestock	Training	Comments
Central West Slopes and Plains	**Bilby Blooms Native Nursery** Anthony O'Halloran Binnaway	02 6844 1044		X		Medium scale nursery – grow from seed supplied, collect local seed, provide service for plant identification www.bilbyblooms.com.au.
Central West Slopes and Plains	**STIPA native grass** (multiple suppliers) Central West and Lachlan	Colin Seis 02 63 759 256	X			Landholders involved in the organisation can contract harvest native grass seed on request. www.stipa.com.au
Central West Slopes and Plains	**Narromine Transplants** Colin Reid Narromine	02 6889 2111		X		Specialise in carbon plantings. Large provenance orders will be considered. www.transplants.com.au
Central West Slopes and Plains	**Grenfell community Nursery** Mikla Lewis Grenfell	0428248325		X		Nursery is aiming to commence operations in 2012. Tubestock from locally collected seed.
Central West Slopes and Plains	**Carnegie Natives** Malcolm Carnegie West Wyalong	02 69 753 418		X		Large scale nursery. Local provenance seed
Central West Slopes and Plains	**Gumtree Nursery** Greg & Lani Weston Young	02 6382 5990		X		Medium scale nursery. Grows local native plants. Can grow from seed supplied. Provenance details on request.

District Location	Names of suppliers	Contacts	Seed	Tubestock	Training	Comments
Central West Slopes and Plains	**Burrendong Arboretum** Jim Dutton (Curator) Wellington	02 6846 7454		X	X	Speciality threatened species seed collection & propagation www.burrendongarboretum.org.
Central West Slopes and Plains	**Oz plants** Mark Eisenhauer Cowra	02 63 422 010		X		Medium scale nursery mostly trees and shrubs. Local provenance seed collected. ozplants@iprimus.com.au
Central West Slopes and Plains	**McDonalds Farm Trees** - Allan McDonald Darby's Falls	02 63 451 922		X		Large scale nursery that supplies local native plants. Provenance details can be provided.
Central West Slopes and Plains	**Outback Harvest** Andrew Knop Dubbo	6889 7050 0407 937 610	X		X	Central West provenance seed collection - trees & shrubs. Revegetation and ecological restoration planning & design.
Central West Slopes and Plains	**Diversity Native Seeds** Geoff Williams Coonabarabran	02 6842 2959	X			Specialises in bulk native seed for use in direct seeding and for selected species will supply smaller quantities. Extensive seed production area.info@diversitynativeseeds.com.au
Central West Slopes and Plains	Toolijooa's Central West Green Team	**Head Office:** 02 9986 1859	X	X		Works with 12 Councils across the Central West of NSW as part of the Central West Salinity and Water Quality Alliance, an initiative funded by the Central West CMA.
South West Slopes /Eastern Riverina	**Matt & Lee Crosbie** Tarcutta	0413 821 798	X			Native grass specialist. Machine harvest Tarcutta- Wagga-Holbrook area.
Southwest Slopes & Riverina	**Coleambally Saltbush Native Nursery** Coleambally	02 6954 4215		X		Medium scale nursery. Local provenance seed collected targeting mid & lower Murrumbidgee / Lachlan.
South West Slopes /Eastern Riverina	**Jayfields Farmtree Nursery** Tim & Kelly Glass Holbrook	02 6036 7235		X		Large-scale nursery supplying a variety of tree, shrub and understorey species. Provenance details can be provided. Supply area south – central NSW. www.jayfieldsnursery.com
South West Slopes /Eastern Riverina	**Landcare Community Nursery** Tumut	0427568131 02-6947 4339	X			Tubestock from locally collected seed.

Table 12: Seed suppliers and propagation services continued

Location	Names of suppliers	Contacts	Seed	Tubestock	Training	Comments
Central Tablelands	**Colin Seis** Gulgong	02 63 759 256	X			Supply of native grass seed on request. No machine hire anymore.
Central Tablelands	**Australian Seed Company** Hazelbrook www.ausseed.com.au	02 475 86132	X			Grass, trees, shrub and understory seed. Provenance details can be provided for many collections of eucalypts and acacias.
Central Tablelands	**Lithgow and District Community Nursery** Lithgow	02 6353 1126		X		Tubestock from locally collected seed. Prefer to grow to order for Lithgow area.
Central Tablelands	**Dean Environmental Services** Les Dean Molong	0429601843	X	X	X	Collect provenance seeds on requests in the Central West and Lachlan catchments. Small-scale seedbank and nursery Can do hands on seed collecting and nursery training.
Central Tablelands	**SJ Landscape Construction** Scott Lillis Wollar	63734278	X	X	X	Seed collect, propagate & plant in the upper & mid catchments of Central West, Lachlan, Border Rivers-Gwydir, Hunter All. Take a variety of seed work. sjland@hwy.com.au
Central Tablelands	**Farm Trees and Planting Service (Windy Hill)** Orange –Mudgee- Bathurst www.windyhillfarmtrees.com	02 63 628 619		X		Large scale nursery that supply local native plants. Provenance details can be provided. They also propagate plants from seed supplied.
Central Tablelands	**Mike & Sue Pridmore** Rylstone (formerly Badger Ground Native Nursery)	02 6379 1184	X		X	Collect provenance seeds on request. Mainly local collections of trees, wattles & understorey plants. Can do hands on seed collecting and nursery training.
Central Tablelands	**Blue Wren Bush Farm –** Geoff & Judy Windsor Wattle Flat	02 6337 7155		X		Small scale nursery for Bathurst district specialise in local understorey species. Collect own seed.

Table 12: Seed suppliers and propagation services continued

Location	Names of suppliers	Contacts	Seed	Tubestock	Training	Comments
Southern Tablelands (including ACT)	**Greening Australia** Stephen Bruce Canberra Seed & Nursery coordinator www.grassywoodland.com.au	02 6253 3035	X	X	X	Collects, purchases and trades in provenance seed: grass, trees, shrubs and groundcovers. Seed Production Area partnerships. Propagate and sell local provenance plants from own seed or seed provided by client. Tailored training available about managing the natural environment including seed collecting (such as Florabank), plant identification & propagation. Can supply mid and upper catchments of Lachlan, Murrumbidgee and Central west, Hawkesbury- Nepean & Southern Rivers
Southern Tablelands (including ACT)	**Yarralumla Nursery** Canberra www.tams.act.gov.au/live/yarralumla_nursery	02 62072444		X		Supply native plant plants. Provenance details can be provided
Southern Tablelands (including ACT)	**Natural Capital** Gundaroo Owen Whittaker www.naturalcapital.com.au	02 6227 1427	X		X	Collects and supplies provenance native grass, tree, shrub and some understorey species. Native vegetation training. Service Canberra to Hillston.
Southern Tablelands (including ACT)	**Lyndfield Park** Gunning	02 4845 1282	X	X	X	Collects & supplies of tree & shrub seed for over 20 years. Collect from trees mainly within Gunning Shire, seed orchards, & planted trees & shrubs on own farm. http://live.greeningaustralia.org.au/nativevegetation/pages/page126.html
Southern Tablelands (including ACT)	**Roger Warren** Boorowa rogerdwn@bigpond.com	0428 846 355 or (02) 63846355	X			Specialise in Native grass harvesting- will travel
Southern Tablelands (including ACT)	**Australian Tree Seed centre** Canberra	02-6246 4857	X			Provenance tree seed from wild populations and seed production areas. Mostly specialise in forestry seed products. Australia wide. www.csiro.au/org/Australian-Tree-Seed-Centre.html

Table 12: Seed suppliers and propagation services continued

Location	Names of suppliers	Contacts	Seed	Tubestock	Training	Comments
Southern Tablelands (including ACT)	**Seeds and Plants Australia** Canberra Dan Saunders (nee Ganter)	02 6247 7180	X	X		Supply of native plant seed and plants. Provenance details can be provided www.seedsandplantsaustralia.com.au
Southern Tablelands (including ACT)	Tim Booth Canberra (Carwoola)	0416073020	X			Local tree, shrub and bulk native grass. Target south east Queanbeyan
Southern Tablelands (including ACT)	**Alessi Native seeds** Windellama Paul Alessi	0248 445149	X			Supply of native plant seed from Southern Highlands of NSW. Trade large volumes of native grass seed. Provenance details can be provided www.alessinativeseeds.com.au
Southern Tablelands (including ACT)	**Provincial Plants & Landscapes** Canberra	02 62626456		X		Supply native plant plants. Provenance details can be provided. www.plantsandlandscapes.com.au/
Southern Tablelands (including ACT)	Wamboin Landcare Nursery Bywong	02 62369158 (Geoff) 02 62369048 (Roger)		X		Supply native plant plants. Provenance details can be provided

Table 12: Seed suppliers and propagation services continued

			OTHER ASSISTANCE			
Location	**Names of suppliers**	**Contacts**	**Seed**	**Tubestock**	**Training**	**Comments**
Central West Slopes and Plains	**Lachlan CMA** Cowra	02 6341 1600			X	Grass harvesting and sowing machinery not for hire. Available for demonstrations.
Central Tablelands	**TAFE- Western NSW** Marita Sydes – Teacher Orange Rural Skills Centre	02 6391 5777			X	Community seed banking linked to training.
South West Slopes	**TAFE- Riverina** Jeanette Coventry Wagga Wagga Horticulture Tech. Officer	02-69395031		X	X	Community seed banking and small scale nursery sales linked to training.
Central West Slopes and Plains/ Central Tablelands	**Conservation Volunteers Australia** Bathurst -Canberra	Bathurst 02 6331 7711 Canberra 02 6247 7770			X	Volunteer activities can include seed collecting and plant propagation depending on the project activities. Service all areas www.conservationvolunteers.com.au/Training.html.
Central West Slopes and Plains	**Australian Native Plant Society - Central West**	Lyn Burgett 02 6331 9170		X		Advice with plant propagation.
Central Tablelands	**CSU- Little Trees propagation group** Orange	Cilla Kinross 02-63657651	X	X		Small scale local seed collection and propagation for Summer Hill Creekcare, which includes the university and local properties. Will give away to group volunteers or local Landcare groups. Propagate from seed and cuttings. ckinross@csu.edu.au
Central West Slopes and Plains/ South West Slopes	Orange Field Naturalist and Conservation Society Dubbo Field Naturalists Murrumbidgee Field Naturalists	Cilla Kinross Janis Hosking Bill Moller			X X X	http://orangefieldnats.com/ www.dubbofieldnats.org.au www.mfn.org.au/

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Appendix 1: Revegetation considerations before seed collecting and planting

Revegetation by planting (or direct seeding) is a process of artificially re-introducing native plant species into a degraded or altered site. Success of establishment needs to consider the future use of the area relative to the current condition of the site. Condition is directly influenced by:

1. Past history and management such as weed type, persistence and dominance, phosphorous and nitrogen levels, grazing pressure by both pest animal and domestic stock and catastrophic events such fire or flooding.
2. Natural attributes and features such as altitude, soil, rainfall, aspect, slope position and geology especially significant where terrain changes rapidly across the landscape.

Correct species selection for the site

Past History and management:
When choosing species to plant (or direct seed) it is of no benefit to establish less resilient (tough) species in a highly degraded site even though they may have once grown there and are preferred by the land manager or client. This is probably quite obvious for very weedy areas, but for sites persisting with high phosphorus levels it may not be so obvious. (Dorrough et al 2008) found native plant diversity incompatible with high available phosphorous levels over 20 mg/kg (Colwell test). Orchids, lilies, daises and some shrubs (and their mycorrhizal fungi) were largely lost from grasslands while native grasses such as Wallaby and Weeping Meadow Grass were more tolerant, persisting as a small groups of highly productive tolerant native grasses in the presence of exotic annual clovers, grasses and broad leaved weeds.

The introduction of “less resilient” (sensitive) species to altered landscapes could be considered in later years when site conditions improve as a result of no fertilization, revised grazing regimes and influence of older plantings on site soil, temperature, moisture and plant competition.

Carr et al (2010) state that “while it is impossible or impractical to expect to restore ecological communities exactly as they once were, ‘novel landscapes’ can be created which reproduce some of the ecological functions, structure and diversity of past communities on a site. Planning for restoration needs to aim for high survival and growth, rapid building of site resilience (against weed invasion and catastrophic events) and self-sustainability. The species and relative abundances for a chosen revegetation site should be based on collating local knowledge, ecological advice, plant community vegetation descriptions and some reference from the scientific literature. There is no revegetation formula that fits all sites but previous results exhibiting similar characteristics and desired outcomes achieved should be referenced to refine future investment”.

Natural attributes and features
Plants have adapted to suit local site conditions. Plant adaptions are most prevalent in relation to environmental stresses such water availability (rainfall, runoff and soil moisture retention), temperature fluctuations, nutrient availability and exposure to pollination. The correlation of plant species to soil type is particularly strong and helps form the basis for selecting provenance zones. Plants grown from seed from a similar site or habitat matching are more likely to survive long-term and produce viable offspring.

Spacing plants

The spacing of plantings is dependent on the end goal. Nature has not provided any hard and fast rules to follow but observing the composition and density of quality remnants is a good guide. For sites that are to be planted in high quality box gum areas or to represent box gum woodland, the ratio of trees to shrubs to groundcovers should reflect the natural species composition of the area. Generally, trees should be very sparse (no more the 10-15% total cover), the shrub species should be sparse (no more the 20% total cover) but can be planted as small groves (excellent for small insectivorous birds like wren, robin etc.) and scattered individuals. The ground covers can be planted in clumps of minimum 20 plants (approximately 20cm apart) to encourage cross pollination and collectively out compete weeds.

Valuing seed

Referenced from Carr et al (2010)

"Seed is one of the greatest limitations to carrying out revegetation, particularly where direct seeding is a major component in order to keep costs down. The seed that is used is often difficult to collect because of fragmentation of natural stands. Some species only produce seed when the conditions are right, every few years, while others ripen and drop their seed very quickly. Seed is a precious commodity that should not be wasted. Poor quality seed can lead to failure of the revegetation project in a number of ways:

1. The seed fails to germinate or grows slowly. This can be due to collection of immature seed (poor viability), collecting seed from a population which is not big enough to allow outcrossing, or by storing the seed incorrectly. It can also be the result of using seed that is poorly adapted to the environment of the revegetation site.
2. The seed grows into plants with poor resistance to insects and diseases, drought, waterlogging or other adverse conditions. This can be due to insufficient outcrossing, or a lack of sufficient genetic diversity to ensure that some plants survive to sexual maturity. Similarly, it can be the result of using seed that is poorly adapted to the environment of the revegetation site.
3. The seed grows into plants which are incapable of breeding or which produce weak or sterile offspring. This can result from mixing seed from populations with different chromosome numbers or from collecting seed from too few closely related plants, or from plants not sufficiently outcrossed.
4. The plant populations established from the seed fail to adapt over subsequent generations to conditions imposed by changing climates, principally due to a lack of genetic diversity in the population.

Some of these effects will be immediate (poor germination may mean the site has to be re-sown) or long term (the site fails to be self-sustaining due to second generation failure). When measured against the restoration goals, these will lead to failure in the project.
Florabank recommends that provenance should be just one consideration when collecting seed for revegetation. Seed managers must also take account of Taxonomy, Seed Source Populations and Handling and Storage Procedures."

Revegetation Methods

The most common form of revegetation is either planting or direct seeding by machine or hand. The summary table below distinguishes revegetation methods and offers some advantages and disadvantages for each.

NATURAL REGENERATION	PLANTING	DIRECT SEEDING
• Protects and enhances existing remnant native vegetation • Eliminate / restrict disturbance – grazing, weeds, high nutrient levels • Initiate regeneration triggers e.g. fire, select grazing • Supplement with direct seeding or planting methods if required to enhance species diversity and habitat	• Tubestock seedlings • Advanced plants • • Transplant - seedlings - saplings	• Hand seed • Machine eg. Rodden 111 Burford, modified direct driller • Brushmatting/ lay thatch • Hydro seeding/ hydro mulching

Some advantages and disadvantages of revegetation methods

TECHNIQUE	ADVANTAGES	DISADVANTAGES
Natural Regeneration	• Work with what is on site • Results are more natural and can have more diversity especially the ground layer if not too weedy • Hardy because of local genetic material • Low maintenance	• Results unpredictable and influenced by site health, the weather and natural triggers such as soil moisture content • Inappropriate in highly degraded or disturbed sites • May need some assistance e.g. weed control, fencing, select grazing • Can be low species diversity in areas lacking healthy seed reserves to trigger natural germination
Direct Seeding	• Cheaper & simpler than other methods • Mostly use tree and shrub species • Hardy if seed collected locally • Low maintenance • Higher diversity achievable	• Can be difficult obtaining sufficient quantities of seed from a chosen species • Unpredictable germination • Grass and “fluffy” seed hard to use • Inappropriate in some areas e.g. Very weedy, rocky • Requires good site preparation- weeds • Need training in machine use
Planting	• Able to be designed for specific purposes and areas • Low seedling mortality if site prepared properly and suitable species planted • Results are immediate • Select species	• Can be expensive & labour intensive e.g. weed control, tree guards, time to prepare and plant site • Can be hard to source wanted species of correct provenance • High maintenance • Long lead in time from propagation to planting –up to 2 years • Difficult to reproduce a natural balance of species.

Selecting good quality seedlings/ tubestock

Recommendations are:

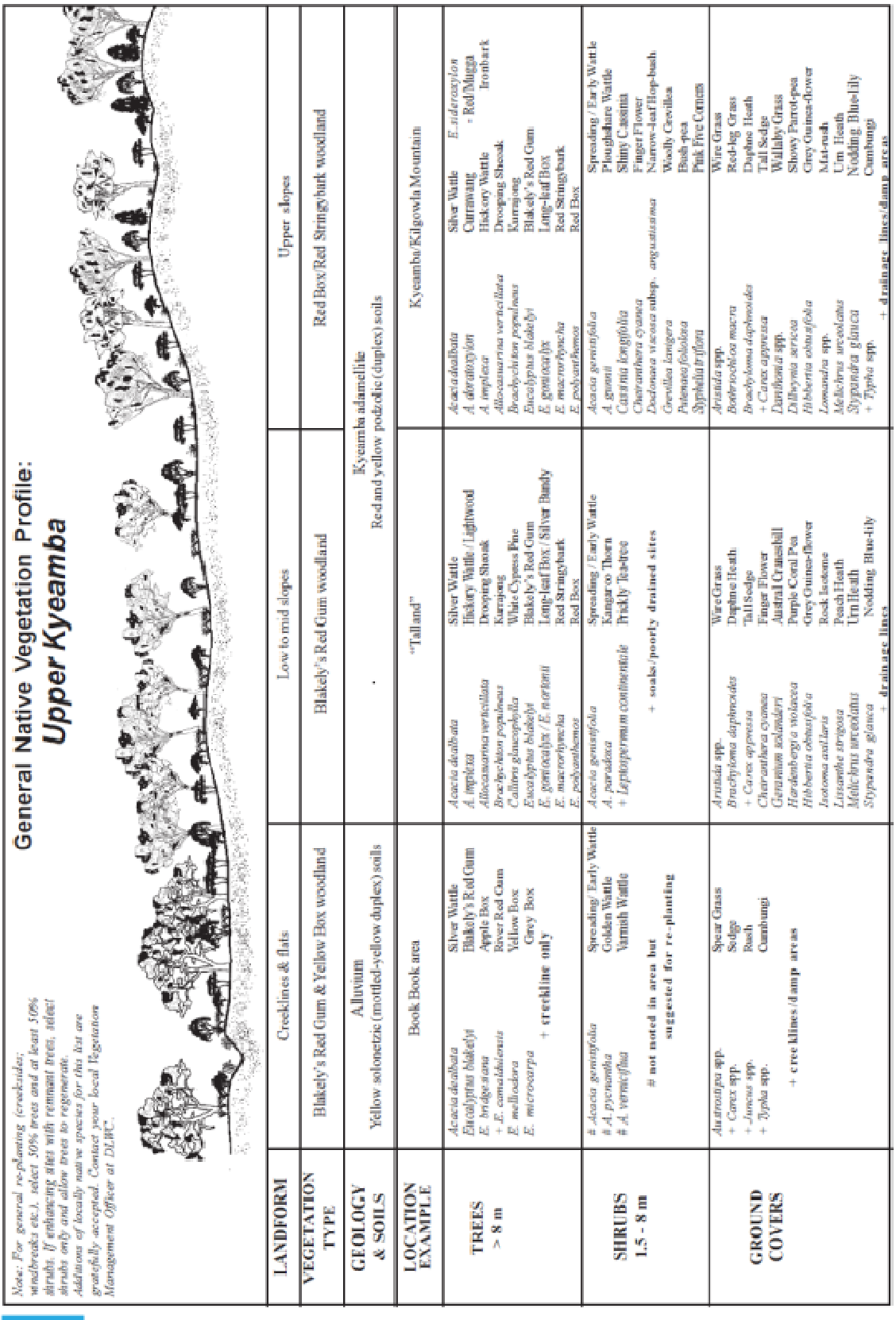
- **Hardened off plants** - plants that have been acclimatised to local weather conditions will survive the shock of planting best. Hardening off to less water and from partial shading to full sunlight should take place at the nursery over three weeks.
- **No insect or fungal damage** - plants should be free of scale, caterpillars, aphids, weevils, cutworms, egg larvae, diseases, disfiguring knobs and other defects.
- **No nutrient deficiencies** - plants should have healthy fresh green foliage. Yellowing, curled, sickly or speckled foliage should be avoided.
- **Plants should be actively growing and well established** in free draining potting mix, and have normal habits of growth typical of the species. Aim for plants with single straight stems not long and lanky and fresh new growth.
- **Size of the plants** -should be in proportion to the pot size. A root to shoot ratio of no more than 1:2 is recommended, although this can vary with some species.
- **Roots** should be:
    - dense & fibrous, but not root bound;
    - air pruned (no roots showing on the bottom of the pot);
    - Main roots straight with no kinking or curling upwards (J rooting) and
    - Plants with J rooting can die after a few years from self-restriction.
- Eucalypt trees that have small swollen balls (lignotubers, where the plant stores energy) at the base of the stem could indicate that the plant has been stressed or restricted in the pot for too long.
- Properly labelled - correct common and botanical names ideally place where seed was collected and sowing date.

Greening Australia's 12 principles to successful revegetation

1. Build soil moisture before planting.
2. Eliminate weed competition for at least two years after planting.
3. Plan seed supply well in advance.
4. Select the right species and provenance.
5. Only use high-quality seed.
6. Plant in the correct season to minimise heat stress and water deficit.
7. Only use healthy seedlings that meet specifications.
8. Do not plant if ground preparation is inadequate.
9. Protect seedlings from browsing and grazing until they are tall enough to resist damage.
10. Soil nutrients, particularly nitrogen and phosphorous, should be depleted before planting to resist re-invasion by exotic weeds.
11. Continue to monitor the site and adjust management according to what you see.
12. Minimise disturbance in native vegetation in good condition.

A useful guide to help with revegetation of box gum woodlands is *A guide to Managing Box Gum Grassy Woodlands by* Rawlings, K, Freudenberger, D and Carr, D. (2010).

Appendix 2: Example of a sub-catchment native vegetation profile



General Native Vegetation Profile:
Upper Kyeamba

Note: For general re-planting (creeklines, windbreaks etc.), select 50% trees and at least 50% shrubs. If enhancing sites with remnant trees, select shrubs only and allow trees to regenerate. Additions of locally native species for this list are gratefully accepted. Contact your local Vegetation Management Officer at DLWC.

LANDFORM	Creeklines & flats		Low to mid slopes		Upper slopes	
VEGETATION TYPE	Blakely's Red Gum & Yellow Box woodland		Blakely's Red Gum woodland		Red Box/Red Stringybark woodland	
GEOLOGY & SOILS	Alluvium Yellow solonetzic (mottled-yellow duplex) soils		Kyeamba adamellite Red and yellow podzolic (duplex) soils			
LOCATION EXAMPLE	Book Book area		"Tall and"		Kyeamba/Kilgowla Mountain	
TREES > 8 m	*Acacia dealbata* *Eucalyptus blakelyi* *E. bridgesiana* *+ E. camaldulensis* *E. melliodora* *E. microcarpa* + creekline only	Silver Wattle Blakely's Red Gum Apple Box River Red Gum Yellow Box Grey Box	*Acacia dealbata* *A. implexa* *Allocasuarina verticillata* *Bracychiton populneus* *Callitris glaucophylla* *Eucalyptus blakelyi* *E. goniocalyx / E. nortonii* *E. macrorhyncha* *E. polyanthemos*	Silver Wattle Hickory Wattle / Lightwood Drooping Sheoak Kurrajong White Cypress Pine Blakely's Red Gum Long-leaf Box / Silver Bundy Red Stringybark Red Box	*Acacia dealbata* *A. laboratoryion* *A. implexa* *Allocasuarina verticillata* *Bracychiton populneus* *Eucalyptus blakelyi* *E. goniocalyx* *E. macrorhyncha* *E. polyanthemos*	Silver Wattle *E. nitrocaylon* Currawang - Red Mugga Hickory Wattle Ironbark Drooping Sheoak Kurrajong Blakely's Red Gum Long-leaf Box Red Stringybark Red Box
SHRUBS 1.5 - 8 m	# *Acacia genistifolia* # *A. pycnantha* # *A. vermiculata* # not noted in area but suggested for re-planting	Spreading/ Early Wattle Golden Wattle Varnish Wattle	*Acacia genistifolia* *A. paradoxa* *+ Leptospermum continentale* + soaks/poorly drained sites	Spreading / Early Wattle Kangaroo Thorn Prickly Tea-tree	*Acacia genistifolia* *A. spinii* *Cassinia longifolia* *Chorizandhera cyanea* *Daviesia viscosa subsp. angustissima* *Grevillea lanigera* *Pultenaea foliolosa* *Styphelia triflora*	Spreading / Early Wattle Ploughshare Wattle Shiny Cassinia Finger Flower Narrow-leaf Hop-bush Woolly Grevillea Bush-pea Pink Five-Corners
GROUND COVERS	*Austrostipa spp.* *+ Carex spp.* *+ Juncus spp.* *+ Typha spp.* + cree klines/damp areas	Spear Grass Sedge Rush Cumbungi	*Aristida spp.* *Brachyloma daphnoides* *+ Carex appressa* *Chorizandhera cyanea* *Geranium solanderi* *Hardenbergia violacea* *Hibbertia obtusifolia* *Isotoma axillaris* *Lissanthe strigosa* *Melichrus urceolatus* *Styphandra glauca* + drainage lines	Wire Grass Daphne Heath Tall Sedge Finger Flower Austral Crane's-bill Purple Coral Pea Grey Guinea-flower Rock Isotome Peach Heath Um Heath Nodding Blue-lily	*Aristida spp.* *Bothriochloa macra* *Brachyloma daphnoides* *+ Carex appressa* *Dianella spp.* *Dillwynia sericea* *Hibbertia obtusifolia* *Lomandra spp.* *Melichrus urceolatus* *Styphandra glauca* *+ Typha spp.* + drainage lines/damp areas	Wire Grass Red-leg Grass Daphne Heath Tall Sedge Wallaby Grass Showy Parrot-pea Grey Guinea-flower Mat-rush Um Heath Nodding Blue-lily Cumbungi

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Source:http://www.murray.cma.nsw.gov.au/swsrguide/pdf/vegetation%20profiles/Upper%20Kyeamba.pdf

Appendix 3: Seed harvest Licences and permits

The information provided for seed collection permits and licences in NSW and on Commonwealth land is a guide only. Every effort has been made to source the most up to date information as of November 2011 however; you are advised to contact the relevant authority/ land owner to clarify legal rights, responsibilities and obligations. Greening Australia cannot be held responsible for the misuse or abuse or incorrect information provided.

Land Use	NPWS Permit Needed	Permission required
National Parks and Nature Reserves	Yes will require a S132 licence. Contact National Parks and Wildlife Service Ph: 02 9585 6540	Yes but permission only given if particular species cannot be sourced elsewhere.
Commonwealth Land	Only if the vegetation community or plant is threatened or endangered Need an EPBC Act Part 13 permit for this activity.	Yes permission of land manger. Notification given of when and where collecting.
State Forest	Yes, will require a S132 licence if the vegetation community or plant is threatened or endangered under NSW legislation	Yes from State Forests/Department of Primary Industry (DPI). Notification given of when and where collecting. Royalty payment.
Traveling Stock Reserves (Crown Land)	Yes, will require a S132 licence if the vegetation community or plant is threatened or endangered under NSW legislation	Yes contact your local Livestock Health and Pest Authority. Fee may be required
Private land e.g. farms	Yes, will require a S132 licence if the vegetation community or plant is threatened or endangered under NSW legislation	Landholder permission. Fee may be required but often request a small amount of seed/ plants in return
Council Roadsides	Yes, will require a S132 licence if the vegetation community or plant is threatened or endangered under NSW legislation	Yes, written or verbal permission. Council may require notification of when and where. Strict WH&S working by roadsides
State Highways e.g.. RTA, Vic Roads	Yes, will require a S132 licence if the vegetation community or plant is threatened or endangered under NSW legislation	Yes, written or verbal permission. Authorities may require notification of when and where and require safety signage and other WH&S specifications
Crown Land e.g.. Cemeteries	Yes, will require a S132 licence if the vegetation community or plant is threatened or endangered under NSW legislation or if site is a covenant managed by NPWS	Yes local council or National Parks and Wildlife service.
Voluntary Conservation Agreement on private land (Covenant)	Yes, will require a S132 licence if the vegetation community or plant is threatened or endangered under NSW legislation	From landholder, only to be used for private use not commercial. Collect seed in the conservation area only if seed of the particular species is not available elsewhere, or is to be planted in the covenant or adjacent site.
** Permit always needed if collecting endangered plant or vegetation community (e.g. Box-Gum Grassy Woodland) on any land use. As a general rule NPWS exclude collection of individually listed threatened species. Collection of threatened species would only be permitted to a specific request and with specific conditions attached regarding use and end point of the material.*		

Commonly asked questions about seed collecting permits

Q 1: **If a NSW property owner is collecting seed from an ecologically endangered (or threatened) plant community on his/her land such as a Grassy Box Gum woodland, is a licence required for:**

a. personal use? ;

Yes- All species within an EEC are protected so a permit is likely to be required.

b. for sale?; *Yes, will require a S132 licence to sell the seed or the propagated plants.*

c. barter/ donate as part of a community seedbank?

The seedbank operator may need a licence to collect/acquire/hold seed from EECs.

Q. 2: **How much time does it take NPWS to process a licence?**

Approximately 6 weeks, depending on completeness of application, amount of consultation required, and backlog.

Q 3: **What are the penalties if you collect seed without permission from threatened plants or ecologically endangered communities?**

Can be up to 100 penalty units (1 penalty unit = $110), or 6 months prison, or both for each offence

Q4: **Can a Landcare group submit a seed collection licence to cover all members even though there may not be a specific project? This seed may go towards a community seedbank for future projects.**

NPWS would need to discuss the specifics further and there may need to be an identifiable project rather than just general collection, but this probably works in with answer 1c above.

Q 5: Is there a NSW application fee for a seed collecting licence?

An application fee has not been approved for s132c licences as yet. Until a determination is made there is no fee.

Q 6: Where do I find a NSW s132c application licence form?

Contact Scientific Licensing Officer | Wildlife Licensing and Management Unit | Office of Environment and Heritage | Department of Premier and Cabinet | PO Box 1967 Hurstville NSW 1481 | Phone: 02 9585 6539 or go to web address
http://www.environment.nsw.gov.au/resources/licensing/ScientificLicenceApplication1009.pdf

Q 7: I intend collecting seed off Commonwealth land that has a listed threatened species and/ or ecological community. Where do I found out more about an EPBC Act Part 13 permit?

Contact the Assessment Officer |Commonwealth and Territories Section |Approvals and Wildlife Division Department of Sustainability, Environment, Water, Population and Communities on 02 6274 1893 or EPBC.permits@environment.gov.au.

A proposal which is likely to have a significant impact on a matter of National Environmental Significance is likely to require referral under section 67 of the EPBC Act. For further information, refer to http://www.environment.gov.au/epbc/approval.html.

In the ACT (that is not Commonwealth owned land) contact Territory and Municipal Services| Land Management and Planning |Licensing and Compliance on 02-62076376

Question 8: Where do I find a list of threatened plants or ecological endangered communities?

NSW - http://www.environment.nsw.gov.au/threatenedspecies/whatists.htm
Commonwealth http://www.environment.gov.au/epbc/protect/species-communities.htm

Appendix 4: Native Seed Collection Data Sheet

Native Seed Collection Field Data Sheet

(Greening Australia office use only)

Collection number:

Storage Date:

Genus:

Species:

Date collected:

……..…..day……..…..month……..…..year

Grams:

Site name: **Nearest Road:** **Nearest town:**

Current tenure: *please circle*

Private land	Crown Land	State Forest	NPWS Park or Reserve	Road Reserve	Travelling Stock Reserve	Other (*specify)*

Origin of parent plants: *please circle*

Remnant	Revegetation	Seed Production Area	Unknown	Other

Latitude: …….. °……..’ ……..” South
Longitude…….. °……..’ ……..” *East*
OR
Easting: __ __ __ __ __ __
Northing: __ __ __ __ __ __ __
Geodetic datum (if using GPS): _____

Number of plants collected from: *please circle*

<10	10-20	21-50	51-100	101-200	>200

Number of plants in collection area: *please circle*

<10	10-20	21-50	51-100	101-200	>200

Collection range (radius) *please circle*

<1km	1-5km	5-20km	20- 50km	>50km

Collector name:

Signature:

……

Information provided below is optional, but useful if available

Seed crop quantity: *please circle*

Heavy	Medium	Light

Seed crop timing: *please circle*

Early	Peak	Late

Risk of seed lot contamination: weeds/other plant seeds
please circle

High	Moderate	Low

Risk of seed lot contamination: insect/fungal attack
please circle

High	Moderate	Low

Aspect: *please circle*

N	NE	E	SE
S	S W	W	NW

Position on slope: *please circle*

Watercourse	Flat	Crest	Dune
Lower slope	Mid Slope	Upper slope	Other

Surface soil / geology description: *Please circle*

Texture: Colour: Soil pH: Geology:

Sand	Clay	Loam

Appendix 5: Useful plant identification and seed references

The following is not intended to be a complete list and the inclusion of an individual, organisation or business is not necessarily an endorsement of their product or service

Websites

1. Useful sites providing box gum woodlands links

- **Florabank weblinks** http://www.florabank.org.au/default.asp?V_DOC_ID=759#5

- **Greening Australia Resource Guide**
http://www.greeningaustralia.org.au/resources/resources

- **Office of Environment & Heritage – Plant references**
http://www.environment.nsw.gov.au/cpp/CmnReferencesPlants.htm

- **Grassy Box Woodland Conservation Management Network**
http://www.gbwcmn.net.au

- **Catchment Management Authority** - http://www.cma.nsw.gov.au

2. Plant and seed websites relevant to box gum woodlands

- **Greening Australia Grassy woodlands seed and nursery trade**
http://www.grassywoodlands.org.au

- **Species Navigator plant fact sheet**
http://www.florabank.org.au/lucid/key/Species%20Navigator/Media/Html/index.htm

- **Living Atlas:** The ALA has a facility called 'explore your area' that lists all knows plant and animal species in a 5 km or 10 km radius of any town or map coordinate. For many of the species records it will show a GPS location on a Google earth image
http://www.ala.org.au

- **NSW BioNet**: whole-of-government system for flora and fauna sightings information
http://www.bionet.nsw.gov.au/

- **What's its Name? (plant names & name changes)**
http://www.anbg.gov.au/win/index.html

- **PlantNet- plant identification** http://plantnet.rbgsyd.nsw.gov.au

- **Australian Virtual herbarium** http://www.chah.gov.au/avh/about.jsp

- **Australian Society for Growing Australian Plants** http://www.austplants-nsw.org.au

- **Floradata database (seed collection months, seed viability and germination, seed treatments and propagation methods**)
http://www.florabank.org.au/default.asp?V_DOC_ID=986

- **Aus Grass** http://ausgrass2.myspecies.info/

- **Plant databases**
  http://www.rbgsyd.nsw.gov.au/welcome_to_bgt/quick_links/Plant_databases

- **Floristic Lists of New South Wales** (catalogued lists are arranged by 1: 250 000 Map Sheet title)
  http://www.rbgsyd.nsw.gov.au/science/Evolutionary_Ecology_Research/floristic_lists_of_nsw

- **Greening Australia Victorian grasslands** http://www.greeningaustralia.org.au/our-projects/biodiversity/grassy-groundcover

- **NPWS seed collecting license**
http://www.environment.nsw.gov.au/wildlifelicences/ScientificResearchLicences.htm

- **DPI paddock plants**
http://www.dpi.nsw.gov.au/agriculture/resources/private-forestry/paddock-plants

- **Native grasses fact sheet**
http://cw.cma.nsw.gov.au/WorkingWithUs/bestmanagementpractice.html

- **Threatened Species** www.threatenedspecies.environment.nsw.gov.au

- **Plant photos** http://www.flickr.com/photos/nswgrassyecosystems

Books, Brochures & CD's

Title	Author	Plant	Seed
What Seed is That?	Bonney, N. (2003 revised). Neville Bonney, Tantanoola		x
Australian Tree Seed Centre Operations Manual.	Gunn, B. (2001). CSIRO Publishing.		x
Plant Germplasm Conservation in Australia: Strategies and Guidelines for developing, managing and utilising ex- situ collections.	Offord C.A. and Meahgher P.F (2009) Australian Network for Plant Conservation.		x
Seed Collection of Australian Native Plants, For Revegetation, Tree Planting and Direct Seeding.	Ralph, M. (1999) 2nd Edition. Bushland Horticulture.		x
Growing Australian Native Plants from Seed For Revegetation, Tree Planting and Direct Seeding	Ralph, M. (2003). Bushland Horticulture.		x
From Seeds to Leaves.	Stewart Doug & Robyn (2008). Publisher Blank Inc.		x
Australian Seeds: a guide to their collection, identification and biology.	Sweedman, L. and Merritt, D. (Eds.) (2006) CSIRO Publishing.		x
Guidelines for the translocation of Threatened Plants in Australia.	Vallee, L., Hogbin, T., Monks, L., Makinson, B., Matthes, M. and Rossetto, M. (2004). Australian Network of Plant Conservation, Canberra.		x
"Sex in SPAs" – a guide to establishing genetic diversity in Seed Production Areas. *(Brochure)*	Pickup, M. (2008) Greening Australia Capital Region http://www.florabank.org.au/default.asp?V_DOC_ID=895.		x
Introducing Seed Production Areas: An Answer to Native Seed Shortages. *(Brochure)*	Vanzella, B. (2008). Greening Australia Capital Region http://www.florabank.org.au/default.asp?V_DOC_ID=895.		x
Wattle: Acacias of Australia (CD)	Maslin, B.R. (2001) CSIRO.	x	
Eucalyptus, an illustrated guide to identification Vol 1	Brooker, I. & Kleinig, D. (1990). CSIRO publishing.	x	
A Guide to the Eucalypts of the Central West of NSW	Bower C. & Semple W. (1993) Dept. of Conservation & Land Management, Orange.	x	

Title	Author	Plant	Seed
Plants of Western NSW	Cunningham, G. H., Mulham, W.E., Milthorpe, P.L. and Leigh, J.H. (1981). CSIRO publishing.	x	
Ausgrass: Grasses of Australia (CD)	Sharp, D. and Simon B.K. (2002) CSIRO publishing.	x	
Grassland Flora: a field guide for the Southern Tablelands (NSW & ACT)	Eddy, D., Mallinson, D., Rehwinkel, R & Sharp. S. (1998), Environment ACT, NSW NPWS, WWF Australia, ANBG, DLWC, and Environment Australia.	x	
A Practical Guide to Revegetation in the mid Lachlan Region	Sydes et al (2003) Greening Australia NSW	x	x
South west Slopes revegetation Guide ***Book or website***	Edited by Fleur Stelling with a major contribution by Karen Walker (1998) http://www.csu.edu.au/faculty/science/herbarium/index.htm	x	x
Planting Companion: A guide to revegetation in the ACT region	Gould, L. (2005) Greening Australia for ACT Forests	x	x
Web based herbarium- Charles Sturt University	http://www.csu.edu.au/cgi-pub/herbarium/herbpix-2	x	
Native Trees and Shrubs of South-Eastern Australia **Available as book or CD**	Costermans, L. First published in 1981 (revised 1983, reprinted with addendum 2009) Landsdowne publishers.	x	
Native Grasses. Identification Handbook for Temperate Australia	Meredith (1996) CSIRO publishing.	x	
Euclid: Eucalypts of Southern Australia (CD)	Brooker, M.I.H., Slee ,A.V., Connors, J.R. and Duffy S.M . (2006) 3rd ed. Centre for Plant Biodiversity Research. Australian National Herbarium	x	
Bidgee Bush. An identification Guide to Common native Species of the South Western Slopes of NSW	Walter, K., Burrows, G. and McMahon, L. (2001) Greening Australia.	x	
Temperate woodland conservation and management	Lindenmayer, D., Bennett, A. and Hobbs, R.eds. (2010) CSIRO publishing.	x	x
Ocean Shores to Desert Dunes Subtitle: The Native Vegetation of	Keith (2006) New South Wales Government, Department of	x	

Title	Author	Plant	Seed
New South Wales and the ACT	Environment and Conservation		
New South Wales Vegetation Classification and Assessment: Part 2 Plant communities of the NSW South-western Slopes Bioregion and update of NSW Western Plains plant communities, Version 2 of the NSWVCA database J.S. Benson	Benson, J (2008) *Cunninghamia* 10 (4): 599–673 Or http://www.rbgsyd.nsw.gov.au/__data/assets/pdf_file/0006/95847/Cun104599Ben.pdf	x	
A guide to managing Box Gum Grassy Woodlands – Caring for our Country	Rawlings, K, Freudenberger, D and Carr, D. (2010) Greening Australia for the Australian Government	X	X

Papers-published about Seed Collection & Genetics

- **There's more to seed than local provenance**
http://www.florabank.org.au/files/Carr%202008%20Thinking%20Bush%207%20More%20to%20seed_low.pdf

- **Conserving genetic diversity at the species, patch and landscape scale**
http://live.greeningaustralia.org.au/nativevegetation/pages/pdf/Authors%20R/10_Ryan.pdf

- **Seed supply for broad scale restoration: maximizing evolutionary potential**
http://www.seedingvictoria.com.au/cb_pages/images/Maximizing%20evolutionary%20potential.pdf

- **Genetics and ecological viability of plant populations in remnant vegetation**
http://lwa.gov.au/files/products/native-vegetation-program/pn30058/pn30058_0.pdf

- **Local seed not the best for revegetation**
http://www.csiro.au/news/Seed-Sourcing.html

- **Managing genetic diversity in remnant vegetation**
http://lwa.gov.au/files/products/native-vegetation-program/pk071323/pk071323.pdf

- **Should we be more critical of remnant seed sources being used for revegetation?**
http://onlinelibrary.wiley.com/doi/10.1111/j.1442-8903.2006.00311.x/abstract

- **Ecology & Genetics of Remnant Vegetation**
http://www.anbg.gov.au/cpbr/program/sc/eco_gen.htm

- **Composite provenancing of seed for restoration: progressing the'local is best' paradigm for seed sourcing**
http://www.birdsaustralia.com.au/images/stories/publications/soab/SOAB-2009.pdf

- **A Practical Genetic Contribution towards Best-practice Seed-sourcing Guidelines for Ecological Restoration**
http://search.informit.com.au/documentSummary;dn=838149294284712;res=IELHSS

- **Expanding horizons for herbaceous ecosystem restoration: the Grassy Groundcover Restoration Project**
http://onlinelibrary.wiley.com/doi/10.1111/j.1442-8903.2010.00547.x/abstract

Other references can also be found at
http://www.florabank.org.au/default.asp?V_DOC_ID=891

Appendix 6: Grassy Box Woodland Seed Collection Guide