North East NSW Forestry Hub

A STOCKTAKE OF DURABLE EUCALYPT PLANTATION RESEARCH

FINAL REPORT - SEPTEMBER 2026

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Disclaimer

This report compiles findings from existing published literature and internal reports, together with input from selected phone interviews. Information provided is the best available and has been prepared to provide an overview of past research and management practices.

About this study

The purpose of this study was to undertake a stocktake of tree breeding research on durable eucalypt species grown in northeast NSW plantations.

The aim of this study was to identify, capture and reference past tree breeding initiatives and programs and associated research trials for northeast NSW durable eucalypt species. It is anticipated that the compilation and interpretation of these research and development initiatives within a single report will help avoid the loss of valuable tree breeding knowledge and research and may be used as a guide to help inform future plantation tree breeding initiatives.

Acknowledgement

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Table of Contents

EXECUTIVE SUMMARY **1**

RECOMMENDATIONS **3**

PART 1: LITERATURE REVIEW **6**

NSW-based Research 6
Hardwood Tree Breeding Program *6*
1) Pre-1994 ..... *6*
2) 1994-2001 ..... *8*
3) 2002-2011 ..... *10*
4) 2011-2013 ..... *13*
Seed production resources *16*
Key Species and performance data *26*
Other NSW Research 27
Other projects and research 30
CSIRO Australian Tree Seed Centre (ATSC) *30*
Australian Low Rainfall Tree Improvement Group (ALRTIG) *32*
TRIG project (Forestry Australia) *32*
Rural Industries Research and Development Corporation (RIRDC) *34*
Forest and Wood Products Australia (FWPA) *35*
The importance of silviculture in plantation management 36

PART 2: SUMMARY OF INPUT FROM SUBJECT MATTER EXPERTS **40**

Strategic Context and Industry Overview 40
Current Industry Position *40*
Policy and Regulatory Environment *40*
Strategic Opportunity *40*
Key Strategic Issues 41
Genetic Resource Security (Critical Risk) *41*
Genetic improvement *41*
Organisational Capability and Governance *42*
Data and Knowledge Systems *42*
Industry Coordination and Extension Gap *43*
Economic and Land Constraints *43*
Key technical Issues and Insights 44
Genetic Improvement and Species Performance *44*
Seed Supply and Nursery System Constraints *44*
Issues affecting plantation establishment and management *45*
Recommended Strategic Focus *47*

PART 3: SUMMARY OF TREE IMPROVEMENT MATERIAL **49**

3.1 Source material: Birk (2022) with updates from Mannes (2026) and FCNSW GIS listing (2026) 49
a) FCNSW seed orchards *49*
b) FCNSW BBT trials *52*
c) FCNSW CCV trials *53*
d) FCNSW Minor species trials *54*
e) FCNSW seed production areas *56*

f) FCNSW trials now in National Park *57*
g) FCNSW Plus trees – (from GIS list (2026) *58*
3.2 Source material: CSIRO Australian Tree Seed Centre 73

REFERENCES 77

APPENDIX A – INDIVIDUAL SME RESPONSES 81

A1. David Mannes – Resource/Tactical Planning Manager, FCNSW 81
A2. Graeme Sonter – Plantation Manager, FCNSW 83
A3. Nick Meyer, Hugh Cherry (DPI Plantation Regulation Unit) 85
A4. David Bush, Nigel England (CSIRO / Australian Tree Seed Centre) 86
A5. Michael Henson (Independent Forester) 87
A6. Mark Wright (Super Forest Plantations) 88
A7. Chad Sheppeard (BioCarbon) 92
A8. Fabiano Ximenes (NSW DPIRD) 93

Executive Summary

Changes in forest tenure and a diminishing supply of native forest timber necessitates a strategic transition toward plantation-based resources to supply the hardwood industry. This report consolidates work done for the North East NSW Forestry Hub to investigate and summarise information available on the growth, management and use of durable eucalypt species in plantations on the NSW North Coast. Three separate reports have been prepared as part of this project – a Literature Review, a Subject Matter Expert summary report and a Consolidated Summary of existing trial, seed orchard and seed production area information.

Swain (1911) recognised that the North Coast of New South Wales has a “monopoly on the most durable hardwood species in the world”. Even at the time of Swain’s writing, the amount of durable material available was limited. Ongoing changes to forest tenure means that there must be an increasing reliance on plantation-based resources.

The literature review summarises findings from previous studies, trials and reports. Birk (2022) has been the major source of information for this review of hardwood tree improvement in New South Wales. NSW invested substantially in hardwood tree improvement from the early 1990s, including progeny trials, seedling seed orchards and clonal seed orchards. Although technically sound, these programs were weakened by delayed thinning, poor maintenance and limited transfer of results into operations. Consequently, deployment of genetically improved seed was minimal. This was exacerbated by the scaling back of programs after 2011. Many trials and orchards persist, but their condition and usefulness are variable.

Information from earlier research, together with input from subject matter experts has been used to identify priority issues. In addition to genetic improvement, the economic viability of durable hardwood plantations relies on sound silvicultural management, especially thinning and pruning. There are challenges finding commercial outlets for early-stage wood residues.

Strategic Recommendations

1. Prioritise Genetic Resource Security: Collect and manage improved seed, protect vulnerable assets including trials and seed orchards. Genomic testing could be useful to trace pedigrees and identify desirable traits for genetic improvement.
2. Consolidate Data and Legacy Trials: Consolidate existing information for the management of data from legacy trials, historical provenance records and plus-tree locations across public and private management tenures.
3. Target High-Productivity Species: Avoid fragmented investments by focusing primarily on core high-productivity species with mature market pathways (*E. pilularis*, *E. cloeziana* and *Corymbia citriodora ssp. variegata*) and match species to site conditions.
4. Build Extension and Market Infrastructure: Develop regional silvicultural guidelines and transparent operational cost case studies. Proactively support pilot regional biochar, BioCarbon and biofuel initiatives to convert low-value forest thinnings into active revenue streams.

There is a clear opportunity to refocus efforts on those durable species that have demonstrated long-term performance under NSW conditions, supported by targeted use of existing trials, orchards and plus-tree resources. The Hub can play a coordinating role by linking remaining genetic assets to site-matched pilot plantings, supporting seed availability and utilising trials to support operational deployment. Recommendations are included to support the future focus of the Hub in this area.

Recommendations

1. **Prioritise Genetic Resource Security**
    - Explore options for funding and support to:
        - Protect and maintain existing seed orchards (e.g. Corowa)
        - Facilitate collection and management of seed from existing improved material
        - Expand seed orchards for key species utilising existing progeny trials and seed production areas
        - Establish backup/insurance orchards to mitigate the loss of genetically improved material
        - Undertake genetic testing of trees, trials and seed production areas to facilitate family and pedigree identification.

2. **Support investment in Data, Monitoring and Trials**
    - Support AFWI/FWPA and/or conduct projects to:
        - Consolidate existing relevant trial information (including progeny trials)
        - Monitor and maintain legacy trials
        - Facilitate the coordinated management of seed orchard, seed production area and plus tree data
        - Investigate suitability and performance of improved material from NZ (*Eucalyptus bosistoana* and *Eucalyptus globoidea*).
    - Identify and propose mechanisms to address gaps in:
        - Historical documentation
        - Provenance and pedigree records
        - Resources available for trial maintenance.
    - Support data consolidation and improve data sharing to reduce the risk of loss of information.

3. **Enable Genetic Characterisation**
    - Support projects to undertake genomic testing to:
        - Identify genetic properties of desirable traits within target species
        - Characterise high-performing stands and individuals
        - Confirm or identify family-level relatedness in existing trials
        - Establish pedigree of unknown seed sources.
    - Facilitate the development and expansion of structured breeding programs targeting desired traits in key species (e.g. reduced end-splitting in Gympie Messmate, reduced sapwood band width and improved density).

4. **Focus Investment on Priority Species**
    - Avoid dilution of effort by focusing on:
        - High productivity species with established markets e.g. E. pilularis, *E. cloeziana* and *Corymbia citriodora* ssp *variegata*
        - Species suitable for available sites.
    - Target key species:
        - Blackbutt *(E. pilularis)*
        - Spotted gum *(Corymbia spp.)*
        - Gympie messmate *(E. cloeziana)*
        - Sydney blue gum *(E. saligna)*
        - Silvertop stringybark *(E. laevopinea)*
        - Blue-leaved stringybark *(E. agglomerata)* (on drier/sandy sites).

5. **Provide Strategic Capability and Operational Support**
    - Assist with the development of:
        - Dedicated plantation management capability
        - Silvicultural guidelines for key species
        - Clear strategic implementation pathways
        - Projects to investigate market opportunities for lower value products from thinning of plantations (and regrowth stands), including biochar, BioCarbon and renewable diesel.

6. **Support Collaboration and Knowledge Sharing**
    - Facilitate collaboration with and between:
        - Forestry Corporation NSW (David Mannes)
        - HQPlantations (Mark Jones)
        - Universities, especially Sunshine Coast University (David Lee)
        - Private plantation growers e.g. Super Forest Plantations (Mark Wright).
        - Forest and Wood Products Australia (FWPA)
        - Australian Forest and Wood Innovations (AFWI)
        - Durable Eucalypt Growers Forum
        - New Zealand Dryland Forests Innovation (Paul Millen).

7. **Funding and Policy Support**
    - Provide information and expert advice to inform policy development
    - Develop solid case studies with transparent figures and costs for different silvicultural operations to facilitate business development opportunities
    - Identify opportunities to:
        - Secure government support
        - Align plantation expansion with broader policy (e.g. emissions reduction, carbon sequestration, land use and market opportunities).

Part 1: Literature Review

NSW-based Research

The majority of hardwood tree improvement work in NSW was undertaken by predecessor organisations of the current Forestry Corporation of NSW (FCNSW).

Hardwood Tree Breeding Program

The following sections describing the history of the hardwood tree breeding program in NSW are mostly taken from Birk (2022), which provides a detailed summary of the status of hardwood genetic resources managed by FCNSW.

1) Pre-1994

Around 11,000 hectares of blackbutt plantations were established in NSW between 1930 and 1990, mostly in the mid-1960s to mid-1970s, with only about 300 ha of blackbutt planted between 1985 and the early 1990s (Johnson and Nikles, 1997).

Birk (2022) notes that there was no formal hardwood breeding program in NSW prior to 1994, but that a program of testing species and provenances was undertaken in NSW for more than 50 years. Intensive selection of superior trees was undertaken in NSW between late 1993 and early 1995, by screening high-quality natural stands and high-quality plantations 20+ years old in Central and North Coastal State Forests (Johnson and Nikles, 1997).

Provenance testing of *E. pilularis* (Blackbutt) started in the late 1950s. There was also early interest in testing spotted gum *(E. maculata,* now *C. maculata)* and Gympie messmate *(E. cloeziana*), and to a lesser extent, Blue-leaved Stringybark (*E. agglomerata*) (Johnson and Stanton, 1993). Formal species trials and provenance tests were increased during the 1960s and 1970s, particularly for the coastal eucalypts. The establishment of a plantation program from the early 1970s provided the main impetus for establishing trials in NSW (Johnson and Stanton, 1993). These trials were mainly planted on ex-forest sites. Interest subsequently broadened to include tableland areas and higher altitude species.

The report by Johnson and Stanton (1993) includes analysed data, and provides a detailed summary of the "locations, establishment history, and average results for growth traits and survival of the entries (species, provenances etc.)" for eucalypt species planted in 25 species trials (64 species) and 33 provenance trials (11 species) established between 1961 and 1990 in New South Wales.

A key finding of the study is the marked divergence between short-term growth performance and long-term durability. Many species ranked highly at early ages but later declined due to poor survival, site intolerance or sensitivity to climatic stress. In contrast, a smaller group of species consistently maintained performance through time, emerging as strong contenders for plantation forestry. Johnson and Stanton (1993) showed that long-term trials are essential for distinguishing durable species from those that show transient early vigour.

In relation to durable species, *Eucalyptus agglomerata* (Blue-leaved stringybark) emerged as one of the most durable species tested across coastal lowland and lower-elevation environments. It showed good survival and growth at most trial sites, across a wide range of soil types and moisture regimes. Johnson and Stanton (1993) highlight the reliability of *E. agglomerata* in both species and provenance trials and identify it as a strong candidate for genetic improvement due to its consistent adaptability.

Eucalyptus pilularis (Blackbutt) also performed well across the trial network. Although survival was variable on some sites, its growth rankings were consistently strong across environments. Provenance trials revealed substantial genetic variation within the species, indicating that careful seed source selection could further enhance durability and reduce establishment risk.

Eucalyptus cloeziana (Gympie messmate) exhibited good performance as a durable species particularly in northern and inland environments. The species combined good height growth with generally acceptable survival, although performance varied among provenances. Johnson and Stanton noted that the best-performing provenances showed consistent results across trials, reinforcing the importance of provenance selection in achieving long-term durability.

Eucalyptus globoidea (White stringybark) also demonstrated consistent, medium-to-high performance in several coastal and southern low-altitude trials. While it was not always among the fastest-growing species, the combination of steady growth and moderate survival across sites identified it as a species worthy of further provenance testing and development.

Overall, Johnson and Stanton (1993) demonstrate that good plantation performance arises from an interaction between species-level adaptability and careful provenance selection and highlight the importance long-term evaluation.

Surviving provenance trials retain a broad genetic base from the wild populations. Seed from Plus Trees in these trials is still collected for forest plantation establishment.

2) 1994-2001

The commencement of the "post-1994" hardwood plantation expansion, including the joint venture plantation scheme, was the driver that initiated a breeding focus and resulted in a major breeding program for Blackbutt (Birk 2022).

The hardwood tree improvement program commenced in the early 1990s and most of the breeding population progeny trials established for Blackbutt and Spotted Gum were extensive, low cost, seedling seed orchards (SSOs). New species-provenance and hybrid trials were also planted between 1997 and 2001.

An economic appraisal of the benefits of eucalypt plantations established under Joint Venture (JV) programs was undertaken in 1995 (State Forests NSW, 1995). The objectives of this report were to:

i. Expand on and provide more detail on the environmental and social benefits of eucalypt plantations.
ii. Attempt to quantify as many of the environmental and social impacts as possible in money terms.
iii. Compile information on the benefits and costs of the environmental and social effects of eucalypt hardwood plantation development.

Birk (2022) notes that the trial program focused on the three key species identified from the previous generation of trials (*E. pilularis, E. dunnii* and *E. grandis*). Spotted Gum (*Corymbia citriodora subsp. variegata* (CCV)) was also included because it was being planted extensively on sites not suited to the other species. These four species accounted for 92% of the 15,400 ha of forests planted between 1994 and 1999. 51 trials planted over 80 ha were established in this period to 2001 including:

- 18 progeny trials (also called Breeding Seed Orchards, BSOs)
- 14 new species – provenance trials
- 3 extensive seedling seed orchards (ESSOs)
- 16 clonal trials.

These trials became the major source of future genetic selections for breeding, clones and seed supply for these key species. The development of clonal propagation techniques (grafting) enabled more rigorous testing of top performing germplasm and deployment in clonal seed orchards (CSOs).

Johnson and Nikles (1997) prepared a proposed tree improvement plan for NSW Blackbutt using genetic material available from:

- 600 intensively selected plus trees in wild stands and plantations.
- Open pollinated seed from 300 NSW plus trees and 50 average Queensland trees.
- Bulk, open-pollinated seed from trees sampled during normal seed collection.

However, Birk (2022) notes that, although a foundational plan for an 'advanced generation' improvement program had been initiated, problems identified by new staff with different visions, poorly defined objectives, limited across-site testing, poor scheduling and maintenance of trials, poor information management and transfer of results to operations resulted in a revision to the tree improvement strategy and a new field program initiated. One critical observation was that there had been no thinning of breeding population trials (BSOs) or seed orchards (ESSOs) to which limited flowering and seed production due to high stocking levels resulting in thin crowns.

3) 2002-2011

Birk (2022) reports that the revised tree improvement strategy emphasised improved genetic gain from tested superior clones selected in progeny trials. A major breeding strategy was developed for *Corymbia spp*, particularly *C. citriodora* ssp. *variegata (CCV)* following the Regional Forestry Agreement (RFA) process that reduced harvest volumes in native Spotted Gum forests.

The hardwood genetic selection objective was realigned with business needs to identify germplasm with superior economic traits including wood properties and disease resistance. Selections were made according to the relevance of these traits for four key species *(E. pilularis, E. dunnii, E. grandis* and *CCV).* It was described as a Multiple Population Breeding Strategy for Family and Clonal Deployment. The proposed improvement program was built off the 1990s breeding population trials but involved a more advanced breeding strategy including Clonal propagation. The aim with clones was to capture and deploy genetic gain sooner than is possible with a seedling-based strategy. The elements of the new strategy were:

1. A hierarchy of populations of increasing levels of selection and improvement for the four key species and separation of populations into unrelated superlines (to ensure outcrosses and avoid in-breeding), and a shortened (6-year) breeding cycle with final selection at 5 years based on survival, growth, form, frost tolerance, insect resistance and rooting of grafts.
    a. Establishing open-pollinated clonal seed orchards (CSOs) to provide a genetically improved resource suitable for commercial plantation operations. The plan was to establish small orchards across a range of sites to better understand site x orchard interactions while delivering improved seed for plantations. It was argued that CSOs would deliver larger gains (at higher cost) and could be used for future controlled pollination (CP) operations.
    b. Related studies focused on flowering dynamics of *E. pilularis* and *E. dunnii.*
    c. Conversion of small areas of high performing plantation into seed orchards.

2. Species, provenance and hybrid seedling testing trials to identify taxa that could replace the top four species on North Coast problem sites where these species do not perform well. This work tested hybrids and involved cooperative arrangements, including testing new species and provenances in the Riverina.
3. Testing of field selected clones produced through vegetative propagation (initiated in 1998-99).
4. Extensive clonal testing across sites of (a) 'in house' superior selections and (b) acquired clones (mainly hybrids from other organisation including CSIRO, CSIR, Fletcher Challenge, Gene Technics, Dendros Seeds and Saltgrow).
5. Deployment of seed and clones of improved genotypes though clonal seed orchards and clonal cuttings propagation.

Underpinning the revised strategy was the intent to replace seedlings derived from native provenance seed collections with seed from trial selections and clonal orchards as quickly as possible. While elements of this strategy had merit, the ambitious scope and implementation expectations put the program at risk. Nevertheless, considerable progress was made on some aspects but was subsequently impacted by the departure of key staff between 2009 and 2010.

Outcomes included:

- Clonal seed orchards to supply Blackbutt seed for FCNSW established at Tarkeeth S.F. and Grafton Agriculture Research and Advisory Station (GARAS) with clones sourced from BSOs at Hannam Vale and Clybucca.
- Commercial clonal seed orchards established on private land at Corowa involving two and three party 10-year Agreements *(E. dunnii* clones sourced from Provenance-family progeny trials and BSOs at Boambee and Megan).
- At least 100 new trials established between 2002 and 2007-08 of which at least:
    - 54 were on private land (Joint Ventures (JVs), annuities, mine rehabilitation, salinity sites).
    - 46 were progeny trials to identify top selections (families and individuals).
    - 14 were clonal trials testing clones selected from NSW trials and forests and hybrid clones selected across many sites, for site specific deployment.

  - 32 trials were testing hybrid eucalypts (specific crosses).
  - 17 pure species were under test not including the multiple sub-species of *Corymbia.*

- The motivation for these trials was to identify the best germplasm for site-specific deployment. Unfortunately, the trials were too young to have delivered results when the program was halted.
- Wood properties testing was undertaken on germplasm in several older trials of several species, but except as noted, it is not clear if results were used to make further selections:
  - *E. pilularis* 1997 progeny trial at Hannam Vale in Comboyne State Forest (SF) (a key source of clones for the Blackbutt CSOs)
  - *E. dunnii* 1995 progeny trials at Boambee and Megan (source of clones for Corowa CSO)
  - *E. pilularis* 1999 field-select clonal trial at Wedding Bells
  - *E. pilularis* 2004 seedling/clonal trial at Tuckers Nob
  - *C. citriodora subsp. variegata (CCV)* 2003 clonal trial at Wedding Bells
  - *E. pellita* 2003 progeny trials at Weddings Bells and Tuckers Nob
  - *E. resinifera* 2003 progeny trial at Tuckers Nob.

Despite the intent to increase deployment of improved germplasm, no improved seed was deployed in forest operations during this period from either the prior generation of progeny trials or seedling orchards planted in the 1990s.

Several papers produced during this period summarised Forests NSW achievements in tree improvement in three species:

- *E. dunnii* with a primary focus on wood properties and dimensional stability (Smith and Henson 2007)
- *E. pilularis* with an objective of replacing native forest timber with improved plantation trees from clonal seed orchards delivering improved wood properties (Smith and Henson 2007).
- *Corymbia spp.* tree improvement strategy (Smith *et.al.* 2007)

- Establishment of provenance seed orchards, limitations of growing the pure species and benefits from varieties being planted across a range of site conditions (Lee 2007).

4) 2011-2013

The primary strategic focus during this period was deploying improved germplasm where this is available, particularly of *E. pilularis*. Genetically improved resources were identified and seed was collected with some ongoing resource management, particularly in the Blackbutt clonal seed orchards.

Management of the 10-year Agreements and commercial arrangements with third party landowners in the Corowa clonal seed orchard was an ongoing requirement during this period.

Although the revenue received for clonal *E. dunnii* and *CCV* seed sold from Corowa orchard was at times substantial, sales were suspended around 2008 and the market subsequently declined. The Forestry Corporation JV agreements terminated progressively between 2015 and 2018, but management of the sites continued with the establishment of a partnership between the CSIRO Australian Tree Seed Centre (ATSC) and V.L. Carroll Pty Ltd in 2002 and 2003. As the CSIRO partnership agreements were typically for 10 or 15 years, this arrangement has since lapsed. It is unfortunate that little of the seed produced was required for FCNSW operations.

Birk (2022) found no record of any implementation plans for proposed genetic gain trials to validate performance expectations of *E. pilularis, C. variegata (CCV)* and *E. dunnii* in trial records.

Following the completion of the initial 2011 review, FCNSW wound back its hardwood tree improvement capacity due to limited opportunity for commercial sales of seed.

However, some trial sites and seed orchards remain available. These are summarised in Table 1 below.

Forestry Corporation NSW is currently focused on accessing improved Blackbutt (*E. pilularis*) seed from existing seed orchard sites at Trenyr (Grafton), Tarkeeth, Comboyn/Hannam Vale and Tamban (Clybucca).

Silvertop stringybark (*E. laevopinea*) and Blue leaved stringybark (*E. agglomerata*) seed is currently sourced from best quality plantation trees. There are plans to develop Extensive Seedling Seed Orchards (ESSOs) for *E. laevopinea*, *E. agglomerata*, Gympie Messmate (E. *cloeziana*) and Sydney Blue Gum (*E. saligna*)[1].

[1] David Mannes, *pers.comm*. 2026)

Table 1: Summary of key FCNSW trials and orchards (from Birk, 2022 and Mannes 2026[2])

Trial / Orchard	Species	Notes
Tarkeeth Clonal Seed Orchard (CSO) 1 and 2	*E. pilularis*	Poor site with poor management. Wind damage, inconsistent seed. Active monitoring.
Grafton CSO	*E. pilularis*	Inland site, slow growth and limited production. Active monitoring.
Hannam Vale (Comboyne) Breeding Seed Orchard (BSO) and Extensive Seedling Seed Orchard (ESSO)	*E. pilularis*	Key progeny trial. Rogued and actively managed. ESSO has been thinned and is being monitored.
Tamban (Clybucca) BSO and ESSO	*E. pilularis*	Rogued and actively managed. ESSO has been thinned and is being monitored.
Grange (Ingalba) BSO	*E. pilularis*	Poor condition due to drought. Rogued and actively managed.
Wedding Bells SSO (1974)	*E. grandis*	Old, degraded. Previous source of Flooded Gum seed. Not used (not a preferred species).
Corowa SSO/CSOs	*C. citriodora* ssp *variegata* (CCV) (CSO), *E. cladocalyx* (SSO), *E. sideroxylon* (SSO)	Best improved germplasm. Joint Venture (JV) expired. *C. maculata* and *E. dunnii* orchards discontinued. CSIRO retaining responsibility but no resources for management.
Timms Vale BSO	*E. agglomerata*	Blue-leaf Stringybark seed source but only a few trees remain within Blackbutt plantation. Barely a BSO now.
Tuckers Nob trials	*E. pellita*, *E. resinifera*	Seed source but not managed as a seed orchard. No data available. *E. pellita* is poor performer. *E. resinifera* doing well but grows on Blackbutt sites so monitored only.
2003–2007 Minor species progeny trials	Various	Condition varies; many on poor sites at Grafton Agricultural and Research Advisory Station (GARAS)

[2] David Mannes (FCNSW) *pers. comm.* 2026)

Seed production resources

In addition to providing historical background to the hardwood tree improvement program in NSW, Birk (2022) provides a detailed summary of seed production resources that were available at the time the main body of the report was written in 2011, noting that the hardwood tree improvement program has been suspended by FCNSW. The summary of alternative seed resources is provided below.

FCNSW trials, orchards and seed stands

Birk (2022) provides a guide to the different levels of genetic improvement available at the time that are relevant to *E. pilularis*, *E. grandis*, *E. dunnii* and *C. variegata* (CCV), starting with the least improved seed source.

1) **Wild seed** - usually recognised by provenance or location. **Provenance trials** are a way of testing mixed seedlots collected from across many sites to identify the best performers.
2) **Seed Stands** – are usually part of an existing forest/plantation and therefore only produce wild seed. Seed stands may be thinned to retain visually better trees. Although this does not improve seed genetically, thinning does improve the seed production potential of the better-looking trees.
3) '**Plus trees**' – are selected from within known good Provenances. Each Plus tree produces a 'family' and has been tested in **Progeny trials**. The practice in NSW has been to call these progeny trials **Breeding Seed Orchards** (BSOs). Testing in Progeny trials is referred to as ' Backwards Selection' as it uses offspring to identify the top Plus trees.
4) **Extensive Seedling Seed Orchards** (ESSOs) have been established usually alongside Progeny trials/BSOs with the expectation that they would be thinned at the same time to remove the poorest families to leave top selections as seed sources.

5) **Family blocks** were often planted at the same time as and alongside BSOs and ESSOs probably using Plus trees, again, as seed sources.

These seed sources only provide one level of operational genetic improvement, associated with Plus Tree selection. The next level of improvement was achieved when progeny trials were culled (thinned) to leave the superior selections. The top trees therefore included both Plus trees (First Generation selections) and superior offspring (Second Generation selections).

6) Following from 3) above - progeny trials were culled based on genetic analysis of growth and form and become '**Breeding Seed Orchards** (BSOs) (now known as First Generation Seedling Seed Orchards (SSOs). Open pollination between the top selections was a planned breeding step to provide improved crosses. The open pollinated seed was available to be deployed and tested to make further selections through subsequent progeny trials.

However, many progeny trials remain unthinned and have not had the poorer performers removed. If progeny trials are not culled, the seed is only equivalent to seed from the original Plus trees. Additionally, without thinning, trees in these trials are unlikely to develop crowns suitable for seed production.

The NSW improvement program underwent a change in breeding strategy in the early 2000s. Rather than continue with another generation of Progeny trial selections, the first and second generation top selections were grafted to produce genetically identical replicates for

a) testing in clonal trials and b) planting in clonal seed orchards. The aim of this approach was most likely to produce more improved seed for plantation operations. At this time new species and hybrids were also introduced into the testing program through another series of progeny trials.

7) **Clonal trials**

Note that cloning is simply a means of replication and does not produce any additional genetic gain.

- Plus trees selected in BSOs were grafted to produce clones of first and second generation selections (multiple replicates) which were tested in Clonal trials. The cloning of the Plus trees improved the analytical power of the trial as each replicate was genetically identical.
- Identical replicates provide the opportunity to make 'Forward Selections' with more confidence than is possible in seedling Progeny trials, in which all entities are genetically different. Forward Selection pushes the improvement process ahead faster than the traditional Backward Selection testing of the parent through its offspring.
- Clonal trials do not represent another improvement step, instead involving the testing of thousands of clones to eliminate the poorer trees from the genetic resource. Although some second generation 'Forward Selections' in clonal trials will be 'winners' these will be infrequent. Once culled, there is an increase in the overall level of improvement and gain in the residual retained trees in a clonal trial.
- Another benefit of clonal testing is the opportunity to establish multiple identical genetics by environment (G x E) trials to compared performance of identical genetic material across a range of sites. If top germplasm is deployed on a site-specific basis related to performance, this raises operational gain. However, there were no useful outcomes from the historic NSW clonal testing program because the trials were too young when the program ceased. Many trials have since been lost as most were on Joint Venture (JV) or Annuity agreement land.

8) **Clonal Seed Orchards** (CSOs) – planted with cloned replicates of the first and second generation selections. These were established for *E. pilularis*, *E. dunnii*, *C. variegata* (CCV) and *E. nitens* (Shining Gum).

9) The next level of genetic improvement is achieved with **Controlled Pollination** (CP)**.** The progeny (seedlings) derived from control pollination between specific families (e.g. second generation selections) can then be tested in progeny trials. Some control pollination was undertaken with Blackbutt but there are no outputs from this part of the FCNSW program.

Birk (2022) prepared an adjunct summary workbook with details of all the Eucalypt orchards, trials and stands in the hardwood tree improvement program known at the time of preparation of the report (see Part 3 of this report). Some sites have been used for seed collection and others are potential resources for seed collection. The summary includes priority and minor species used in hardwood plantations and other species that could be of commercial interest and are summarised by species. Older (pre-1995) provenance trials are listed separately and minor species for forest operations are also listed. The information had been collected across multiple sources and varies considerably for each genetic resource. Some listed trials will not be of any further use. The list will be updated with a summary of remaining trials and plus tree locations as part of the North East Forestry Hub project.

Seed orchards and seed production areas

Most seed orchards established in NSW were for the three key species: *Eucalyptus pilularis*, *Corymbia citriodora* ssp. *variegata (CCV)* and *E. dunnii*. Other seed orchards were established for minor species including *E. agglomerata*, *E. argophloia*, *E. cloeziana*, *E. grandis* and *E. nitens*. All orchards were created by converting progeny trials and clonal trials following measurement and roguing. The Orchard listing also includes Seed Production Areas (SPAs) which are typically stands identified within plantations.

Seed orchards are the priority sites for seed collections. Trials are the next best option to avoid wild seed. Seed collectors target Plus Trees in progeny trials but this varies by species. Some historical trials have been converted to Seedling Seed Orchards (SSOs). Some trial conversion has been done visually, rather than based on genetic analysis.

A Seed Stand may be an old trial that has not been well managed or simply part of a plantation, especially for minor species. Collection teams would also generally report on the condition of orchards and collection areas, although this is informal as no written reports could be found (Hegney, *pers. comm*. in Birk (2022)).

The summary workbook prepared by Birk (2022) contains listings of seed Orchards and Seed Production Areas (SPAs). It is not clear if the resources (orchards, trials and stands) identified are the only current seed collection sites or if other collection sites are included from time to time. This information, together with recent data extracted from the FCNSW GIS, is summarised in Part 3 of this report.

The following list, from Birk (2022) summarises seed sources for species of interest for which there was more relevant information available at the time. This indicates the trials/orchards that should contain some levels of genetic improvement. Information for *Eucalyptus grandis* and *E. dunnii* has been excluded from the original summary in Birk (2022) as these are non-durable species.

Blackbutt Seed Sources

1) **Tarkeeth *E. pilularis* clonal seed orchards** were established on a coastal site in Tarkeeth State Forest near Urunga, south of Coffs Harbour, in 2002 and 2004.
    - Clones in these orchards were derived from top selections (first and second generation) in two 1997 progeny trials (Hannam Vale and Clybucca). The first generation Plus trees were 'backwards' selections whereas the second generation progeny were 'forward' selections.
    - Selections for Tarkeeth 1 in November 2002 included 55 clones (some Plus trees and seedling offspring) selected from the 3-year growth data and from tree form data in the Hannam Vale trial.
    - The Tarkeeth 2 orchard was planted in March 2004 from 43 selections made after joint analysis of data from all five progeny trials in NSW and Qld (Jarvis 2003). No detailed trial records were found for this trial.

2) **GARAS *E. pilularis* clonal seed orchard** was established on an inland site at the Grafton Agricultural Research and Advisory Station (GARAS) in 2005. This orchard includes clones of 46 selections from the Hannam Vale and Clybucca trials. The overriding aim of planting these additional CSOs was to buffer against the reduce the risk of total loss of the primary clonal seed production resources.

It is important to note that:

- The multiple *E. pilularis* CSOs are **not** replicate seed orchards because different selections were cloned for each orchard based on different analyses, trials and traits. Selections were however, largely based on growth and form.
- *E. pilularis* Plus tree selections from across a wide geographic range (loosely Provenances first generation) were tested in Progeny trials. Top parents and progeny went into the CSO which included clones of family mixes.
- Blackbutt CSO seed production is erratic from year to year. Wild seed has been needed to support requirements in poor production years.
- Selections for the CSO at Tarkeeth (2002) were from the Hannam Vale trials and many families (22) were planted.
- The Blackbutt CSOs are failing due to poor site conditions and poor management. Both the Tarkeeth and Grafton CSOs have some mortality and are affected by wind which causes breakage at the graft or windthrow. There are recent inventories of standing trees (and flowering), particularly for the Grafton orchard. Initial seed production at Tarkeeth was prolific but trees became too tall and dormant, so they were pollarded and subsequent buds aborted. Thinning and ongoing management is required. The two sites are currently being monitored[3].
- Little seed has been provided by the Blackbutt CSOs seed collections from Plus trees and wild seed has been needed to meet FCNSW operational requirements.

[3] David Mannes (*pers. comm.)* 2026

3) **Grafton Elite *E. pilularis* seed orchard** was also established at the Grafton GARAS site to enable controlled pollination, but this was not carried out. The orchard is now an open pollinated clonal orchard with fewer ramets (trees) than the other orchards. This orchard is a limited genetic resource but has not suffered wind damage which has occurred on the Tarkeeth CSO sites. No seed has been collected.

Flowering and seed production are erratic across all these clonal and elite orchards and bud abortion is common but not understood. Active management is required to ensure that seed is accessible. Excessive height growth at Tarkeeth has resulted in wind damage. Trees in all orchards have been pollarded at some time, some more than once, but seed production remains poor[4]. A review of the selections in the orchards should be undertaken if seed collection is to be continued.

4) **Hannam Vale Breeding Seed Orchard / Seedling Seed Orchard 1997**

- The Hannam Vale culled Progeny trial is the source of clones for CSOs. Genetic selections were based on data from both Hannam Vale and Clybucca Progeny trials/BSOs.
- The Hannam Vale and Clybucca BSOs were thinned late so tree crowns remained thin and were not suited to seed production. These BSOs are critical reserves or backups of improved seed (and clones). Although they are not genetically equivalent to the CSOs, they are similar.
- Hannam Vale BSO remains a key progeny trial. Both Hannam Vale and Clybucca BSOs have been rogued and are being actively managed[4].

5) Hannam Vale and Clybucca Extensive Seedling Seed Orchards (ESSOs)

- These ESSOs are adjacent to the BSOs and established at the same time.
- These *E. pilularis* ESSOs (and adjacent Family blocks) have recently been thinned are currently being monitored[4].

[4] David Mannes (*pers. comm.*) 2026

Spotted Gum Seed Sources

Although three species of *Corymbia* have been planted operationally in post-1994 plantations, *C. citriodora* ssp. *variegata* (CCV) is the predominant Spotted Gum species planted for sawn wood in northern NSW (Henson *et.al.*, 2007). It was the key species targeted in the Forests NSW Spotted gum (*Corymbia*) improvement program and the only species of *Corymbia* seed collected.

Johnson *et.al.* (2009) reported results from a large provenance and progeny trial of Spotted Gum (*Corymbia* spp.) established in north-eastern New South Wales to quantify genetic variation in growth, stem form and tolerance to Quambalaria shoot blight (*Quambalaria pitereka*). The trial assessed 194 open-pollinated families from 31 provenances (mainly *C. citriodora* subsp. *variegata*, with some *C. maculata*, *C. henryi* and intergrades) for diameter, height, straightness, branching and disease damage. Results showed highly significant differences among provenances and among families within provenances for growth traits and shoot blight damage. Several south-east Queensland provenances (notably Home, Wolvi, Woondum, Brooyar and Wondai) combined superior early growth, good form and low disease damage, whereas many southern NSW provenances suffered substantially higher shoot blight damage.

1) Forests NSW established four *Corymbia* CCV **Clonal Seed Orchards** as joint-venture partnerships near Corowa on the properties 'Maroondah' and 'Sargoods' in 2005 and 2006, respectively. Management of the CSOs was done in conjunction with the CSIRO Australian Tree Seed Centre. The original Joint Venture (JV) Agreements expired between 2015 and 2018. The properties acquired by V.L. Carroll Pty. Ltd. But have subsequently been sold. CSIRO is maintaining responsibility for the sites but lack the resources for management[5]

   A CCV **Clonal Seed Orchard** was also planted in northern NSW at Grafton (GARAS) in 2007-08. It was established on a poor quality site, the trees were subject to severe insect attack and have not produced seed.

[5] Nigel England (*pers. comm.)* 2026

2) Morpeth **Extensive Seedling Seed Orchard** (ESSO GSDHC003)

Birk (2022) reports that a 5 hectare *Corymbia* orchard was planted in 1997 with a bulked seedlot of 'best bet' families including 25 NSW Plus trees, 27 "average" trees (seed purchased from CSIRO) and 4 individual "average" trees in the Wolvi area, SE Queensland (seed donated by QDPI-Forestry). The establishment report does not state the pedigree details. The aim of this orchard was to provide seed after an operational thinning and to supply Plus trees for a second generation breeding population, although this is unlikely to have been completed. This resource is less genetically improved than the CSOs. The 1999-2001 Progeny trials would be a more appropriate alternate seed source if managed appropriately. The orchard is still listed but is not currently being used[6].

Minor Species Seed Collection Sources

A number of Progeny trials were established between 2003-2007 for a wide range of minor species. Poor site selection means that those established on the Grafton GARAS site have poor growth and in some cases, poor survival. Seed sources for other minor species were identified by Birk (2022) and durable species relevant to this study are noted below. The summary of sites will be updated in the separate report summarising the status of remaining sites and trials managed by FCNSW.

1) Blue-leaf Stringybark

- A *E. agglomerata* **Progeny trial BSO/SSO** (G23081) was planted in 1979 at Timms Vale, Wild Cattle Creek S.F. with Provenance material from FCNSW and CSIRO seedlots. It has been culled to leave the best selections although its current condition is not known. Measurements obtained in 2008 include growth, form and wood quality. This is the main seed collection site for *E. agglomerata* but is currently considered "barely a BSO" as only a few trees remain within a plantation[7].
- A converted Provenance trial (SSO) was established in 2003-04 in Cairncross S.F. using Fletcher's NZ germplasm, but little is on record for this resource (GHN04-AG03B).

[6] David Mannes (*pers. comm.) 2026*
[7] David Mannes (*pers .comm.)* 2026

2) Queensland (Western) White Gum

- *E. argophloia* was planted as a **Seed stand** using bulk wild seed at Ingalba, Grange State Forest in 1999.
- In 2005 a **Seed Production Area/Seed Stand** of unimproved *E. argophloia* was planted at Corowa using grafted varietal material (clones) derived from unimproved seed, originally from CSIRO. Advice from CSIRO is that seed is no longer available from this site[8].

3) Silver-top Stringybark

A stand of *E. laevopinea* in Gloucester plantation, Chichester State Forest (SF) was thinned in 1967-69 to create a **Seed Production Area.** Plus trees were identified and the resource is documented and mapped. The area is not used for seed collection and its condition is unknown.

4) Gympie Messmate

Two *E. cloeziana* **progeny trials BSO/SSOs** were planted in 1964 in Tamban (G2302T) and Nambucca (G2302S). The trial aim was to compare the performance of Queensland Provenances including two that previously had been established in northern NSW, locally described as NSW Provenances. Superior Provenances were identified and Plus trees were subsequently identified from wood quality studies. This trial has been culled and is the only site used at present as a seed source.

5) Red Mahogany

A **Progeny trial/SSO** of *E. resinifera* was established at Tuckers Nob in 2004. This trial has been a seed collection site. The trial is mapped with Plus tree numbers, but it is very unlikely that the trial has been converted to a SSO through culling. It is unlikely to have been measured. No electronic records were found for this resource. As *E. resinifera* grows on Blackbutt sites there are no plantings planned for this species and this site is being monitored only[9].

[8] Nigel England *(pers. comm.)* 2026
[9] David Mannes (*pers. comm.)* 2026

Key Species and performance data

Birk (2022) summarised performance from major low-rainfall and high-durability trials (see Table 2).

Table 2: Performance of key durable species in NSW (from Birk 2022)

Species	Durability Class	Rainfall Range	Key Findings
Sugar Gum (*E. cladocalyx*)	Class 1	250–500 mm	High survival on marginal lands; excellent for windbreaks and carbon sequestration.
Red Ironbark (*E. sideroxylon*)	Class 1	500–800 mm	Maintained >80% survival over 57 months in NSW trials; high resistance to drought.
Coastal Grey Box (*E. bosistoana*)	Class 1	700–1400 mm	Exceptional stiffness (3x Radiata Pine); requires higher fertility sites for optimal growth.
Spotted Gum (*C. maculata/ citriodora*)	Class 2	500–800 mm+	Superior height growth (4.8–5.5 m at 57 months) but susceptible to frost in central regions.
Yellow Gum (*E. leucoxylon*)	Class 1/2	400–800 mm	Highlighted as a key species for low-rainfall durability trials.

Other NSW Research

Horne (1978) analysed the impact of fertiliser applied at age one month to plantations of Flooded gum (*Eucalyptus grandis*) and Blackbutt (*E. pilularis*) on the North Coast of New South Wales. The results showed that at age 10 years the volume per hectare of Blackbutt (and Flooded Gum) was 30% higher than unfertilised plots. If the response remained static, the increase due to fertiliser would be equivalent to a 20% difference at age 15 years.

Grant and Joe (1994) evaluated strength properties of Blackbutt (*Eucalyptus pilularis*) and Spotted Gum (*Corymbia maculata)* using timber sampled at sawmills. The aim of the study was to determine strength groups for seasoned and unseasoned regrowth Blackbutt and Spotted Gum. The study found that the strength groups were equal to or higher than values published in AS 2878. The mechanical properties of Spotted Gum grown on the North Coast were superior to material from the South Coast.

West (1998) investigated thinning and pruning schedules for *Eucalyptus grandis, E. pilularis, E. dunnii* and *Corymbia variegata* plantations in the Northern Rivers regions of New South Wales. The schedules reported are developed using an assessment of internal rate of return (IRR) and aimed to produce a wide range of log products for both high quality solid wood products and reconstituted wood products. From the perspective of durable species, *E. pilularis* plantations in the region were expected to yield and IRR between 2% and 8%, depending on site productivity. West noted that an emphasis on planting *E. pilularis* is likely to produce a higher proportion of larger log products than (the non-durable species) *E. grandis*. West also noted that the somewhat radical thinning regime, with second thinning to a residual stocking below 100 stems per hectare could expose the stands to wind damage and could also result in increased understorey development.

Johnson *et.al.* (2009b) report on results of a trial of potentially commercial tree species, planted over 45 sites across low-rainfall sites (500–800 mm annual rainfall) in New South Wales. Nine species were assessed for survival and height at ages 10–57 months and for stem form at 57 months. Seven the nine species included in the trial were durable species – *Acacia*

mearnsii (Black Wattle), *Corymbia maculata, C. citriodora* ssp. *variegata* (Spotted Gum), *Eucalyptus argophloia* (Queensland Western White Gum), *E. camaldulensis* (River Red Gum), *E. cladocalyx* (Sugar Gum) and *E. sideroxylon* (Red Ironbark). Other species planted were *Pinus pinaster* and clones of *E. camaldulensis* and *E. globulus/E. grandis*.

Conclusions from the study were:

a) There were large variations in survival and mean height of the species tested to 57 months of age. *E. camaldulensis* generally performed well. Most other species had moderate to high survival overall, except for *A. mearnsii*, which had mostly died by the end of the trial.

b) The southern origin species *E. cladocalyx* showed better growth and survival at southern sites compared with northern sites, while the northern origin E. argophloia grew equally well at both northern and southern sites.

c) Differences between NSW regions were significant for survival, with South region recording better survival than the North and Central regions. Higher survival and/or growth in the south was associated with a lack of severe frosts, in contrast to records of repeated frosts occurring at some North and Central region sites in the early years of the trial.

d) Tree form was highly variable among species, with the Spotted Gums were notably straight stemmed. *E. cladocalyx* was most affected by forking and had the poorest stem straightness. However, this may have been due to the Marble Range provenance used, which is now known to have generally poor form.

e) The Spotted Gums showed good potential as a log-producing species in medium to low- rainfall areas at the relatively young age of 5 years. However, this would require reliably frost-free sites. *Eucalyptus sideroxylon* also showed promise for commercial use, with a high survival rate reasonable height growth and freedom from forking, although the crookedness of many trees was its main drawback. Considering growth and survival alone, *E. camaldulensis* was superior.

Bi *et.al.* (2014) report on trials of nine potential plantation species established at 45 sites over three broad regions across the western slopes of New South Wales. These trials coincided with the Millennium Drought (2001–2009) and provide a robust test of drought tolerance during establishment (0–10 years). Survival responses were analysed against long-term aridity (AI) and cumulative drought severity (CDS).

The most drought tolerant species were:

- *Eucalyptus camaldulensis* (River Red Gum) with 80% survival at 10 years. This was least affected by increasing drought severity and the best all-round choice for semi-arid NSW.
- *Eucalyptus sideroxylon* (Red Ironbark) with 73% survival. This species showed equal or greater drought tolerance than *E. camaldulensis* under severe drought.

Moderate drought tolerance was shown by *Corymbia maculata* and *Corymbia variegata* (Spotted gums). Survival was not strongly affected by drought severity, with 60% and 54% survival respectively, but these species are sensitive to frost below about -4°C.

More careful site selection is needed for *E. argophloia, E. cladocalyx and* the Eucalyptus hybrid because of their sensitivity to drought conditions and temperature extremes. *Eucalyptus argophloia* had good performance under moderate drought but showed a strong decline under severe, prolonged drought. Eucalyptus hybrid clones showed moderate survival (58%) but were sensitive to aridity, drought severity and frost. *Eucalyptus cladocalyx* had 42% survival and was sensitive to severe drought, heat and frost. Performance for *E. cladocalyx* was strongly provenance dependent. *Acacia mearnsii* (6% survival) was extremely drought-sensitive and unsuitable for dryland environments.

Other projects and research

CSIRO Australian Tree Seed Centre (ATSC)

The CSIRO Australian Tree Seed Centre (ATSC)[10] established *Corymbia maculata* seedling seed orchards near Deniliquin in 1995, in conjunction with Riverina Trees and local landowners. These were originally established as trials to test performance of provenances, families and individuals and then measured and thinned in 2000 and 2002 and converted to seedling seed orchards (SSOs). The SSOs contain between 48 and 61 families of *Corymbia maculata* sourced across its natural distribution.

In 2002 and 2003 CSIRO and V.L. Carroll Pty Ltd jointly established, a clonal seed orchard near Corowa, New South Wales. The clonal seed orchard is made up of 22 clones, selected from the Deniliquin seedling seed orchards. The orchard was planted in rows with individual clones planted in blocks of three to assist the pollination process. No identical clones are planted together assuring high out crossing rates.

However, CSIRO contracts for the joint management of seed orchards were only for 10-15 years and have now expired. V.L. Carroll sold the property several years ago. CSIRO has maintained contact with the new owner who has been willing to retain some, but not all, of the trees. The new owner is open to any plan that would generate income from the trees.[11] Seed orchards remain for *E. cladocalyx* (SSO), *E. sideroxylon* (SSO) and *Corymbia citriodora* ssp *variegata CCV* (CSO). The clonal seed orchards for *C. maculata* and *E. dunnii* are no longer available. There has been no active management of the remaining trees, apart from a measurement of the *E. cladocalyx* trial in 2025[12].

The ATSC also established a *Eucalyptus cladocalyx* provenance-family trial in 1998 near Benalla, Victoria, followed in 2001 by a trial near Corowa, NSW.[13] The Corowa trial was

[10] https://www.csiro.au/en/about/facilities-collections/Collections/ATSC/ATSC-CorymbiaMaculata-NSW
[11] Nigel England (*pers. comm.)* 2026
[12] Nigel England (*pers. comm.)* 2026
[13] https://www.csiro.au/en/about/facilities-collections/Collections/ATSC/ATSC-Ecladocalyx-VIC-NSW

established with funding from the Australian Low Rainfall Tree Improvement Group (ALRTIG), and is now managed by CSIRO following the sale of the property previously owned by V.L. Carroll.

Both trials were established to test for superior provenances, families and individuals, with the intention of converting the trials into seedling seed orchards based on assessment results. The Corowa site underwent its first thinning 2006. The *E. cladocalyx* site at Corowa is overdue for thinning, but there are no resources to do this. The owner has looked for outlets for the wood without success to date.[14]

Original selections were made from natural provenances, semi-improved planted stands in Victoria. The Department of Primary Industries of South Australia (PIRSA) established a seed production area at Kersbrook, in the Adelaide Hills, which was considered to have the best performing *Eucalyptus cladocalyx* seed available.

Seed from the *Eucalyptus cladocalyx* seedling seed orchards became available in 2008 and can be purchased from the ATSC.

The ATSC has two publications available on its website. The first, Carter (1987), is a practical handbook produced to guide the raising of seedlings and the establishment of species and provenance trials for Australian tree species. The handbook emphasises that genetic choice (species and provenance) is one of the most cost-effective ways to improve plantation productivity, potentially increasing yields by up to 25% without additional land or establishment costs, provided trials are well designed and maintained. Although more of an operations manual, this publication includes a reproducible framework for comparative testing of durable tree species and provenances under variable site conditions.

The second ATSC publication (Gunn, 2001), provides a comprehensive, practical guide to the collection, processing, testing and storage of seed collected from Australian species. The manual documents standardised procedures used in managing seed from initial planning and

[14] Nigel England (*pers. comm.)* 2026

field collection through to laboratory handling and dispatch and includes detailed guidance on collection timing, methods for different taxa appendices with practical tools such as data sheets, equipment checklists and species-specific seed collection calendars.

The manual also provides detailed coverage of post-collection seed handling, including seed extraction, cleaning, viability and germination testing, moisture management, storage conditions, quarantine procedures and documentation. Procedures for overcoming seed dormancy, assessing viability and vigour, and maintaining long-term seed quality in storage are included.

Australian Low Rainfall Tree Improvement Group (ALRTIG)

The Australian Low Rainfall Tree Improvement Group (ALRTIG) was a collaborative national program formed in 1998 to focus on the genetic improvement of tree species suited for the 400–600 mm rainfall zone of southern Australia. Harwood *et.al.* (2001) published a compendium of hardwood breeding strategies as part of the Rural Industries Research and Development Corporation (RIRDC) project CSF-58A. In addition to providing an overview of species selection process and tree improvement strategies, Harwood *et.al.* provides details of genetic improvement strategies for the key species *Eucalyptus camaldulensis* (River Red Gum), *E. cladocalyx* (Sugar Gum), *E. occidentalis* (Swamp Yate), *E. tricarpa* (Red Ironbark) and Spotted Gums (*Corymbia* species). Each species section is self-contained, and as such, the compendium is designed as a working document for hardwood tree improvement programs. Although focused on southern Australia, the species information could also be a useful reference for drier parts of North East New South Wales.

TRIG project (Forestry Australia)

The Trials Review, Information and Genetics (TRIG) Project (Lacey *et.al.*, 2023) reviewed more than five decades of farm forestry trials across Victoria to identify tree species suitable for long-term, resilient and commercially viable farm plantings. Although it was prepared to support farm forestry in Victoria, the investigation covered a number of durable species. The

report provides the following information, which may be relevant to North Coast NSW planting.

1. Spotted Gums (*Corymbia spp.*)

Key species include *Corymbia maculata* (Spotted gum) and *Corymbia citriodora* ssp. *variegata CCV* (Lemon-scented gum) and provide the strongest evidence base in the TRIG project. Productivity modelling showed good to excellent growth (>40 cm DBH at 25 years in high-quality zones). The study found wide site suitability across Victoria (>400 mm rainfall) and that Spotted Gums were considered the benchmark durable hardwood for Victorian farm forestry.

2. Sugar Gum (*Eucalyptus cladocalyx*)

As found in other studies, *E. cladocalyx* has moderate-high timber durability and is suitable for lower rainfall and marginal sites with exceptional drought tolerance and reliable survival. There is a well-developed seed supply including first and second generation material. Much of this has been developed by the CSIRO Australian Tree Seed Centre.

3. Ironbarks (*Eucalyptus sideroxylon* and *Eucalyptus tricarpa*)

These species provide very hard, durable timber suited to long-life products and demonstrated stable performance in 20–30 year trials. Studies showed that this species benefits strongly from thinning to improve form. However, seed supply remains a constraint due to late flowering.

4. Other Durable Species investigated

a. *Eucalyptus melliodora* (Yellow box): good durability, variable growth.
b. *Eucalyptus occidentalis* (Swamp yate): tolerant, durable, wet-site suited.
c. *Eucalyptus camaldulensis* (River red gum): durable timber, site-specific performance.
d. *Eucalyptus leucoxylon* (Yellow gum): durable but limited scale data.

The TRIG report provides an overview of tree breeding, seed production systems and a summary of seed availability for the species investigated (see Table 3 below). Lacey *et.al.* (2023) also provide insights from David Bush (CSIRO) on the availability of improved seed for

key species of interest (*Corymbia spp, E. cladocalyx, E. occidentalis*), noting that the CSIRO ATSC has invested significantly in the genetic improvement of these species. The report also investigates alternative carbon and biodiversity markets.

Table 3: Improved seed supply information (modified from Lacey *et.al.* (2023))

Species	No. of suppliers	Level of improvement	Production capacity	Comments
Corymbia citriodora ssp. variegata	3	1st Gen	Very High	
Corymbia maculata	3	1st Gen	Very High	Good availability
Corymbia henryi	2	1st Gen	Moderate	Small amount available
Eucalyptus camaldulensis	2	1st Gen	Moderate	Demand low, little seed on hand
Eucalyptus cladocalyx	4	1st & 2nd Gen	Very High	Well served for 1st Gen seed
Eucalyptus cypellocarpa	0	NA	None	
Eucalyptus grandis	2	1st Gen	Moderate	Demand is low
Eucalyptus leucoxylon	1	Best Provenances	Low	
Eucalyptus melliodora	2	1st Gen	Moderate	Demand low, no seed on hand
Eucalyptus muelleriana	2	1st Gen	Moderate	Small amount available
Eucalyptus occidentalis	3	1st Gen	High	Heaps available, demand is low
Eucalyptus saligna	3	1st Gen	High	Small amount available, demand is low
Eucalyptus sideroxylon	3	1st Gen	Low	Late flowering. Demand exceeds supply
Eucalyptus tereticornis	0	NA	None	
Eucalyptus tricarpa	2	1st Gen	Low	Late flowering. Demand exceeds supply

Rural Industries Research and Development Corporation (RIRDC)

McCarthy and Cookson (2008) conducted a literature review on uses, susceptibility to insects and natural durability of five species commonly planted for farm forestry in lower rainfall environments – sugar gum (*Eucalyptus cladocalyx*), spotted gum (*Corymbia maculata*

and *C. variegata*), red ironbark (E. *sideroxylon/E. tricarpa*), yellow gum (E. *leucoxylon*) and swamp yate (*E. occidentalis*). Sugar gum and red ironbark appear to be the most naturally durable of these species, with service lives in excess of 25 years expected from these species. Spotted gum and yellow gum also provide adequate service lives, ranging from 15 to 25 years. No information on the natural durability of swamp yate is currently available. The analysis was predominantly based on native forest timber. While there is some uncertainty as to whether the published durability ratings will apply to regrowth or plantation-grown timbers, further field and laboratory testing was planned subsequent to this study as part of a project called "*Natural durability of Eucalyptus trees for farm forestry in lower rainfall areas"* to assess the effect of tree age on natural durability. A reference to this second project was not found.

A further study (Cookson and McCarthy (2013) reported on the influence of age and density on above-ground durability. This study found that after nine years' exposure, heartwood from *Eucalyptus sideroxylon, Corymbia* spp., *E. cladocalyx* and *E. occidentalis* trees aged 30–50 or 80+ years had similar natural durability. However, except for *E. cladocalyx*, the heartwood from trees less than 25 years old was less durable than that from older trees for *Corymbia* spp., *E. leucoxylon, E. occidentalis* and *E. sideroxylon*.

Forest and Wood Products Australia (FWPA)

McGrath *et.al.* (2024) prepared a report for FWPA under project VNC516-1920. Although this report focuses on *Eucalyptus globulus* and *E. nitens* plantations in southern Australia, it does provide information on ways to improve knowledge underpinning decisions on the location and management of hardwood plantations, through modelling of potential productivity using APSIM process-based modelling.

The broad objective of providing information to support plantation establishment and management decision-making was achieved by:

1. Developing a forest modelling and prediction framework based on climate and environmental factors that allows the estimation of yield gaps.

2. Demonstrating the utility and robustness of the prediction platform in the form of case study applications.

APSIM is not calibrated to durable species and would need time progression of biomass allocation to different components (leaves. branches, stem etc.), as well as stem metrics (DBH, height, BA, volume) to add this functionality[15]. However, other process-based models, for example 3PG[16] include parameterisation for some durable Eucalypt species, should there be interest in this modelling approach. Paul *et.al.* (2007) describes calibration of 3PG for *Eucalyptus cladocalyx* and *Corymbia maculata*. Smethurst *et.al.* (2022) includes a comparison of APSIM with the 3-PG and Cabala process-based models.

The importance of silviculture in plantation management

While tree improvement is an important factor in increasing the productivity of hardwood plantations, the importance of effective silvicultural management (thinning, pruning and fertiliser application) to improve growth, productivity and tree health is also important and has been well documented e.g. Forrester *et.al*. (2013), Nichols *et.al*. (2010) and West (1998).

The benefits of thinning include reducing competition and accelerating growth of selected crop trees by increasing the availability and uptake of light, water and nutrients. Thinning has also been linked to higher solid-wood recovery and, in some contexts, less tension wood, less end-splitting and less drying degrade (Forrester *et.al*. (2013).

Nichols *et.al*. (2010) identified knots as a major limiting factor in several subtropical eucalypt species. Pruning is therefore often undertaken in conjunction with thinning to improve the production of solid wood.

West (1998) developed thinning and pruning schedules for Northern Rivers plantation species including *E. pilularis* and *C. variegata*, with economic analysis based on empirical growth and yield prediction modelling.

[15] Smethurst *pers. comm*. 2026
[16] https://3pg.forestry.ubc.ca/software/

Forrester *et.al.* (2013) suggest that thinning is an important tool for increasing final-crop-tree growth, shortening rotations and influencing several wood-quality and log-quality outcomes, noting that responses vary with timing, intensity, site quality and stand structure. Focusing growth on final crop trees, typically the largest 200 stems per hectare (Forrester *et.al.*, 2013) or as low as 100 stems per hectare (West, 1998).

While thinning of plantations is a key component of good plantation management, access to markets for low value thinning material and managing thinning residues can significantly affect the economics of these operations. In some cases, growers may delay first thinning until it becomes commercial, even when the plantations are intended for solid-wood end products (Nichols *et.al*., 2010).

There is growing interest in the potential role that biochar can play in plantation management.

Biochar is a carbon rich product which can be produced from low value wood residues through pyrolysis, which is controlled burning/thermochemical conversion in a reduced oxygen environment (Rodriguez Franco *et.al*., 2024; Dumroese *et.al.*, 2020).

Antonangelo *et.al.* (2025) reviewed over 150 studies to examine the effects of biochar produced by pyrolysis on soil health and tree-based crops. There are additional benefits from biochar production through reduction of windrowing and burning. Converting residues into biochar (via centralised facilities or place-based methods) provides local environmental benefits by diverting biomass from carbon-intensive disposal (burning/decomposition) to a process that sequesters carbon and can reduce soil GHG emissions (Ghosh *et.al.*, 2024; Dumroese *et.al.* 2020; Rodriguez Franco *et.al*., 2024).

Studies suggest that benefits from the application of biochar include improved soil water retention, increased cation exchange capacity (CEC), resulting in improved nutrient holding capacity and nutrient cycling and vegetation enhancement, improving post-disturbance forest health and resilience to future disturbance (Dumroese *et.al.* 2020; Rodriguez Franco

et.al., 2024; Ghosh *et.al.*, 2024). McGrath (2026)[17] notes that as biochar generally has a high surface area, it is quite porous which makes it ideal to retain N and increase the cation exchange capacity of the soil, improving retention of K, Ca, Mg cations. This will be especially beneficial on sandy soils.

One of the challenges in developing a commercial biochar product is that successful marketing is likely to require production of a biochar/fertiliser blend, and how this pricing compares to fertiliser alone[18,19]. Antonangelo *et.al.* (2025) references a study showing that growth and nutrient uptake was enhanced when wood-derived biochar was combined with organic fertiliser.

Markets are emerging for the use of low value residue or thinnings material as feedstock for bioproducts. While there is also a potential market for carbon credits, Ghosh *et.al.* (2024) note that, although biochar-based carbon credits can incentivise adoption, these will depend on robust quantification, monitoring and verification of long-term carbon storage. In addition, AECOM (2019) notes that Australia's soil carbon method currently excludes biochar-derived soil carbon from earning Australian Carbon Credit Units (ACCUs), which means that until a new/updated methodology is prepared, biochar projects can only rely on voluntary international carbon markets. This may be a less reliable business model[20]. In 2025 the ANZ Biochar Industry Group submitted an expression of interest proposing that a biochar method be added to the ACCU scheme[21].

Other NSW market opportunities for utilising thinning material include:

- **BioCarbon** – a high-value product that is targeted at replacing coke in electric steel furnaces. Sheppeard (2026)[22] has stated that the current proof of concept plant at Bulahdelah has Federal government funding to expand this to a pilot plant. However,

[17] McGrath *(pers.comm.)* 2026
[18] Sheppeard *(pers.comm.)* 2026
[19] McGrath *(pers.comm.)* 2026
[20] Sheppeard *(pers.comm.)* 2026
[21] https://www.anzbig.org/blog/anzbig-submits-accu-method-eoi
[22] Sheppeard *(pers.comm.)* 2026

the BioCarbon plant prefers sawmill residue due to its low moisture and low ash content. Extra processing is required to use wetter forest-sourced material.

- **Licella renewable diesel** - Licella is one of the few businesses in Australia with technology that is capable of producing renewable diesel and other liquid biofuels at scale in NSW from a variety of feedstock types, utilising a patented and Australian-developed Cat-HTR™ (Catalytic Hydrothermal Reactor) hydrothermal liquefaction (HTL) technology. Ximines (2026a) suggests that there may be an opportunity conduct demonstration trials to investigate the feasibility of producing renewable diesel and other fuels from harvest residues if suitable funding can be obtained.
- **SEATA/Roundhill Engineering Biochar**[23] – the SEATA pyrolysis process produces biochar and clean syngas. In addition to a static biochar facility, the company has developed a prototype mobile torrefaction unit. The SEATA pyrolysis process does not produce a liquid product, with the output comprising of approximately 35% char and 65% syngas. This results in savings compared to traditional pyrolysis technology as there is no need for costly oxygen plants and air separation units, and no ash residues are generated (Ximenes, 2026b). Several regulatory and licence restrictions will need to be overcome to be able to scale up this operation.

Given the importance of thinning hardwood plantations and current problems utilising low value thinnings material, further investigation and support for the development of alternative markets will improve the economics of plantation management.

[23] https://www.seatagroup.com.au

Part 2: Summary of input from Subject Matter Experts

Refer to Appendix A for individual SME responses.

Strategic Context and Industry Overview

Current Industry Position

- Hardwood plantation development in northern NSW remains limited in scale and growth potential, largely due to:
    - High land costs
    - Limited suitable expansion areas
    - Operational and workforce constraints.
- Existing plantation assets are often under-utilised or sub-optimally managed, reducing returns.
- Where available, improved genetic material is showing strong gains, including:
    - Faster growth than previous generations
    - Comparable performance at younger ages.

Policy and Regulatory Environment

- The regulatory framework is:
    - Resource constrained
    - Outdated and not fit for purpose, particularly for emerging plantation models (e.g. carbon plantations).
- Agencies have limited capacity for extension services, impacting grower support.

Strategic Opportunity

- Significant opportunity exists to:
    - Lift productivity through genetic gain and improved silviculture.
    - Enhance value recovery from the existing plantation resource.
    - Rebuild industry structure through coordination and extension.

Key Strategic Issues

Genetic Resource Security (Critical Risk)

- Seed availability is currently constrained, limiting planting programs.
- There is a risk of loss of key improved genetic material (germplasm) due to:
    - Limited resources to manage existing seed orchards and seed collection
    - Expiry of access agreements
    - Land-use changes.
- Historical trials and genetic material are incompletely documented and at risk.

Implication:

Without intervention, future plantation programs will be constrained by lack of improved seed and genetic diversity.

Genetic improvement

- There is very little active genetic improvement currently undertaken for durable eucalypt species suitable for the North Coast.
- Forestry Corporation obtains Spotted Gum seed from the Corowa seed orchard, but this is not being managed.
- New Zealand Dryland Forests Innovation (NZDFI) has an active breeding program (XyloGene) for Coastal Grey Box (*E. bosistoana*) which is a Class 1 durable species. However, the natural range is likely to make this unsuitable for the North Coast. For this reason, this species is not planted by Super Forest Plantations[24]
- NZDFI also undertakes genetic improvement of White Stringybark (*E. globoidea*) which is a Class 2 durable species. First generation XyloGene-branded improved *E. globoidea* seed produced by NZDFI's breeding programme is available for purchase. The natural range of *E. globoidea* is better suited to the North Coast of NSW (see Figure 1).
- NZFDI are well advanced with its breeding program and will be grafting new selections for *E. bosistoana* orchard later in 2026 and are preparing for a third-generation seed orchard for *E. globoidea*.[25]

[24] Mark Wright (*pers. comm.)* 2026
[25] Shaf van Ballekom (*pers. comm.*) 2026

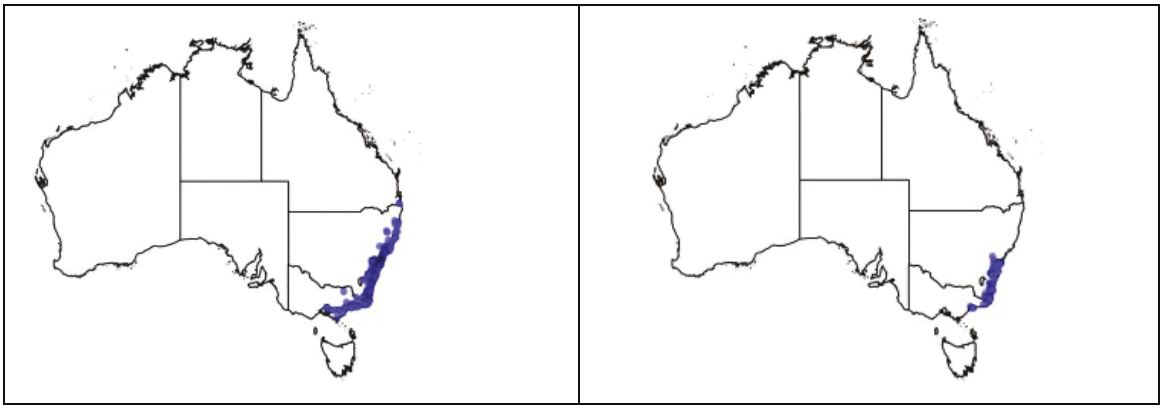


Figure 1: Natural range of White Stringybark (*E. globoidea*) (left) and Coastal Grey Box (*E. bosistoana*) (right).

Organisational Capability and Governance

- Currently there is no dedicated plantation management structure in key organisations, although FCNSW is in the process of developing a hardwood plantation strategy.
- Internal capability gaps include:
    - Strategy execution
    - Coordinated plantation management and planning.
- This results in decision delays and fragmented delivery.

Implication:

Even with strong genetics, outcomes will remain limited without organisational capability uplift.

Data and Knowledge Systems

- Historical data (e.g. trials, seed orchards, plus trees) is:
    - Fragmented
    - Inconsistently recorded
    - At risk of loss.
- Confidence in existing datasets is low in some areas.
- Consolidation of location and content information is important.

Implication:

Poor data are limiting:

- Effective species-site matching
- Genetic improvement programs
- Investment decisions.

Industry Coordination and Extension Gap

- There is no effective extension system for private growers.
- This is a result of lack of:
    - Trusted advisory services
    - Industry coordination
    - Case studies and economic benchmarks.

Implication:

Smaller growers lack confidence and guidance, leading to:

- Mismanagement of plantations
- Sub-optimal economic outcomes.

Economic and Land Constraints

- Expansion of the hardwood plantation resource is limited by:
    - High land costs
    - Narrow geographic suitability (high rainfall, good soils).
- Based on past experience, joint venture models are seen as high risk and difficult to manage.

Implication:

Future growth is likely to depend more on:

- Intensification of existing areas rather than expansion
- Maximising production potential through genetic improvement.

Key technical Issues and Insights

Genetic Improvement and Species Performance

- Priority species:
    - Blackbutt *(E. pilularis)*
    - Spotted gum *(Corymbia spp.)*
    - Gympie messmate *(E. cloeziana)*
    - Sydney blue gum *(E. saligna)*
    - Silvertop stringybark *(E. laevopinea)*
    - [Blue-leaved stringybark *(E. agglomerata)* on drier/sandy sites]
- Observed outcomes:
    - Significant growth rate improvements
    - Potential to shorten rotation lengths (up to ~10 years)

Implication:

Genetic gain is real and material—but dependent on:

- Reliable seed supply
- Utilising existing improved or superior material to develop tree improvement options
- Support for management of existing seed orchards
- Focusing on site-suitable species.

Seed Supply and Nursery System Constraints

- Constraints include:
    - Access to improved seed
    - Limited nursery capacity and capability
    - High exposure to environmental risks (e.g. hail, disease)
    - Timing mismatch between seedling readiness and planting windows.

Implication:

Seed supply constraints are both:

- Genetic (availability of improved seed)
- Operational (nursery system limitations).

Issues affecting plantation establishment and management

Potential gains from genetically improved material will not be realised without effective plantation establishment and management, especially thinning and pruning. Key issues are summarised below.

Site-Species Matching

- Critical factors for plantation establishment:
    - Soil type
    - Rainfall and seasonal distribution
    - Elevation and frost risk
    - Effective rooting depth.
- Commercial thresholds:
    - ~15+ MAI required
    - Typically ≥1250 mm rainfall in coastal regions.

Implication:

Poor site-species matching increases:

- Pest susceptibility
- Growth variability
- Economic risk.

Plantation Operations

- Challenges:
    - Variable planting quality from contractors
    - Limited availability of skilled labour
    - Mechanised planting systems can be used for hardwood plantation establishment, but costs could be a disincentive[26]
    - Silvicultural management, including thinning, is essential to maximise the return from plantations
    - Markets for low value thinnings products are limited, but new opportunities are emerging
    - Transport costs limit viable haulage distance to 50-150 km. This could be mitigated by on-site processing.

[26] Refer Sutton (2026) for a summary of mechanised planting

- Short rotation lengths/faster growth rates may impact wood properties – lower density, higher shrinkage during drying, lower durability due to reduced amount of heartwood.

Implication:

Operational consistency is not assured, affecting:

- Stand establishment quality
- Long-term productivity.

Currently limited markets (small poles, biocarbon, biochar) are likely to result in sub-optimal silviculture. Development of markets for low value thinnings material is essential to improve the economics of plantation management.

Desired durable properties may be compromised in short-rotation plantations. This may be partially offset by tree improvement selection for desired attributes.

Pests, Browsing and Establishment Risk

- Key issues:
  - Wallaby browsing causing mortality
  - Insect pests requiring early intervention.
- Non-lethal controls (e.g. deterrents) are only partially effective

Implication:

Establishment risk remains a major cost driver, particularly on high-pressure browsing sites

Weed Control Systems

- Current approaches:
  - Manual (limited labour availability)
  - Ground-based (operator dependent)
  - Aerial (restricted by perception and terrain)
  - Emerging RPA/drone systems (promising but immature)

Implication:

Weed control remains:

- A labour and technology constraint
- A key determinant of early growth and survival.

Recommended Strategic Focus

The Forestry Hub is well positioned to lead in:

- Genetic resource coordination
- Data integration and preservation
- Facilitating collaborative operations
- Support for establishing markets for low value thinnings material
- Industry extension and knowledge transfer.

Immediate (0–2 Years)

- Secure seed supply by:
    - Establishing projects to improve silvicultural management of existing resources
    - Protecting existing orchards
    - Supporting the collection of improved seed, especially for key production species.
    - Target Quambalaria resistant CCV from clonal seed orchards.
- Support data collection and management by:
    - Consolidating trial and plus-tree datasets
    - Validating information.
- Encourage improved silviculture on existing plantations
- Strengthen collaboration by:
    - Formalise partnerships with research organisations, universities, growers and seed suppliers.

Medium-Term (2–5 Years)

- Facilitate and support the establishment of breeding seed orchards
- Develop plantation capability by supporting the formalisation of strategies and dedicated management structures.
- Supporting the implementation of improved silviculture aligned to genetic gains.
- Continue support for better silviculture and management.
- Support the continued development of new markets, especially biochar, biocarbon and syngas, that can utilise low value thinnings material.

Long-Term (5+ Years)

- Expand genetic improvement programs – utilise germplasm from plus trees and existing seed production areas, trials and seed orchards.
- Utilise genomic tools to identify provenance/pedigree and to identify markers for desired traits.
- Develop “insurance” orchards
- Build extension and advisory systems.

North East NSW Forestry Hub

Part 3: Summary of tree improvement material

3.1 Source material: Birk (2022) with updates from Mannes (2026) and FCNSW GIS listing (2026)

a) FCNSW seed orchards

Trial Type	Type	Species	Trial Code	SF name	Locality	Estab	Tenure	Notes
Progeny/ Orchard	SSO/BSO	E. pilularis	GPGHC001	Comboyne	Hannam Vale	1997	State Forest	Not used for collections; This is the same as the Hannam Vale BSO/ESSO below; SSO was thinned; converted to BSO
CSO/ Orchard	CSO 2	E. pilularis	GHN0215 Epil99A	Tarkeeth	Tarkeeth	2003-4	State Forest	Good condition but site issues; managed; There were more clonal trials planted at Tarkeeth (2002-2004). Summary documentation is for this trial. See file records for info on other trials.
CSO/ Orchard	CSO	E. pilularis	BBT-CSO Trial 1	GARAS Crown Lease	Trenayr	2004-5	Other Crown Timber Land	Managed
Elite Seed Orchard	CSO	E. pilularis	BBT_elite trial 1	GARAS Crown Lease	Trenayr	2004-5	Other Crown Timber Land	Managed
Orchard	BSO/SSO	E. pilularis	GSDHC001	Comboyne	Hannam Vale		State Forest	BSO rogued out in 2025/26

Blackbutt | Spotted Gum | Other durable | Not durable

Trial Type	Type	Species	Trial Code	SF name	Locality	Estab	Tenure	Notes
Orchard	BSO/SSO	E. pilularis	GSDHN004	Tamban	Clybucca		State Forest	BSO rogued out in 2025
Orchard	ESSO	E. pilularis	GSDHC001	Comboyne	Hannam Vale		State Forest	Thinned late 2024
Orchard	ESSO	E. pilularis	GSDHC004	Tamban	Clybucca		State Forest	Thinned late 2025
Orchard	CSOs (2)	Corymbia CCV		Corowa (Maroondah)		2005-6		50 clones selected for vol, form, Quambalaria, frost; 12 cones selected for frost tolerance in 2001 ALTRIG CCV trial; Selections from 4 progeny trials 1999/2001 Grafton Casino)
Orchard	CSOs (2)	Corymbia CCV		Corowa (Sargoods)		2005-6		28 clones from Woondum & Home prevenances; Selections from 4 progeny trials 1999/2001 Grafton Casino)
Orchard	CSO	Corymbia CCV		GARAS Crown Lease	Trenayr	2007-8	Other Crown Timber Land	Poor quality; slow growing; severe insect attack; No seed produced
Bulk Planting/ Orchard	CCV TC clones	Corymbia CCV	GHN05-CV05A	GARAS Crown Lease	Trenayr	2004-5	Other Crown Timber Land	Terminated
Orchard	ESSO	C. CCV	GSDHC003		Morpeth Park			Still exists, still accessible. Hasn't been thinned.

Blackbutt	Spotted Gum	Other durable	Not durable

Trial Type	Type	Species	Trial Code	SF name	Locality	Estab	Tenure	Notes
Orchard	Provenance and SSO	E. agglomerata		Wild Cattle Creek	Timmsvale	1979	State Forest	Main seed collection site: Top provenances identified; seed produced and used; considered valuable source of Plus trees; thinned for orchard isolated trees within a blackbutt plantation; measured 1992 & 2008 (including wood properties) condition unknown; Only 4 provenances had > 70% survival at 13 yr.
Orchard	SSO	E. agglomerata	G23081	Wild Cattle Creek	Dorrigo	1999	State Forest	No information available
Progeny Trial	Progeny (SSO?)	E. pellita		Tuckers Nob	Tuckers Nob	2004	State Forest	Verbal report of this trial - nothing in records
Progeny Trial	Progeny (SSO?)	E. resinifera		Tuckers Nob	Tuckers Nob		State Forest	Still there, planned for thinning

Blackbutt	Spotted Gum	Other durable	Not durable

b) FCNSW BBT trials

Trial Type	Species	Trial Code	SF Name	Locality	Estab	CptNo	Tenure	Notes
Progeny	E. pilularis	GPGHN001	Grange	Ingalba	1998	7279	State Forest	Establishment report and design available; 2012 photos; layout and design on file; genetic treatments on record; healthy, good growth; about 20 bosistoana at this site; extensive drought death, thinned in 2020 (post mortality) poor condition but still monitored for seed
Seedling/Clone STP	E. pilularis	GHN05-PI05B	Tuckers Nob	Tuckers Nob	2004-5	73	State Forest	Expected to be in reasonable condition but no knowledge; thinning planned, located recently and mapped with GPS
Clone	E. pilularis	GCLHN007	Wedding Bells	Crabtrees	1999	7392	State Forest	No knowledge of condition; not mapped
Clone	E. pilularis	GHN0309	Boorabee	Goodings	2002-3	7268	State Forest	No knowledge of condition - could be same material as Tarkeeth; not mapped, some mortality (terminated)
Clone	E. pilularis	GHN07-PI05A	Wild Cattle Creek	Wild Cattle Creek	2006-7	549	State Forest	No establishment report; layout on file with mud map; burnt in 2019, but in ok condition, not visited since 2020
Clone	E. pilularis	GHN07-PI05B	Wild Cattle Creek	Wild Cattle Creek	2006-7	549	State Forest	No establishment report; no knowledge of condition - expected to be in reasonable condition; design details; burnt in 2019, but in ok condition, not visited since 2020.
Progeny	E. pilularis	GPGHC002	Tamban		1998		State Forest	From 2026 GIS list
Clone	E. pilularis	GHN0213		Gurranang	2002			From 2026 GIS list
Clone	E. pilularis	GHN0201		Halls	2002			From 2026 GIS list

Blackbutt | Spotted Gum | Other durable | Not durable

c) FCNSW CCV trials

Trial Type	Species	Trial Code	SF Name	Locality	Estab	CptNo	Tenure	Notes
Progeny planted to be BSO	CCV	GHN0101	Eden Creek	Dyraaba	2000-1	7523	State Forest	Establishment report, genetic treatments, trial design, location map available; Woondum Provenance; still exists, accessible, planned for thinning
BSO	CCV	GHN0102	(Singh)	Tallawandi	2001			From 2026 GIS list
Clone	CCV	GHN0303	Newry		2003		State Forest	From 2026 GIS list
Progeny	CCV	GHN99-CV03A	Eden Creek	Dyraaba	1999	7174	State Forest	Mixed information in the records; some survival issues initially; still exists, accessible
Clone	CCV	GHN0303	Newry	Newry	2002-3	275	State Forest	May be some issues on actual layout vs planned but appears to be updated; could be alternate seed source to Corowa though pedigrees need checking; recently mapped
Progeny	CCV	GCLHN002	Bonalbo		1999		State Forest	From 2026 GIS list
Clone	CCV	GCLHN003	Grange	Ingalba	1999	7277	State Forest	Establishment report available (see May 1999 hard copy), genetic treatments, design details; small trees affected by disease and insects in early years
Clone	CCV	GCLHN004	Bonalbo	Swan	1999	7365	State Forest	Establishment report available (see May 1999 hard copy), design details, genetic records, location map; still exists, accessible
Clone	CCV	GCLHN005	Eden Creek	Dyraaba	1999	7174	State Forest	Last trial planted in set; poorer stock; best growth and health; still exists, accessible

Blackbutt | Spotted Gum | Other durable | Not durable

Trial Type	Species	Trial Code	SF Name	Locality	Estab	CptNo	Tenure	Notes
Block	C. torelliana	GHN04-CT03A Ctorr04A Prov 1	Section 7 Purchase	Barragunda	2003-4	120	Section 7	
Insecticide Trial	CCV	GHN05-HY05D	GARAS	Trenayr	2004-5	3	Other Crown Timber Land	Clone2 Confidor

d) FCNSW Minor species trials

Trial Type	Species	Trial Code	SF Name	Locality	Estab	CptNo	TenureID	Notes
Progeny Trial	Corymbia CCC	GHN06-CI03A	GARAS Crown Lease	Trenayr	2006-7	2	Other Crown Timber Land	Design with row plots, treatment, pedigree etc; no establishment report. Terminated
Progeny Trial	Corymbia: CCV; henryi; CCC; maculata	GHN07-CV03A (trial 2)	Section 7 Purchase	Barragunda	2007-8	119	Section 7	Design with row plots, treatment, pedigree etc; no establishment report; unclear if this was actually planted. C. henryi is sub-spp of interest
Progeny Trial	C. maculata	GHN06-MA03A	GARAS Crown Lease	Trenayr	2006-7	2	Other Crown Timber Land	Design with row plots, treatment, pedigree etc; no establishment report. Terminated
Progeny Trial - row plot	CCV, CCC, HEN	GHN06-CV03A	GARAS Crown Lease	Trenayr	2006-7	2	Other Crown Timber Land	Design with row plots, treatment, pedigree etc; no establishment report; poor growth; no seed produced; C. henryi is a sub-spp of interest
Progeny Trial	C. torelliana	GHN06-CT03A	GARAS Crown Lease	Trenayr	2006-7	2	Other Crown Timber Land	Design with row plots, treatment, pedigree etc; no establishment report; poor growth on a poor site

Blackbutt | Spotted Gum | Other durable | Not durable

Trial Type	Species	Trial Code	SF Name	Locality	Estab	CptNo	TenureID	Notes
Blocks	C. torelliana		Section 7 Purchase	Barragunda	2003-4	120	Section 7	Design with row plots, treatment, pedigree etc; no establishment report; little information available
Progeny Trial	E. moluccana	GHN05-MO03B (trial 2)	GARAS Crown Lease	Trenayr	2004-5	3	Other Crown Timber Land	Design with row plots, treatment, pedigree etc; no establishment report; tree survival good; growth poor; seed production years off
Clonal Trial	E. resinifera	GHN04-RE03A	(Zuills)		2004			From 2026 GIS list
Progeny Trial	E. resinifera	GHN04-RE03C ER03C (trial 3)	Tuckers Nob	Tuckers Nob	2003-4	71	State Forest	No establishment details; but design and layout; good condition late 2014; flowered early; seed collection site; plus trees identified; mapped
Progeny Trial - Row plots	E. longirostrata	GHN05-LO03C (trial 3)	GARAS Crown Lease	Trenayr	2004-5	3	Other Crown Timber Land	Design with row plots, treatment, pedigree etc; no establishment report; survival good but poor growth; seed production years off
Progeny Trial - Row plot	E. argophloia	GHN05-AR03A (trial 1)	GARAS Crown Lease	Trenayr	2004-5	3	Other Crown Timber Land	No establishment report; design with row plots, treatment, pedigree etc; survival good but poor growth; seed production years off
Progeny Trial	E. tricarpa	GPHGR001		Walla Walla	2000			From 2026 GIS list
Clonal Trial	E. acmenoides	GHN04-AC03A	Cairncross		2004			From 2026 GIS list
Progeny Trial	E. cloeziana	GHN04CL03A	Sommerville		2004			From 2026 GIS list

Blackbutt | Spotted Gum | Other durable | Not durable

Trial Type	Species	Trial Code	SF Name	Locality	Estab	CptNo	TenureID	Notes
Provenance Trial	E. cloeziana	G2/3.2	Tabbimoble		1963			From 2026 GIS list
Research Plot	E. longirostrata	GHC05-LO03A	(Dartbrook)		2005			From 2026 GIS list
Research Plot	E. longirostrata	GHC05-LO03B	(Dartbrook)		2005			From 2026 GIS list
Progeny Trial	E. longirostrata	GHN04-LO03B	(Emu Creek)		2004			From 2026 GIS list
Progeny Trial	E. longirostrata	GHC07-LO03A	(Lawrence)		2007			From 2026 GIS list
Progeny Trial	E. longirostrata	GHC07-LO03B	(Rappville)		2007			From 2026 GIS list
Research Plot	E. longirostrata	GHC04-LO03C	(Rix's Creek)		2004			From 2026 GIS list
Progeny Trial	E. longirostrata	GHN04-LO03A	(Zuills)		2004			From 2026 GIS list
Progeny Trial	E. longirostrata	GHN07-LO03E	(Howick)		2007			From 2026 GIS list
Progeny Trial	E. moluccana	GHC05-MO03A	(Dartbrook)		2005			From 2026 GIS list
Clonal Trial	E. pellita x E.scias	GHN04-PE03A	(Zuills)		2004			From 2026 GIS list
Clonal Trial	E. pellita x E.scias	GHN04-PE03	Tuckers Nob		2004			From 2026 GIS list
Clonal Trial	E. pellita x E.scias	GHN05-PI05B	Tuckers Nob		2005			From 2026 GIS list
Clonal Trial	E. pellita x E.scias	GHN04-PE03B	Wedding Bells		2004			From 2026 GIS list
Progeny Trial	E. saligna	GHN07-SA03A	(FEA)		2007			From 2026 GIS list
Progeny Trial	E. saligna	GHN07-SA03B	(Hurfords)		2007			From 2026 GIS list
Research Plot	E. saligna	GHN0306	Wedding Bells		2022			From 2026 GIS list
Progeny Trial	E. tricarpa	GPGHR001	(Walla Walla)		2000			From 2026 GIS list

Blackbutt	Spotted Gum	Other durable	Not durable

e) FCNSW seed production areas

Type	Species	Trial Code	Site	Estab	Notes
Seed Stand	E. argophloia		Grange S.F.	1999	
Clonal SPA	E. argophloia		Corowa	2005	Currently the only site used for seed collection, Joint operation with landowner (Sargoods pedigree details
SPA	E. laevopinea				No information available, condition unknown, not used for seed collection

f) FCNSW trials now in National Park

Trial Type	Species	Trial number	Planting date	Locality	Notes
?	E. agglomerata	?		Watagan	Now in a National Park; Still there, in good condition
Provenance	E. cloeziana	G2302T	1964	Tamban	Within GKNP; doesn't look thinned, seed collected from select trees in 2026; supe provenances (Plus trees) identified; Provenances from QLD (7) and NSW (2)
Provenance	E. cloeziana	G2302S	1964	Nambucca	Within GKNP; doesn't look thinned; superior provenances (Plus trees) identified; Provenances from QLD (7) and NSW (2)
Orchard	SSO	E. cloeziana	1964	Nambucca	Within GKNP and not authorised plantation. Seed Collections made from select tr Secondary seed source; Top families (provenances) identified
Orchard	BSO/SSO	E. cloeziana	1964	Ingalba	Within GKNP and not authorised plantation. Seed Collections made from select tr Secondary seed source; Top families (provenances) identified. Plus tree identified wood quality studies

Blackbutt	Spotted Gum	Other durable	Not durable

g) FCNSW Plus trees – (from GIS list (2026)

(Note: durable species only)

Plus Tree ID	Species	State Forest
VARP10003	C. citriodora ssp. variegata	
VARP10004	C. citriodora ssp. variegata	
VARP10005	C. citriodora ssp. variegata	
VARP10030	C. citriodora ssp. variegata	
VARP10041	C. citriodora ssp. variegata	
VARP10042	C. citriodora ssp. variegata	
VARP10043	C. citriodora ssp. variegata	
VARP10049	C. citriodora ssp. variegata	
VARP10055	C. citriodora ssp. variegata	Bagawa
VARP10001	C. citriodora ssp. variegata	Boundary Creek
VARP10002	C. citriodora ssp. variegata	Boundary Creek
VARP10006	C. citriodora ssp. variegata	Dalmorton
VARP10007	C. citriodora ssp. variegata	Dalmorton
VARP10008	C. citriodora ssp. variegata	Dalmorton
VARP10009	C. citriodora ssp. variegata	Dalmorton
VARP10010	C. citriodora ssp. variegata	Dalmorton
VARP10011	C. citriodora ssp. variegata	Dalmorton
VARP10012	C. citriodora ssp. variegata	Dalmorton
VARP10013	C. citriodora ssp. variegata	Dalmorton
VARP10014	C. citriodora ssp. variegata	Dalmorton
VARP10015	C. citriodora ssp. variegata	Dalmorton
VARP10016	C. citriodora ssp. variegata	Dalmorton
VARP10017	C. citriodora ssp. variegata	Dalmorton
VARP10018	C. citriodora ssp. variegata	Grange
VARP10019	C. citriodora ssp. variegata	Grange
VARP10020	C. citriodora ssp. variegata	Grange
VARP10021	C. citriodora ssp. variegata	Grange
VARP10022	C. citriodora ssp. variegata	Grange
VARP10023	C. citriodora ssp. variegata	Grange
VARP10024	C. citriodora ssp. variegata	Grange
VARP10025	C. citriodora ssp. variegata	Grange
VARP10026	C. citriodora ssp. variegata	Grange
VARP10027	C. citriodora ssp. variegata	Grange

Plus Tree ID	Species	State Forest
VARP10028	C. citriodora ssp. variegata	Grange
VARP10029	C. citriodora ssp. variegata	Ingalba
VARP10053	C. citriodora ssp. variegata	Ingalba
VARP10054	C. citriodora ssp. variegata	Ingalba
VARP10031	C. citriodora ssp. variegata	Kangaroo River
VARP10032	C. citriodora ssp. variegata	Kangaroo River
VARP10033	C. citriodora ssp. variegata	Kangaroo River
VARP10034	C. citriodora ssp. variegata	Kangaroo River
VARP10035	C. citriodora ssp. variegata	Kangaroo River
VARP10036	C. citriodora ssp. variegata	Kangaroo River
VARP10037	C. citriodora ssp. variegata	Kangaroo River
VARP10038	C. citriodora ssp. variegata	Kangaroo River
VARP10039	C. citriodora ssp. variegata	Kangaroo River
VARP10040	C. citriodora ssp. variegata	Kangaroo River
VARP10044	C. citriodora ssp. variegata	Richmond Range
VARP10045	C. citriodora ssp. variegata	Richmond Range
VARP10046	C. citriodora ssp. variegata	Richmond Range
VARP10047	C. citriodora ssp. variegata	Richmond Range
VARP10048	C. citriodora ssp. variegata	Richmond Range
VARP10050	C. citriodora ssp. variegata	Richmond Range
VARP10051	C. citriodora ssp. variegata	Richmond Range
VARP10052	C. citriodora ssp. variegata	Richmond Range
HENP10014	C. henryi	
HENP10015	C. henryi	
HENP10024	C. henryi	
HENP10025	C. henryi	
HENP10029	C. henryi	
HENP10030	C. henryi	
HENP10031	C. henryi	
HENP10001	C. henryi	Bom Bom
HENP10002	C. henryi	Bom Bom
HENP10004	C. henryi	Bom Bom
HENP10006	C. henryi	Braemar
HENP10007	C. henryi	Braemar
HENP10009	C. henryi	Braemar
HENP10011	C. henryi	Bungawalbin

Plus Tree ID	Species	State Forest
HENP10012	C. henryi	Bungawalbin
HENP10013	C. henryi	Bungawalbin
HENP10016	C. henryi	Candole
HENP10017	C. henryi	Candole
HENP10018	C. henryi	Candole
HENP10019	C. henryi	Candole
HENP10020	C. henryi	Candole
HENP10003	C. henryi	Divines
HENP10005	C. henryi	Divines
HENP10008	C. henryi	Ellangowan
HENP10010	C. henryi	Ellangowan
HENP10021	C. henryi	Glenugie
HENP10022	C. henryi	Glenugie
HENP10023	C. henryi	Glenugie
HENP10026	C. henryi	Tabbimoble
HENP10027	C. henryi	Tabbimoble
HENP10028	C. henryi	Tabbimoble
AGT00001	E. agglomerata	Wild Cattle Creek
AGT00002	E. agglomerata	Wild Cattle Creek
AGT00003	E. agglomerata	Wild Cattle Creek
AGT00004	E. agglomerata	Wild Cattle Creek
AGT00006	E. agglomerata	Wild Cattle Creek
AGT00007	E. agglomerata	Wild Cattle Creek
AGT00008	E. agglomerata	Wild Cattle Creek
AGT00009	E. agglomerata	Wild Cattle Creek
AGT00011	E. agglomerata	Wild Cattle Creek
AGT00012	E. agglomerata	Wild Cattle Creek
AGT00013	E. agglomerata	Wild Cattle Creek
AGT00014	E. agglomerata	Wild Cattle Creek
AGT00016	E. agglomerata	Wild Cattle Creek
AGT00017	E. agglomerata	Wild Cattle Creek
AGT00018	E. agglomerata	Wild Cattle Creek
AGT00020	E. agglomerata	Wild Cattle Creek
AGT00021	E. agglomerata	Wild Cattle Creek
AGT00022	E. agglomerata	Wild Cattle Creek
AGT00023	E. agglomerata	Wild Cattle Creek

Plus Tree ID	Species	State Forest
AGT00025	E. agglomerata	Wild Cattle Creek
AGT00026	E. agglomerata	Wild Cattle Creek
AGT00027	E. agglomerata	Wild Cattle Creek
AGT00028	E. agglomerata	Wild Cattle Creek
AGT00029	E. agglomerata	Wild Cattle Creek
AGT00031	E. agglomerata	Wild Cattle Creek
AGT00032	E. agglomerata	Wild Cattle Creek
AGT00033	E. agglomerata	Wild Cattle Creek
AGT00034	E. agglomerata	Wild Cattle Creek
AGT00035	E. agglomerata	Wild Cattle Creek
AGT00036	E. agglomerata	Wild Cattle Creek
AGT00037	E. agglomerata	Wild Cattle Creek
LAT 00024	E. laevopinea	Avon River
LAT 00025	E. laevopinea	Avon River
LAT 00026	E. laevopinea	Avon River
LAT 00027	E. laevopinea	Avon River
LAT 00028	E. laevopinea	Avon River
LAT 00029	E. laevopinea	Avon River
LAT 00030	E. laevopinea	Avon River
LAT 00031	E. laevopinea	Avon River
LAT 00032	E. laevopinea	Avon River
LAT 00033	E. laevopinea	Avon River
LAT 00034	E. laevopinea	Avon River
LAT 00035	E. laevopinea	Avon River
LAT 00036	E. laevopinea	Avon River
SBG + tree SEED1	E. laevopinea	Chaelundi
LAT 00001	E. laevopinea	Chichester
LAT 00002	E. laevopinea	Chichester
LAT 00003	E. laevopinea	Chichester
LAT 00004	E. laevopinea	Chichester
LAT 00005	E. laevopinea	Chichester
LAT 00006	E. laevopinea	Chichester
LAT 00007	E. laevopinea	Chichester
LAT 00008	E. laevopinea	Chichester
LAT 00009	E. laevopinea	Chichester
LAT 00010	E. laevopinea	Chichester

Plus Tree ID	Species	State Forest
LAT 00011	E. laevopinea	Chichester
LAT 00012	E. laevopinea	Chichester
LAT 00013	E. laevopinea	Chichester
LAT 00014	E. laevopinea	Chichester
LAT 00015	E. laevopinea	Chichester
LAT 00016	E. laevopinea	Chichester
LAT 00017	E. laevopinea	Chichester
LAT 00018	E. laevopinea	Chichester
LAT 00019	E. laevopinea	Chichester
LAT 00020	E. laevopinea	Chichester
LAT 00021	E. laevopinea	Chichester
LAT 00022	E. laevopinea	Chichester
LAT 00023	E. laevopinea	Chichester
LAT 00037	E. laevopinea	Chichester
PILP10590	E. pilularis	
PILP10591	E. pilularis	
PILP10001	E. pilularis	Bagawa
PILP10002	E. pilularis	Bagawa
PILP10008	E. pilularis	Ballengarra
PILP10009	E. pilularis	Ballengarra
PILP10010	E. pilularis	Ballengarra
PILP10012	E. pilularis	Bellangry
PILP10013	E. pilularis	Bellangry
PILP10014	E. pilularis	Bellangry
PILP10015	E. pilularis	Bellangry
PILP10016	E. pilularis	Bellangry
PILP10017	E. pilularis	Bellangry
PILP10018	E. pilularis	Bellangry
PILP10019	E. pilularis	Bellangry
PILP10020	E. pilularis	Bellangry
PILP10034	E. pilularis	Bellangry
PILP10035	E. pilularis	Bellangry
PILP10036	E. pilularis	Bellangry
PILP10037	E. pilularis	Bellangry
PILP10039	E. pilularis	Bellangry
PILP10040	E. pilularis	Bellangry

Plus Tree ID	Species	State Forest
PILP10041	E. pilularis	Bellangry
PILP10042	E. pilularis	Bellangry
PILP10011	E. pilularis	Bril Bril
PILP10078	E. pilularis	Broken Bago
PILP10081	E. pilularis	Broken Bago
PILP10083	E. pilularis	Broken Bago
PILP10047	E. pilularis	Buckra Bendinni
PILP10048	E. pilularis	Buckra Bendinni
PILP10069	E. pilularis	Bulga
PILP10070	E. pilularis	Bulga
PILP10071	E. pilularis	Bulga
PILP10072	E. pilularis	Bulga
PILP10073	E. pilularis	Bulga
PILP10074	E. pilularis	Bulga
PILP10075	E. pilularis	Bulga
PILP10076	E. pilularis	Bulga
PILP10077	E. pilularis	Bulga
PILP10082	E. pilularis	Burrawan
PILP10424	E. pilularis	Burrawan
PILP10425	E. pilularis	Burrawan
PILP10426	E. pilularis	Burrawan
PILP10427	E. pilularis	Burrawan
PILP10086	E. pilularis	Cairncross
PILP10087	E. pilularis	Cairncross
PILP10088	E. pilularis	Cairncross
PILP10092	E. pilularis	Cairncross
PILP10093	E. pilularis	Cairncross
PILP10094	E. pilularis	Cairncross
PILP10095	E. pilularis	Cairncross
PILP10096	E. pilularis	Cairncross
PILP10596	E. pilularis	Candole
BBT+ tree SEED 17	E. pilularis	Chaelundi
BBT+ tree SEED1	E. pilularis	Chaelundi
BBT+ tree SEED10	E. pilularis	Chaelundi
BBT+ tree SEED11	E. pilularis	Chaelundi
BBT+ tree SEED14	E. pilularis	Chaelundi

Plus Tree ID	Species	State Forest
BBT+ tree SEED15	E. pilularis	Chaelundi
BBT+ tree SEED16	E. pilularis	Chaelundi
BBT+ tree SEED18	E. pilularis	Chaelundi
BBT+ tree SEED19	E. pilularis	Chaelundi
BBT+ tree SEED2	E. pilularis	Chaelundi
BBT+ tree SEED3	E. pilularis	Chaelundi
BBT+ tree SEED4	E. pilularis	Chaelundi
BBT+ tree SEED5	E. pilularis	Chaelundi
BBT+ tree SEED6	E. pilularis	Chaelundi
BBT+ tree SEED7	E. pilularis	Chaelundi
BBT+ tree SEED8	E. pilularis	Chaelundi
BBT+ tree SEED9	E. pilularis	Chaelundi
BBT+ tree SEED12	E. pilularis	Chaelundi
BBT+ tree SEED13	E. pilularis	Chaelundi
PILP10097	E. pilularis	Clouds Creek
PILP10098	E. pilularis	Clouds Creek
PILP10099	E. pilularis	Clouds Creek
PILP10100	E. pilularis	Clouds Creek
PILP10101	E. pilularis	Clouds Creek
PILP10102	E. pilularis	Clouds Creek
PILP10103	E. pilularis	Clouds Creek
PILP10104	E. pilularis	Clouds Creek
PILP10105	E. pilularis	Clouds Creek
PILP10106	E. pilularis	Clouds Creek
PILP10107	E. pilularis	Clouds Creek
PILP10108	E. pilularis	Clouds Creek
PILP10109	E. pilularis	Comboyne
PILP10110	E. pilularis	Comboyne
PILP10244	E. pilularis	Comboyne
PILP10245	E. pilularis	Comboyne
PILP10246	E. pilularis	Comboyne
PILP10247	E. pilularis	Comboyne
PILP10252	E. pilularis	Comboyne
PILP10254	E. pilularis	Comboyne
PILP10255	E. pilularis	Comboyne
PILP10581	E. pilularis	Comboyne

Plus Tree ID	Species	State Forest
PILP10582	E. pilularis	Comboyne
PILP10583	E. pilularis	Comboyne
PILP10584	E. pilularis	Comboyne
PILP10585	E. pilularis	Comboyne
PILP10586	E. pilularis	Comboyne
PILP10587	E. pilularis	Comboyne
PILP10588	E. pilularis	Comboyne
PILP10589	E. pilularis	Comboyne
PILP10112	E. pilularis	Conglomerate
PILP10113	E. pilularis	Conglomerate
PILP10115	E. pilularis	Conglomerate
PILP10116	E. pilularis	Conglomerate
PILP10117	E. pilularis	Conglomerate
PILP10118	E. pilularis	Conglomerate
PILP10119	E. pilularis	Conglomerate
PILP10120	E. pilularis	Conglomerate
PILP10121	E. pilularis	Conglomerate
PILP10122	E. pilularis	Conglomerate
PILP10123	E. pilularis	Conglomerate
PILP10125	E. pilularis	Conglomerate
PILP10126	E. pilularis	Conglomerate
PILP10127	E. pilularis	Conglomerate
PILP10128	E. pilularis	Conglomerate
PILP10129	E. pilularis	Conglomerate
PILP10130	E. pilularis	Conglomerate
PILP10131	E. pilularis	Coopernook
PILP10132	E. pilularis	Coopernook
PILP10133	E. pilularis	Coopernook
PILP10134	E. pilularis	Coopernook
PILP10135	E. pilularis	Coopernook
PILP10136	E. pilularis	Coopernook
PILP10138	E. pilularis	Coopernook
PILP10139	E. pilularis	Coopernook
PILP10150	E. pilularis	Coopernook
PILP10058	E. pilularis	Dingo
PILP10059	E. pilularis	Dingo

Plus Tree ID	Species	State Forest
PILP10068	E. pilularis	Dingo
PILP10157	E. pilularis	Ellis
PILP10158	E. pilularis	Ellis
PILP10159	E. pilularis	Ellis
PILP10160	E. pilularis	Ellis
PILP10161	E. pilularis	Ellis
PILP10162	E. pilularis	Ellis
PILP10163	E. pilularis	Ellis
PILP10164	E. pilularis	Gladstone
PILP10165	E. pilularis	Gladstone
PILP10166	E. pilularis	Gladstone
PILP10167	E. pilularis	Gladstone
PILP10185	E. pilularis	Johns River
PILP10186	E. pilularis	Johns River
PILP10187	E. pilularis	Johns River
PILP10190	E. pilularis	Kerewong
PILP10191	E. pilularis	Kerewong
PILP10192	E. pilularis	Kerewong
PILP10193	E. pilularis	Kerewong
PILP10199	E. pilularis	Kerewong
PILP10201	E. pilularis	Kerewong
PILP10203	E. pilularis	Kerewong
PILP10205	E. pilularis	Kerewong
PILP10209	E. pilularis	Kerewong
PILP10213	E. pilularis	Kerewong
PILP10214	E. pilularis	Kerewong
PILP10215	E. pilularis	Kerewong
PILP10216	E. pilularis	Kerewong
PILP10217	E. pilularis	Kippara
PILP10218	E. pilularis	Kippara
PILP10219	E. pilularis	Kippara
PILP10220	E. pilularis	Kippara
PILP10140	E. pilularis	Lansdowne
PILP10141	E. pilularis	Lansdowne
PILP10142	E. pilularis	Lansdowne
PILP10144	E. pilularis	Lansdowne

Plus Tree ID	Species	State Forest
PILP10146	E. pilularis	Lansdowne
PILP10147	E. pilularis	Lansdowne
PILP10148	E. pilularis	Lansdowne
PILP10149	E. pilularis	Lansdowne
PILP10233	E. pilularis	Lansdowne
PILP10235	E. pilularis	Lansdowne
PILP10236	E. pilularis	Lansdowne
PILP10237	E. pilularis	Lansdowne
PILP10238	E. pilularis	Lansdowne
PILP10239	E. pilularis	Lansdowne
PILP10240	E. pilularis	Lansdowne
PILP10241	E. pilularis	Lansdowne
PILP10242	E. pilularis	Lansdowne
PILP10243	E. pilularis	Lansdowne
PILP10251	E. pilularis	Lansdowne
PILP10256	E. pilularis	Lansdowne
PILP10257	E. pilularis	Lansdowne
PILP10258	E. pilularis	Lansdowne
PILP10274	E. pilularis	Lorne
PILP10280	E. pilularis	Lorne
PILP10281	E. pilularis	Lorne
PILP10282	E. pilularis	Lorne
PILP10283	E. pilularis	Lorne
PILP10284	E. pilularis	Lorne
PILP10259	E. pilularis	Lower Bucca
PILP10260	E. pilularis	Lower Bucca
PILP10261	E. pilularis	Lower Bucca
PILP10262	E. pilularis	Lower Bucca
PILP10263	E. pilularis	Lower Bucca
PILP10264	E. pilularis	Lower Bucca
PILP10265	E. pilularis	Lower Bucca
PILP10266	E. pilularis	Lower Bucca
PILP10267	E. pilularis	Lower Bucca
PILP10268	E. pilularis	Lower Bucca
PILP10270	E. pilularis	Lower Bucca
PILP10271	E. pilularis	Lower Bucca

Plus Tree ID	Species	State Forest
PILP10272	E. pilularis	Lower Bucca
PILP10291	E. pilularis	Middle Brother
PILP10292	E. pilularis	Middle Brother
PILP10293	E. pilularis	Middle Brother
PILP10297	E. pilularis	Middle Brother
PILP10299	E. pilularis	Middle Brother
PILP10303	E. pilularis	Middle Brother
PILP10304	E. pilularis	Middle Brother
PILP10305	E. pilularis	Middle Brother
PILP10306	E. pilularis	Middle Brother
PILP10307	E. pilularis	Middle Brother
PILP10308	E. pilularis	Middle Brother
PILP10313	E. pilularis	Middle Brother
PILP10314	E. pilularis	Middle Brother
PILP10315	E. pilularis	Middle Brother
PILP10316	E. pilularis	Middle Brother
PILP10317	E. pilularis	Middle Brother
PILP10021	E. pilularis	Mount Boss
PILP10022	E. pilularis	Mount Boss
PILP10023	E. pilularis	Mount Boss
PILP10030	E. pilularis	Mount Boss
PILP10319	E. pilularis	Myall River
PILP10320	E. pilularis	Myall River
PILP10321	E. pilularis	Myall River
PILP10322	E. pilularis	Myall River
PILP10323	E. pilularis	Myall River
PILP10324	E. pilularis	Myall River
PILP10325	E. pilularis	Myall River
PILP10326	E. pilularis	Myall River
PILP10329	E. pilularis	Nana Creek
PILP10330	E. pilularis	Nana Creek
PILP10331	E. pilularis	Nana Creek
PILP10332	E. pilularis	Nana Creek
PILP10343	E. pilularis	Newry
PILP10344	E. pilularis	Newry
PILP10346	E. pilularis	Newry

Plus Tree ID	Species	State Forest
PILP10347	E. pilularis	Newry
PILP10349	E. pilularis	Newry
PILP10350	E. pilularis	Newry
PILP10351	E. pilularis	Newry
PILP10353	E. pilularis	Newry
PILP10354	E. pilularis	Newry
PILP10355	E. pilularis	Newry
PILP10461	E. pilularis	Olney
PILP10464	E. pilularis	Olney
PILP10465	E. pilularis	Olney
PILP10466	E. pilularis	Olney
PILP10467	E. pilularis	Olney
PILP10468	E. pilularis	Olney
PILP10469	E. pilularis	Olney
PILP10470	E. pilularis	Olney
PILP10472	E. pilularis	Olney
PILP10473	E. pilularis	Olney
PILP10479	E. pilularis	Olney
PILP10480	E. pilularis	Olney
PILP10481	E. pilularis	Olney
PILP10482	E. pilularis	Olney
PILP10483	E. pilularis	Olney
PILP10485	E. pilularis	Olney
PILP10486	E. pilularis	Olney
PILP10487	E. pilularis	Olney
PILP10359	E. pilularis	Orara East
PILP10360	E. pilularis	Orara East
PILP10361	E. pilularis	Orara East
PILP10362	E. pilularis	Orara East
PILP10363	E. pilularis	Orara East
PILP10364	E. pilularis	Orara East
PILP10365	E. pilularis	Orara East
PILP10366	E. pilularis	Orara East
PILP10367	E. pilularis	Orara East
PILP10368	E. pilularis	Orara East
PILP10369	E. pilularis	Orara East

Plus Tree ID	Species	State Forest
PILP10370	E. pilularis	Orara East
PILP10504	E. pilularis	Orara East
PILP10505	E. pilularis	Orara East
PILP10506	E. pilularis	Orara East
PILP10507	E. pilularis	Orara East
PILP10327	E. pilularis	Orara West
PILP10328	E. pilularis	Orara West
PILP10371	E. pilularis	Orara West
PILP10372	E. pilularis	Orara West
PILP10373	E. pilularis	Orara West
PILP10374	E. pilularis	Orara West
PILP10375	E. pilularis	Orara West
PILP10376	E. pilularis	Orara West
PILP10397	E. pilularis	Pine Creek
PILP10398	E. pilularis	Pine Creek
PILP10399	E. pilularis	Pine Creek
PILP10400	E. pilularis	Pine Creek
PILP10401	E. pilularis	Pine Creek
PILP10402	E. pilularis	Queens Lake
PILP10403	E. pilularis	Queens Lake
PILP10404	E. pilularis	Queens Lake
PILP10410	E. pilularis	Queens Lake
PILP10411	E. pilularis	Queens Lake
PILP10412	E. pilularis	Queens Lake
PILP10413	E. pilularis	Queens Lake
PILP10414	E. pilularis	Queens Lake
PILP10415	E. pilularis	Queens Lake
PILP10416	E. pilularis	Queens Lake
PILP10417	E. pilularis	Queens Lake
PILP10418	E. pilularis	Queens Lake
PILP10419	E. pilularis	Queens Lake
PILP10420	E. pilularis	Queens Lake
PILP10421	E. pilularis	Queens Lake
PILP10433	E. pilularis	Sheas Nob
PILP10436	E. pilularis	Tamban
PILP10437	E. pilularis	Tamban

Plus Tree ID	Species	State Forest
PILP10438	E. pilularis	Tamban
PILP10439	E. pilularis	Tamban
PILP10440	E. pilularis	Tamban
PILP10442	E. pilularis	Tamban
PILP10443	E. pilularis	Tamban
PILP10444	E. pilularis	Tamban
PILP10445	E. pilularis	Tamban
PILP10446	E. pilularis	Tamban
PILP10447	E. pilularis	Tuckers Nob
PILP10448	E. pilularis	Tuckers Nob
PILP10449	E. pilularis	Tuckers Nob
PILP10450	E. pilularis	Tuckers Nob
PILP10451	E. pilularis	Tuckers Nob
PILP10194	E. pilularis	Upsalls Creek
PILP10195	E. pilularis	Upsalls Creek
PILP10196	E. pilularis	Upsalls Creek
PILP10197	E. pilularis	Upsalls Creek
PILP10198	E. pilularis	Upsalls Creek
PILP10202	E. pilularis	Upsalls Creek
PILP10206	E. pilularis	Upsalls Creek
PILP10207	E. pilularis	Upsalls Creek
PILP10210	E. pilularis	Upsalls Creek
PILP10211	E. pilularis	Upsalls Creek
PILP10212	E. pilularis	Upsalls Creek
PILP10517	E. pilularis	Way Way
PILP10518	E. pilularis	Way Way
PILP10519	E. pilularis	Way Way
PILP10520	E. pilularis	Way Way
PILP10521	E. pilularis	Way Way
PILP10522	E. pilularis	Way Way
PILP10523	E. pilularis	Way Way
PILP10524	E. pilularis	Way Way
PILP10525	E. pilularis	Way Way
PILP10526	E. pilularis	Way Way
PILP10528	E. pilularis	Way Way
PILP10529	E. pilularis	Way Way

Plus Tree ID	Species	State Forest
PILP10530	E. pilularis	Way Way
PILP10531	E. pilularis	Way Way
PILP10532	E. pilularis	Way Way
PILP10488	E. pilularis	Wedding Bells
PILP10489	E. pilularis	Wedding Bells
PILP10490	E. pilularis	Wedding Bells
PILP10491	E. pilularis	Wedding Bells
PILP10492	E. pilularis	Wedding Bells
PILP10493	E. pilularis	Wedding Bells
PILP10494	E. pilularis	Wedding Bells
PILP10495	E. pilularis	Wedding Bells
PILP10496	E. pilularis	Wedding Bells
PILP10497	E. pilularis	Wedding Bells
PILP10498	E. pilularis	Wedding Bells
PILP10499	E. pilularis	Wedding Bells
PILP10501	E. pilularis	Wedding Bells
PILP10502	E. pilularis	Wedding Bells
PILP10503	E. pilularis	Wedding Bells
PILP10508	E. pilularis	Wedding Bells
PILP10509	E. pilularis	Wedding Bells
PILP10510	E. pilularis	Wedding Bells
PILP10511	E. pilularis	Wedding Bells
PILP10512	E. pilularis	Wedding Bells
PILP10514	E. pilularis	Wedding Bells
PILP10515	E. pilularis	Wedding Bells

3.2 Source material: CSIRO Australian Tree Seed Centre

Trial Code	Genus	Species	State	Location
2001_MCV_1	Corymbia	citriodora ssp. variegata	NSW	Willow Tree
2002_MCU_1	Corymbia	maculata	NSW	Corowa
2001_MCU_6	Corymbia	maculata	NSW	Deniliquin
2002_ARG_1	Eucalyptus	argophloia	NSW	Narromine
1996_BAD_2	Eucalyptus	badjensis	NSW	Deniliquin
2020_BEN_1	Eucalyptus	benthamii	NSW	Boorowa
1995_BEN_1	Eucalyptus	benthamii	NSW	Deniliquin
1995_BEN_2	Eucalyptus	benthamii	NSW	Deniliquin
1995_BEN_3	Eucalyptus	benthamii	NSW	Deniliquin
2008_BEN_1	Eucalyptus	benthamii	NSW	Wollombi
1998_CML_1	Eucalyptus	camaldulensis	NSW	Albury
1998_CML_3	Eucalyptus	camaldulensis	NSW	Albury
2000_CML_1	Eucalyptus	camaldulensis	NSW	Cootamundra
2000_CML_2	Eucalyptus	camaldulensis	NSW	Cootamundra
2004_CML_1	Eucalyptus	camaldulensis	NSW	Corowa
1996_CML_2	Eucalyptus	camaldulensis	NSW	Deniliquin
1999_CML_5	Eucalyptus	camaldulensis	NSW	Deniliquin
2000_CML_3	Eucalyptus	camaldulensis	NSW	Deniliquin

Trial Code	Genus	Species	State	Location
1997_CML_2	Eucalyptus	camaldulensis	NSW	Dubbo
1999_CML_1	Eucalyptus	camaldulensis	NSW	Gundagai South
1990_CML_2	Eucalyptus	camaldulensis	NSW	Gundaroo TSR
1989_CML_2	Eucalyptus	camaldulensis	NSW	Murrumbateman
1990_CML_1	Eucalyptus	camaldulensis	NSW	Springview
1999_CML_2	Eucalyptus	camaldulensis	NSW	Wagga Wagga
1999_CML_3	Eucalyptus	camaldulensis	NSW	Wagga Wagga
1999_CML_4	Eucalyptus	camaldulensis	NSW	Wagga Wagga
2002_CML_2	Eucalyptus	camaldulensis	NSW	Wagga Wagga
1996_CML_3	Eucalyptus	camaldulensis	NSW	Wellington
2001_CLD_08	Eucalyptus	cladocalyx	NSW	Corowa
2001_CLD_04	Eucalyptus	cladocalyx	NSW	Wagga Wagga
2003_CLD_3	Eucalyptus	cladocalyx	NSW	Wagga Wagga
1995_DNN_3	Eucalyptus	dunnii	NSW	Coffs Harbour
1995_DNN_4	Eucalyptus	dunnii	NSW	Coffs Harbour
2002_DNN_1	Eucalyptus	dunnii	NSW	Corowa
1995_DNN_2	Eucalyptus	dunnii	NSW	Deniliquin
1995_DNN_5	Eucalyptus	dunnii	NSW	Deniliquin
1995_DNN_6	Eucalyptus	dunnii	NSW	Deniliquin
2005_DNN_1	Eucalyptus	dunnii	NSW	Deniliquin

Trial Code	Genus	Species	State	Location
2005_DNN_2	Eucalyptus	dunnii	NSW	Deniliquin
1995_DNN_7	Eucalyptus	dunnii	NSW	Dorrigo
1982_GDS_2	Eucalyptus	grandis	NSW	Coffs Harbour
1999_GDS_3	Eucalyptus	grandis	NSW	Coleambally
1999_GDS_2	Eucalyptus	grandis	NSW	Darlington Point
1998_GDS_1	Eucalyptus	grandis	NSW	Deniliquin
1999_GDS_1	Eucalyptus	grandis	NSW	Yanco
2001_OLB_4	Eucalyptus	horistes	NSW	West Wyalong
2000_EHX_1	Eucalyptus	hybrids	NSW	Deniliquin
2000_EHX_2	Eucalyptus	hybrids	NSW	Newcastle
2001_EHX_1	Eucalyptus	hybrids	NSW	Whitton
2021_INF_1	Eucalyptus	infera	NSW	Boorowa
2004_OCO_1	Eucalyptus	occidentalis	NSW	Corowa
2001_OCO_6	Eucalyptus	occidentalis	NSW	Narrandera
2003_OCO_5	Eucalyptus	occidentalis	NSW	Wagga Wagga
1998_OCO_1	Eucalyptus	occidentalis	NSW	Wakool
2001_PBA_1	Eucalyptus	polybractea	NSW	West Wyalong
2017_PBA_1	Eucalyptus	polybractea	NSW	West Wyalong
2001_RAD_1	Eucalyptus	radiata	NSW	Casino
2002_SLG_1	Eucalyptus	saligna	NSW	Holbrook

Trial Code	Genus	Species	State	Location
1999_SLG_1	Eucalyptus	saligna	NSW	Little Billabong
1999_SLG_2	Eucalyptus	saligna	NSW	Ournie
2002_SDX_3	Eucalyptus	sideroxylon	NSW	Corowa
2002_SDX_2	Eucalyptus	sideroxylon	NSW	Holbrook
2002_SDX_4	Eucalyptus	sideroxylon	NSW	Wagga Wagga
2001_SDT_5	Eucalyptus	tricarpa	NSW	Walla Walla

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Appendix A – Individual SME Responses

A1. David Mannes – Resource/Tactical Planning Manager, FCNSW

- Forestry Corporation NSW (FCNSW) Plantation Strategy exists but requires simplification and final approval.
- There is opportunity to streamline management of hardwood plantations in conjunction with softwood plantations on the North Coast.
- Seed supply is currently constrained, with a pause on some planting activities until sufficient improved seed is available.
- Blackbutt seed orchards are in good condition and may produce a seed crop in the near term.
- Improved seed has been used in Blackbutt plantations established within the last 15 years.
- Significant effort is underway to identify plus trees and rescue genetic material from legacy trials, particularly in areas at risk of restricted access.
- Primary species focus includes Blackbutt (*E. pilularis*), Spotted Gum (*Corymbia* spp), Gympie Messmate (*E. cloeziana*), Sydney Blue Gum (*E. saligna*) and Silvertop Stringybark (*E. laevopinea*)
- The permanent growth plot (PGP) network has been expanded with 242 plots established in 2025/26.
- Current distribution of plots x species is:

Species	# plots
Blackbutt	94
Gympie Messmate	39
Blue Leaf Stringybark	36
Sydney Blue Gum	28
Silvertop Stringybark	17
Dunn's White Gum	11
Spotted Gum	4
Flooded Gum	12

- Information from earlier PGPs has been lost and is no longer available.
- Improved genetics and/or silviculture are delivering strong productivity gains with mean annual increment (MAI) figures of 20+ m3/ha/yr for Blackbutt, Blue Leaf Stringybark, Sydney Blue Gum, Silvertop Stringybark.
- Key risks:
    - Loss of genetic resources
    - Weak governance
    - Data inconsistency.
- Recommended actions:
    - Secure seed supply
    - Strengthen data systems
    - Establish dedicated plantation capability
    - Invest in monitoring, data management and trial maintenance
    - Support genomic testing of high-performing stands
    - Strengthen collaboration and data sharing across industry stakeholders
    - Focus investment on a small number of high-value species
    - Advocate for funding and policy support for plantation development.

A2. Graeme Sonter – Plantation Manager, FCNSW

- Many historical trials on private land have been lost.
- Ongoing tree improvement required across most key species.
- Opportunities for tree improvement:
    - *E. pilularis* - Needs expansion of seed orchards to enable sufficient supply to the program
    - *Corymbia citriodora* ssp *variegata* (CCV) – requires ongoing tree improvement.
    - *E. cloeziana* – great potential, has been widely planted. Requires ongoing tree improvement.
    - Species which have had no genetic improvement to date and require tree improvement.
        - *E. agglomerata* – useful on lower north coast sites such as in the Watagans on lighter soils derived mainly from sandstones and shale, principally at elevations ranging from 0 to 900m. Has also been used as a mid-slope species in Wild Cattle Creek.
        - *E. laevopinea* – useful on higher elevation sites, 800m to 1,300m ASL, medium to high fertility volcanic soils (basalt/granite). Avoid poorly drained or very low fertility sandy sites. Cold tolerant, suited to frost-prone tableland areas, less suited to warm frost-free coastal zones. Rainfall ≥800mm.
- Site Species Matching
    - Useful to summarise learnings to date for each of the major plantation species, focusing on
        - Suitable soil types
        - Elevation
        - Temperature/Frost risk
        - Rainfall/Drought risk
        - Seasonal rainfall pattern
        - Anticipated growth rates for given effective rooting depth (ERD) and rainfall.

- Significant operational constraints identified:
    - Nursery limitations
    - Pest pressure and browsing
    - Weed control challenges
- Limited expansion potential due to:
    - Land constraints
    - High establishment risk

A3. Nick Meyer, Hugh Cherry (DPI Plantation Regulation Unit)

- DPI's policy is to promote and facilitate plantation development, but the unit is under-resourced and has mostly reverted to a strictly regulatory function with limited extension and education capacity.
- No effective extension system for plantation growers.
- Private plantations often mismanaged due to lack of support.
- There is an opportunity for the Forestry Hub to focus on obtaining a better economic return from the existing private resource, in addition to expanding new plantings.
- Key needs:
    - Improved industry coordination
    - Developing solid case studies with transparent figures and costs for different silvicultural operations to alleviate grower fears and provide facts
    - Stronger plantation “branding”.

A4. David Bush, Nigel England (CSIRO / Australian Tree Seed Centre)

- Australian Tree Seed Centre (ATSC) contracts for seed orchard management at Corowa mostly had 10 or 15 year time limits on them which have all long expired now.
- Previous owner (V.L. Carroll) sold the property some years ago. ATSC has maintained contact with the new owner who has been happy to keep some of the trees but has removed others.
- The *E. cladocalyx* and *E. sideroxylon* seedling seed orchards (SSOs) and the clonal *C. citriodora variegata* (CCV) orchard are still at Corowa. This genetic material belongs to Forestry Corporation NSW. New agreements are needed with the new owner, who is open to any plan that would generate income from the trees.
- ATSC have not done any actual management of the trees for some years now due to a lack of resources and funding.
- The *E. cladocalyx* trial was measured last year. This trial needs thinning (about 10 years ago), but resources have not been available to do this. The owner has looked for outlets for the wood without success so far.
- Emphasis on:
    - Leveraging historical trials
    - Preserving genetic data
    - Expanding collaboration networks.
- Resources are needed to ensure that seed orchards are maintained and managed.
- Collection of seed should be a high priority.

A5. Michael Henson (Independent Forester)

- Short rotation plantations can result in high shrinkage during drying, lower density and reduced durability due to a lower proportion of heartwood. Longer-term management, good silvicultural practices and genetic improvement are needed to ensure future wood quality.
- *Corymbia citriodora* ssp. *variegata* (CCV) identified as key species for seed collection from existing trials and Corowa clonal seed orchard.
- Clonal CCV material is *Quambalaria* resistant. These clones have demonstrated success even on coastal sites which were previously considered unsuitable.
- As Corowa CCV genetic material originated from Forests New South Wales, FCNSW should be entitled to recover it to establish independent seed orchards.
- Spotted Gum trials contain approximately 550 families.
- *E. cloeziana* identified as a high-value species with good form and durability worth prioritising despite challenges with seed germination and availability.
- Other potential sites for collecting material, including historical trials at Tenterfield and near Grafton. Although some trials were on Joint venture (JV) land which have been converted back to grazing, other research trials might still be accessible for evaluation.
- Warwick Moore may be a useful contact for information about Tenterfield/ Emu Creek and Liverpool Plains trial locations and composition.
- Queensland (David Lee, USC) has much CCV material in common. Opportunities for collaboration should be explored.
- Initial focus should be on undertaking good silviculture on existing plantations and planting species that are suitable and site-specific.

A6. Mark Wright (Super Forest Plantations)

- Current best species on Super Forest Plantations estate are Gympie Messmate (*E. cloeziana),* Spotted Gum (*C. citriodora sub. variegata*), White Mahogony (*E. acmenoides*), Blackbutt (*E. pilularis*), Red Mahogony (*E. resinifera*), Grey Gum (*E. propinqua*), Grey Ironbark (*E. siderophloia*).
- Current silviculture program
    - Establishment 800 stems/ha (5 m between rows, 2.5 m within rows)
    - Age 4 (A4) quality survey
    - A5 thin to waste down to 600/ha and prune retained trees
    - A7 second lift pruning
    - A10+ minor harvest
    - A15 thin from below to 300/ha
    - A20-25 commercial thinning to 150/ha
    - A30-35 clearfall.
- *E. cloeziana* trial GHN04CL03 progeny trial established 2004 by FCNSW as part of TEPCO plantings. Contains 20 replicates and 42 treatments. Purchased by Super Forest Plantations from FCNSW. Measurement data are available.
- No improved genetics have been deployed. Currently collect own seed from good stands, plus trees and thinned stands.
- Would like to see large scale tree improvement program to provide a source of improved genetics, building on previous work e.g. Michael Henson's breeding program at Forests NSW.
- Class 1 durable species in plantations grow well and produce good timber.
- Requirements:
    - As much Class 1 durable species as possible – more market options
    - Narrow sapwood band
    - Straight stems.
- Market opportunities for thinnings:
    - Bush poles
    - Nature play (playground material)
    - Fencing – use spindle-less lathe to remove non-durable sapwood

- Species performance
    - Gympie Messmate (*E. cloeziana)*
        - Best consistent and overall performer
        - Can grow on a range of sites and outperforms other species
        - Good form
        - Narrow sapwood band
        - All products can be sold
        - Germination problem – needs good nursery management
        - Heavy branching – needs pruning
        - End splitting – is this an attribute that could be identified for breeding?
    - White Mahogony (*E. acmenoides*)
        - Early plantings had very poor form (could be due to original seed source) – opportunity for genetic improvement? Good form trees are available in native forest e.g. Bungabbee
        - Favoured species by fencing contractors
        - Strong interlocking grain
        - Defect free
        - No end-splitting
        - Very small (1-2 cm sapwood band).
    - Spotted Gum (*C. citriodora sub. variegata*)
        - Class 2 durable species
        - Slow growth
        - Doesn't respond well to late thinning
        - Only suitable for sawlog (can't be peeled)
    - Red Mahogony (*E. resinifera*)
        - Grows straight and fast
        - Problem with gum pockets
        - Structural timber markets only (not sawlog) due to dark colour.
    - Grey Ironbark (*E. siderophloia*)
        - Very large sapwood band
        - Not suitable for peeling - thick bark, poor form.

  - Narrow-leaved Grey Gum (*E. propinqua*)
    - Not planted
    - Fast grower, but poor form.
  - Blackbutt (*E. pilularis*)
    - Class 2 durable species
    - Grows well on good sites, but can have form issues on poor sites
    - Excellent form examples at Mackellar Range, Kyogle, Lismore.
  - Other minor species
    - Brush Box (*Lophostemon confertus)* – low growth rate, can't get crown lift, uncertain market.
    - Tallowwood *(Eucalyptus microcorys)* – highly unsuitable for northern sites, sap pockets, longicorn susceptible.
    - Turpentine (*Syncarpia glomulifera)* – low height in plantations (< 20m), can only get crown lift to where pruned.
- Risks to maintaining and growing the North Coast plantation resource include:
  - Establishment costs
  - Silvicultural treatments required
  - Lack of confidence in genetic material
  - Markets for thinnings
    - Export chip market no longer available
    - Too far from sugar mill for co-generation market
    - Biochar and Biocarbon – noting problem with EPA approval definition of "waste" product.
- Role and opportunity for NE Hub:
  - Encourage development of improved seed, utilising modern genetic testing techniques to facilitate trait selection.
  - Promote growing of highly durable eucalypts, as this is the most valuable timber from North Coast forests and availability will decline as area of native forest is reduced.
  - Good returns are available from well managed plantations, that are selectively thinned and pruned. Sawlog can be produced from 25 years onwards (species and site dependant).

A7. Chad Sheppeard (BioCarbon)

- BioCarbon is a high-end product focusing on replacing coke in electric steel furnaces.
- Federal Government funding has been obtained to develop a proof-of-concept scale plant at Bulahdelah. This will be ~20 times the size of the current pilot plant.
- Commissioning of this plant is expected in Q1 2027.
- Sawmill residue provides the best raw material as it has low ash content and does not require drying.
- Conventional biochar will be difficult to sell to farmers as a stand-alone product. Best option will be to sell as a combined biochar + fertiliser product.

A8. Fabiano Ximenes (NSW DPIRD)

- Biochar is a charcoal-like product made by heating any form of organic matter in a controlled process with limited oxygen (pyrolysis). This product is called “biochar” when it is used as a soil amendment or other uses that store the carbon in a durable form; or “biocarbon” if used for applications where the carbon is released (e.g. metallurgical processes.
- SEATA and Roundhill Engineering, based in Glen Innes, have developed a static pyrolysis technology to produce biochar (35%) and syngas (65%).
- SEATA has also developed a prototype mobile torrefaction unit which can process 200-300 kg/hr.
- There are still significant regulatory barriers in place when utilising “waste” for commercial deployment. For example, because of energy from waste requirements, any gas produced by the plant needs to be flared into the atmosphere rather than used for energy purposes. This is because under the energy from waste policy requirements, facilities generating energy from waste need to be located in certain specific regional precincts.
- However, exemptions are provided if the syngas is used to produce liquid biofuels.
- Clean biomass such as forestry residues is considered “eligible waste fuel” in NSW – which are considered by the EPA to pose a low risk of harm to the environment and human health due to their origin, composition and consistency.
- According to EPA Guidelines, facilities proposing to use eligible waste fuels must meet the following criteria:
    - Be able to demonstrate to the EPA that the proposed waste consistently meets the definition of an EPA-approved eligible waste fuel.
    - Ensure there are no practical, higher order reuse opportunities for the waste.
    - Fully characterise the waste and/or undertake proof of performance (where required).
    - Meet the relevant emission standards as set out in the Clean Air Regulation.
- The following are key steps considered necessary to enable further development of this technology:





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