National Centre for Future Forest Industries

Final Report

15 December 2014

Forward

The National Centre for Future Forest Industries (NCFFI) commenced two and half years ago to fill an important void left by the cessation of the Cooperative Research Centre (CRC) for Forestry after 21 years of continuous support for innovation in the Forestry and Forest Products sector in Australia. This relatively short term investment was an important mechanism for providing some 'breathing space' to industry whilst changes in ownership and in the unfavourable international terms of trade had time to resolve themselves. Importantly, the NCFFI grant provided two key opportunities. The first was to maintain the collaborations that had been established over two decades of the CRC program that, in the absence of some funding support, would necessarily fade and possibly disappear. The second was to maintain some capacity to support the sector. No institution or body in Australia has a mandate or mission to support capacity to drive innovation in the Forestry and Forest Products sector. Industry associations, the industry R&D Corporation, universities and other entities may all play a role, but for none of them is it a primary goal. It is rather a secondary consequence. The CRC program had by default filled this role over a long period of time. The NCFFI took up this responsibility. Consequently, in determining the mix of projects and activities funded or co-funded by the NCFFI grant, maintenance of collaborative links and of domestic capacity to support innovation in the sector were two key criteria for support. I believe we have well and truly achieved these objectives.

It was also my hope that over the two years we could reinvigorate R&D supporting the sector by breaking out of the mould that we grow forests for boards and chips and to make some headway in removing the artificial divide between extractive and non-extractive production. Engaging heavily with building, architectural and engineering expertise, linking these skills and contexts to forestry and wood processing through a supply chain approach, and establishing collaborative project activities involving forest restoration and production on the one estate have all gone a long way to realising these outcomes.

Unfortunately there is still little appetite for private investment in innovation in the sector, particularly in the wood processing part of the value chain and this lack is exacerbated by the near absence of vertical integration in the Australian Forestry and Forest Products industry. In the absence of significant private sector investment, governments at all levels have made it clear that further funding of a national centre or institute will not be forthcoming, despite intense lobbying from industry. Whilst this may change in the medium term, the immediate focus now must be for core skills and hard won collaborations to be maintained in the University sector through access to short-term grants from the Australian Research Council and the R&D corporations. It seems that a loose distributed network of research and development activity is a much more likely vehicle to take

innovation forward than the institutional approach that the sector is used to. This will come at the cost of further reduced capacity and diminishing coordination.

This final report has been written with three objectives in mind. Firstly, it will address the contractual obligations stated in the Funding Agreement between the Commonwealth and the University of Tasmania. Secondly it will provide summaries of the structure of the NCFFI activities, the work undertaken and what we have learned. Thirdly it will provide a list of NCFFI outputs.

Over two and a half years, the NCFFI has undertaken (and facilitated) a significant amount of industry-identified research and development addressing some of the key challenges and opportunities now before the Australian Forestry and Forest Products sectors. NCFFI has maintained and expanded R&D collaborations nationally to provide better integration and more efficient use of facilities and skills. It remains to be seen whether the NCFFI grant will have provided the needed temporary measure to enable industry, with government, to review, redesign and fund an ongoing activity into the future, or whether the NCFFI has simply staved off the inevitable demise of an integrated national Forestry and Forest Products innovation capacity.

Professor Mark Hunt

Director, National Centre for Future Forest Industries

Contents

Section (i): Recipient and Subcontractor Names

Recipient
University of Tasmania

Subcontractors
University of the Sunshine Coast
University of Melbourne
CSIRO
Queensland Department of Agriculture, Fisheries and Forestry
Southern Tree Breeding Association

Section (ii): Project Title

Project B – National Centre for Future Forest Industries

Section (iii): Funds paid under the Agreement

$2,500,000

Section (iv): Statement of Funds, Recipient Contributions and Other Contributions received and spent

Please see the spreadsheet financial summary presented as Table 1.

Funds have been specified follows:

1. Cash from the Department of Industry ($2,500,00)
2. Cash contributions from participants listed on Page 4 of the signed funding agreement (Background, clause M)
3. Other contributions (in-kind) from participants listed on Page 4 of the signed funding agreement (Background, clause M)
4. Cash contribution by the recipient (University of Tasmania)
5. Other contributions (in-kind) from the recipient (University of Tasmania)
6. Contributions from other parties including industry, funding bodies, governments

Additional information:

Column heading “NCFFI Theme” – reflects the themes specified in the Funding Agreement.

Column heading “NCFFI Project ID” - project identifiers used throughout the report and in the NCFFI Program.

Column heading “Project Name” – project name used throughout the report.

Column heading “NCFFI funding” – portion of the NCFFI grant (in dollars) directed to the activity/project.

Column heading “RMDB ID” – Reearch Management Database Identification number used internally by the office for research at the University of Tasmania. Because of various policies and definitions, not all projects or activities have an RMDB ID.

Column heading “Finance ID” – identifying number used in the finance system and associated with a particular project or activity. Some Finance IDs are linked to RMDB IDs and to other Finance IDs.

Column heading “Other identifier” - identifying number or code used by contract system or third party to describe the activity or project.

Column heading “Participant” – name of the relevant participant (partner) organisation. These are the organisations listed in the funding agreement plus one additional organisation – Whitegum Forest & Natural Resources that joined the group subsequently.

Column heading “Participant cash” – refers to cash investment in NCFFI project or activity by a participating organisation. Cash means actual money changed hands or cash was specified in a contract or agreement.

Column heading “Participant in-kind” - refers to salaries and operating spent within an organisation on direct project activity or direct support. These figures are supported by contracts, statements from third party organisations and internal allocations of resources.

Column heading “Funding body/Industry investor” – these are third party organisations (not participants or recipient -- UTAS) who have been involved with NCFFI. This includes corporations, government departments and granting bodies.

Column heading “Funding body/Industry investor cash – accounts for cash from the third party that has been contracted to an activity that formed part of the NCFFI portfolio.

Column heading “Additional partner in-kind” – accounts for additional in-kind resources that were committed under contract with the project or activity.

Column heading “Total investment” – sums the contributions of (1) the original NCFFI grant from the Commonwealth, (2) cash and inkind contributions from UTAS, (3) cash and inkind contributions by participants and (3) contracted cash and inkind contributions from industry, government and grant bodies. This figure reflects the true value of the NCFFI investment in creating R&D activity supporting the sector.

Column heading “Funds associated with other grants” – specifies those activities and associated resources that involved leverage of other Commonwealth government funding either directly or indirectly. Some Commonwealth grants prohibit the counting of some of these fund sources as permitted leverage. For simplicity, any funds that could fall under any such definition have been identified here and summed. The exception here is FWPA funding as FWPA was identified as a Participant/Partner in the funding agreement and thus their funds by definition counted towards Participant contributions.

Column heading “Leverage not associated with other grants” – identifies those funds that are not associated with any other Commonwealth funding source and did not form part of the original NCFFI grant and thus reflect the most narrow definition of leverage achieved.

Thus the $2,500,000 NCFFI grant leveraged over $9,500,000 activity, including nearly $3,500,000 of leverage under the narrowest definition, just under $2,500,000 of which was contributed directly by the participant organisations.

Note: Additional financial information is provided separately as part of the independent audit (Appendix 1). The audit only undertook a very narrow analysis of the total financial activity of the NCFFI (as was specified in the funding agreement) and should be considered in conjunction with the broader analysis provided above.

Table 1. NCFFI Theme and Project Financial Summary including leverage

NCFFI Theme	NCFFI Project ID		NCFFI Funding	RMDB ID	Finance ID	Other identifier	Participant	Participant cash	Participant in-kind	Funding body/Industry investor	Funding body/Industry investor cash	Additional partner inkind	Total Investment	Funds associated with other grants	Leverage not associated with other grants
0 - Administration	0.1	Administration/Directorate	$ 488,268.00		RT 104899		UTAS	$ 113,000.00	$ 120,200.00	NCFFI			$ 721,468.00		$ 233,200.00
1-Future Options	1.1	Utilisation of plantation hardwoods	$ 400,000.00		RT 104848	CRC Project 2.6	UTAS			NCFFI			$ 400,000.00		$ -
1-Future Options	1.1	Utilisation of plantation hardwoods		P0021092	RT 104367	CRC Project 2.6	UTAS			CRC Forestry	$ 400,000.00		$ 400,000.00		$ 400,000.00
1-Future Options	1.1	Utilisation of plantation hardwoods				CRC Project 2.6	Forestry Tasmania		$ 47,695.00	Forestry Tasmania			$ 47,695.00		$ 47,695.00
1-Future Options	1.2	Residues and processing solutions	$ 327,532.00		RT 104841		UTAS		$ 326,745.00	NCFFI			$ 654,277.00		$ 326,745.00
1-Future Options	1.2	Residues and processing solutions		N0012077			UTAS			Tasmanian Timber Promotions Board	$ 181,707.00		$ 181,707.00		$ 181,707.00
1-Future Options	1.2	Residues and processing solutions		N0022490			FWPA	$ 90,000.00		FWPA	$ -		$ 90,000.00		$ 90,000.00
1-Future Options	1.2	Residues and processing solutions		N0022491			FWPA	$ 90,000.00		FWPA	$ -		$ 90,000.00		$ 90,000.00
1-Future Options	1.2	Residues and processing solutions		N0022576			FWPA	$ 45,000.00		FWPA	$ -		$ 45,000.00		$ 45,000.00
1-Future Options	1.2	Residues and processing solutions		3207			UTAS			DIISRTE	$ 15,800.00		$ 15,800.00	$ 15,800.00	
1-Future Options	1.2	Residues and processing solutions		3207			UTAS			Hasel Britton	$ 15,800.00		$ 15,800.00	$ 15,800.00	
1-Future Options	1.2	Residues and processing solutions		3208			UTAS			DIISRTE	$ 19,750.00		$ 19,750.00	$ 19,750.00	
1-Future Options	1.2	Residues and processing solutions		3208			UTAS			Britton Brothers	$ 19,750.00		$ 19,750.00	$ 19,750.00	
1-Future Options	1.2	Residues and processing solutions		3514			UTAS			DIISRTE	$ 49,750.00		$ 49,750.00	$ 49,750.00	
1-Future Options	1.2	Residues and processing solutions		3514			UTAS			Island Workshop	$ 49,750.00		$ 49,750.00	$ 49,750.00	
1-Future Options	1.2	Residues and processing solutions		3481			UTAS			NRAS Inveresk	$ 5,000.00		$ 5,000.00	$ 5,000.00	
1-Future Options	1.2	Residues and processing solutions		3554			UTAS			Porta Mouldings	$ 8,000.00		$ 8,000.00	$ 8,000.00	
1-Future Options	1.2	Residues and processing solutions		3554			UTAS			DSDBI	$ 25,000.00		$ 25,000.00	$ 25,000.00	
1-Future Options	1.3	Peeling and sawing of plantation *E. nitens*	$ 30,000.00	3128			Forestry Tasmania	$ 30,000.00	$ 77,186.00	Forestry Tasmania	$ -		$ 137,186.00		$ 107,186.00
2-Productivity	2.1		$ -										$ -		$ -
2-Productivity	2.2	Potential and actual yield	$ -	H0021548	RT 104842	CRC Project 1.8	CSIRO		$ 228,000.00	CRC Forestry	$ 160,000.00		$ 388,000.00		$ 388,000.00
2-Productivity	2.3	Fast-truck	$ -	H0021548	RT 104845	CRC Project 1.8	USC			CRC Forestry	$ 155,000.00		$ 155,000.00		$ 155,000.00
2-Productivity	2.4	Matching germplasm to site, management and desired products	$ 540,000.00		RT 104847		UTAS		$ 248,576.00	NCFFI			$ 788,576.00		$ 248,576.00
2-Productivity	2.4	Matching germplasm to site, management and desired products				LP120200380	UTAS			ARC	$ 501,000.00		$ 501,000.00	$ 501,000.00	
2-Productivity	2.4	Matching germplasm to site, management and desired products				LP120200380	UTAS			Industry Partners	$ 179,000.00	$ 430,000.00	$ 609,000.00	$ 609,000.00	
2-Productivity	2.4	Matching germplasm to site, management and desired products				LP140100602	UTAS			ARC	$ 295,000.00		$ 295,000.00	$ 295,000.00	
2-Productivity	2.4	Matching germplasm to site, management and desired products				LP140100602	UTAS			Industry Partners	$ 120,000.00	$ 1,600,000.00	$ 1,720,000.00	$ 1,720,000.00	
2-Productivity	2.4	Matching germplasm to site, management and desired products				LP140100406	UTAS			ARC	$ 470,000.00		$ 470,000.00	$ 470,000.00	
2-Productivity	2.4	Matching germplasm to site, management and desired products				LP140100406	UTAS			Industry Partners	$ 145,000.00	$ 1,600,000.00	$ 1,745,000.00	$ 1,745,000.00	
2-Productivity	2.4	Matching germplasm to site, management and desired products			RT 104847		Forestry Tasmania		$ 7,970.00				$ 7,970.00		$ 7,970.00
2-Productivity	2.5	Australian Forestry Operations Research Alliance	$ 150,000.00	3128	RT 105524		USC		$ 325,000.00	AFORA Industry partners	$ 286,250.00		$ 761,250.00		$ 611,250.00
2-Productivity	2.5	Australian Forestry Operations Research Alliance					Forestry Tasmania		$ 35,757.00				$ 35,757.00		$ 35,757.00
2-Productivity	2.6	Linking genetics and chemistry to descrease bark stripping	$ 12,200.00	3128	RT 105207		UTAS			Timberlands	$ 19,350.00		$ 31,550.00		$ 19,350.00
2-Productivity	2.7	Supply chain logistics and transport	$ 25,000.00	3128	RT 103476		UTAS			Norske-Skogge Tasmania			$ 25,000.00		$ -
2-Productivity	2.7	Supply chain logistics and transport		M0021392	RT 106243		UTAS		$ 291,048.00	Workcover	$ 180,000.00		$ 471,048.00	$ 471,048.00	
3-Risk Mitigation	3.1	Linking productivity and risk to traits, genes and environment	$ 130,000.00		RT 104840	CRC Project 1.9	UTAS		$ 49,715.00	NCFFI			$ 179,715.00		$ 49,715.00
3-Risk Mitigation	3.1	Linking productivity and risk to traits, genes and environment		H0021549	RT 104840	CRC Project 1.9	CSIRO	$ 100,000.00	$ 80,277.00	CRC Forestry	$ 100,000.00		$ 280,277.00		$ 280,277.00
3-Risk Mitigation	3.2	Forest Climate Risk Analysis	$ 125,000.00	3128	RT 105519	CNT04357	CSIRO	$ 125,000.00	0	NCFFI			$ 250,000.00		$ 125,000.00
3-Risk Mitigation	3.3	Forest Water Use Project	$ 100,000.00		RT 105523		Whitegum FNR	$ 40,000.00	0	ACIAR	$ 35,000.00	$ -	$ 175,000.00	$ 175,000.00	
3-Risk Mitigation	3.3	Forest Water Use Project			RT 105523		Whitegum FNR			Bioforest	$ 5,000.00	$ -	$ 5,000.00		$ 5,000.00
3-Risk Mitigation	3.3	Forest Water Use Project			RT 105523		Whitegum FNR			FAO	$ 20,000.00	$ -	$ 20,000.00		$ 20,000.00
4- Education and Communication	4.1	Education Project	$ 70,000.00		RT 104843		UTAS	$ 98,000.00		NCFFI			$ 168,000.00		$ 98,000.00
4- Education and Communication	4.1.1	Stuart McDonald PhD project	$ 15,000.00		RT 105826		Greening Australia	$ 9,000.00		Greening Australia	$ -		$ 24,000.00		$ 9,000.00
4- Education and Communication	4.1.2	Mario Vega PhD Project	$ 7,000.00										$ 7,000.00		$ -
4- Education and Communication	4.2	Communication Project	$ 80,000.00		RT104846		USC	$ 40,000.00		CRC Forestry	$ 100,000.00		$ 220,000.00		$ 140,000.00
5-Additional activities	5.1	DNA fingerprinting of Eucalyptus dunnii			RT 105394		UTAS			seedEngergy	$ 25,380.00		$ 25,380.00		$ 25,380.00
5-Additional activities	5.2	Microsatellite markers for clove			RT 105398		UTAS			Griffin Tree Improvement	$ 10,575.00		$ 10,575.00		$ 10,575.00
													$ -		
			$ 2,500,000.00					**$ 780,000.00**	**$ 1,838,169.00**		**$ 3,596,862.00**	**$ 3,630,000.00**	**$ 12,345,031.00**	**$ 6,194,648.00**	**$ 3,650,383.00**

Section (v): Amount of funds remaining in the account referred to in clause 8.4

There are no uncommitted funds left in the account. Commitments to NCFFI projects are presently several thousands of dollars (a little over $64,000) beyond the remaining funding either from the Department of Industry, participants or funders. This liability will be met by the University of Tasmania.

The unspent but committed funds ($931,249.22) are all committed by purchase order, employment contract or third party contract. These committed funds will have been expended by 27 January 2016 (final salary commitment for a longer term project) but will for the most part be expended by the end of the current financial year including a very substantial component that are current liabilities for work already completed by third parties that has yet to be invoiced.

Section (vi): A description and Analysis of the Project, including:

(A) Evidence that the project has been completed, and the milestones have been achieved

Milestone 1. Due 28 September 2012.

Implementation Plan submitted - An implementation plan was completed and provided to the Commonwealth. *Reported December 2012 1st Progress Report*

Governance structure and interim working group membership finalised - Interim Advisory Board met on 1 November 2012. *Reported December 2012 1st Progress Report*

Milestone 2. Due 3 December 2012. Reported December 2012 1st Progress Report and again June 2013 Annual Report

Centre Director recruited - Prof Mark Hunt was recruited in November 2012. He commenced on 28 January 2013. *Reported December 2012 1st Progress Report and again June 2013 Annual Report*

Partnership agreements signed off - a formal partner agreement was drafted and distributed to potential core members of NCFFI. The collaboration agreement that was drafted ahead of the Milestone 2 delivery date was not viewed as a suitable vehicle for taking the NCFFI collaboration forward by the partners. Due to the short term nature of the funding, it was decided that projects should be designed and contracted on an as needs basis rather than falling under a formal collaboration mechanism. Essentially the transaction cost of a formal collaboration did not make sense considering the amount of money involved and the funded life of the Centre and potential partners were not prepared to go down this path. *Reported December 2012 1st Progress Report and again June 2013 Annual Report*

Advisory Board established and operating - The Interim Advisory Board met twice. Finalisation of the Advisory Board took longer than anticipated due to the need to engage a very wide range of stakeholders and ensure that the representation was appropriate to their interests. After coming on board early in 2013, the Director kept in close contact with Interim Advisory Board members and when it became apparent that the board would not be finalised within six months of the initial meeting, held a second meeting of the Interim Advisory Board on 21 May 2013 to ensure that governance expectations were being addressed. The advisory board was formally in place in June 2013, met in person twice (once in Canberra and once in Melbourne) and communicated by email on an *ad hoc* basis. The advisory board members were:

Independent Chair – Dr Gordon Duff
University of Tasmania representatives – Prof Jim Reid and Dr Sarah Jennings
Industry representatives – Mr Cameron Macdonald (HQP Plantations) and Mr Ross Hampton (Australian Forest Products Association)
Research Provider representatives – Dr Michael Kennedy (QDAFF) and Dr Phil Polglase (CSIRO)
Industry Engagement representative – Prof Mark Brown (USC)
Reported December 2012 1st Progress Report, June 2013 Annual Report, December 2013 2nd Progress Report

All research projects initiated - three research projects (with sub-projects) were initiated prior to December 2012 and reported as such. Additional projects were initiated as co-funding became available over the ensuing eighteen months and these were reported in the next progress/annual report. The initial projects operated across four states, engaging five major research providers and directly engaged relevant industrial partners. *Reported December 2012 1st Progress Report, June 2013 Annual Report, December 2013 2nd Progress Report, July 2014 Annual Report*

First progress report supplied to the Commonwealth - the first progress report was submitted as specified. *Reported December 2012 1st Progress Report*

Milestone 3. Due 14 June 2013

First annual report produced - completed and provided to the Commonwealth on time.

First annual report presented to Partners Forum – this milestone was outstanding as at the submission of the 1st Annual Report (June 2013). The Annual Report was subsequently presented to the collaborators in NCFFI and sent to participants in the Centre. Distribution was primarily through the Advisory Board representatives. *Reported June 2013 Annual Report, December 2013 2nd Progress Report*

Milestone 4. Due 13 December 2013

At least one technical report and industry bulletin per theme - completed.

Refereed publications in press – completed

The three themes were focussed differently with respect to both clients and outputs. Consequently the mix of bulletins and refereed publications was not uniformly distributed throughout the centre's life. For instance, Theme 2 consisted of a significant amount of work centred on operations research where technical style outputs are useful, whereas Theme 3 considered questions that are more amenable to delivery to stakeholders through model parameterisation. When considered across the three themes, the minimum output requirements for the centre were well exceeded at all times.

Additionally, in response to industry and other stakeholder feedback, the mix of outputs has been adjusted to focus on 4-5 page technical bulletins and formal peer reviewed publications, omitting lengthy un-refereed technical outputs as the latter have no discernible audience.

It was proposed that the Commonwealth formally recognise that an appropriate combination of industry bulletins (2-5 pages) and peer reviewed journal articles form the published output from the NCFFI and that technical reports not be considered necessary if these other two vehicles are used in line with and in response to industry feedback. These written outputs would be provided alongside in -person presentations and other forms of media (webinars for instance).

Reported 2nd Progress Report December 2013. Commonwealth agreed with the new interpretation of the output metric requirements

Second progress report supplied to Commonwealth - *Reported 2nd Progress Report December 2013*

Milestone 5. Due 31 July 2014

Initial research outputs completed in each thematic area; second annual report prepared and submitted to the Commonwealth - *Reported 2nd Annual Report July 2014*

Business plan for sustainability of Centre prepared with evidence of ingoing third party investment

This milestone was highlighted as 'at risk' in the *July 2014 Annual Report*. There is little appetite by government or industry to fund NCFFI or an alternative into the future. An application has been made to the Australian Research Council Industrial Transformation Program for a Forest Value Training Centre to be funded over five years commencing next calendar year. This proposal has gathered approximately $1.4 million industry cash, nearly $3 million University of Tasmania commitment, approximately $4.5 million industry in-kind support together and is requesting just under $4 million from the ARC over the five years. If the Centre is funded it will not be a substitute for a properly funded and integrated industry R&D Centre or Institute, but it will provide a vehicle for maintaining capacity and collaboration for a further five year period and it will produce a new cohort of industry focused researchers.

Milestone 6. Due 15 December 2014

Three national scale industry workshops/roadshows (one per theme) delivered – it was proposed in the December 2013 Progress report that the requirement for three industry roadshows in the contract be adjusted to permit a single national industry workshop that addressed the three themes. This request was in deference to the industry's current difficult financial situation and the increased difficulty associated with companies trying to fund their staff to three separate events. The suggested change was supported by the participants and the Advisory Board and was approved by the Commonwealth.

A National Industry Research Symposium (Delivery Workshop) was held in Hobart over three days from 25-27 November inclusive. The event was attended by nearly 80 registrants (see Appendix 2), coming from research providers and industry around the country. Thirty five presentations were given, both by researchers and industry collaborators (Appendix 3). Details of presentations are contained within this report.

Associated project documentation, including final report to the Commonwealth completed and delivered – this report

Final reporting including financial report and completion of the project – this report

(B) Details of the extent to which the Project achieved the Outcomes

Project ID:	1.1
Leader:	Matthew Hamilton
Project Title: Utilisation of plantation hardwood	
Project Outcomes	
Outline:	This project aimed to characterise and optimise products from plantations, with a focus on veneer and veneer-based engineered wood products (EWPs) from *Eucalyptus globulus* and *E. nitens.*
Deliverables:	<u>Plantations</u> • delivered a method based on NIR spectroscopy for the detection of non-recoverable collapse bands in radial samples of plantation eucalypts. This needs to be validated using a sawmill trial to relate occurrence within logs to sawing performance an product recovery. Once validated, suitable sampling protocols would allow resource screening and genetic selection to minimise collapse degrade (Downes *et al* 2014b) • made various NIR based applications available to industry partners. • quantified and reported on the extent of site and genetic variation in key solid-wood characteristics. For example: - identified no evidence of genotype by environment interaction and no differences across sites in *E. globulus* stem straightness, a trait that has previously received little attention in the species due to a focus on a pulpwood objective (Blackburn *et al.* 2013). - found that there is potential to improve modulus of elasticity (MOE), a measure of wood stiffness, in *E. nitens* through the exploitation of genetic variation in acoustic wave velocity (AWV) among and within races, the expression of genetic variation in AWV is relatively stable across different growing environments, and past selection for basic density and growth in pulpwood breeding programs is unlikely to have adversely affected MOE (Blackburn *et al.* 2014). • quantified variation in log and veneer characteristics among sites and highlighted possible silvicultural and environmental drivers of variation (Hamilton et al. 2014, McGavin et al. 2014a). <u>Products</u> • produced and reported on rotary veneer and engineered wood products produced from six plantations selected to represent a range of environments and silvicultural regimes under which temperate eucalypt plantations are grown (Hamilton et al. 2014, McGavin et al. 2014ab, McGavin et al. 2015). - quantified rotary veneer green and grade recoveries - identified value-limiting characteristics of logs, veneer and EWPs o log end splitting, sheer strength, appearance characteristics - quantified the relationship between log traits and veneer recovery - identified the potential of hybrid (eucalypt x pine) plywood panels to improve limiting shear strength characteristics in *E. nitens* - surveyed veneer producers, users and specifiers and prototype engineered

	products, including moulded plywood products, were produced based on survey results. <u>Education</u> • provided support for Mario Vega's PhD thesis. His studies, to be completed in 2015, will provide further insights into data collected as part of Project 1.1. Specifically his thesis will address the: - influence of site, storage and steaming on *E. nitens* log-end splitting (Vega *et al.* in prep) - description of patterns of radial variation in Density, microfibril angle and MOE in *E. nitens* (Vega *et al.* 2013) - use of near-infrared to predict wood density and modulus of elasticity in *E. nitens* - characterisation of the wood properties of the Tasmanian *E. nitens* plantation resource using Silviscan^{TM} analysis of samples from 80^{+} diverse plantations - the effect of environmental factors and silviculture on *E. nitens* wood properties
Conclusions:	• NIR applications have proved effective in the quantification of various commercially important wood properties. These represent only some of the commercial opportunities NIR spectroscopy offers industry. Applications are limited primarily by the narrow opportunities plantation growers have for gaining an economic benefit for improved wood quality. • The temperate eucalypt plantation resource is not uniform in terms of its log characteristics and wood properties, highlighting opportunities for silvicultural intervention and product segregation to maximise returns to growers • The temperate plantation resource can produce structural engineered wood products suitable for the existing market. The characteristics of these products, specifically shear strength, could be enhanced through the production of hybrid plywood products (eucalypt x pine) • Based on prototype performance, manufactures involved in prototype production have expressed a desire to use plantation eucalypt veneer in future products.
Outputs:	<u>Articles</u> Blackburn DP, Hamilton MG, Harwood CE, Baker TG, Potts BM (2013) Assessing genetic variation to improve stem straightness in *Eucalyptus globulus*. Annals of Forest Science. 70, 461-470. Blackburn, D., Hamilton, M., Williams, D., Harwood, C., Potts, B., (2014). Acoustic wave velocity as a selection trait in *Eucalyptus nitens*. Forests. 5, 744-762. Blackburn, D and Nolan, G. (2014). The potential for regional rotary veneer peeling in Tasmania. A feasibility study. University of Tasmania, Centre for Sustainable Architecture with Wood and the National Centre for Future Forest Industries. 66 pp.

Downes GM, Touza M, Wentzel-Vietheer M, Harwood CE (2013) NIR detection of tension wood in *Eucalyptus globulus*. In 'Workshop on commercial application of IR spectroscopies to solid wood'. (Eds PJ Harris and CM Altaner) pp. 37-48.

Downes G, Harwood C, Washusen R, Ebdon N, Evans R, White D, Dumbrell I (2014a) Wood properties of Eucalyptus globulus at three sites in Western Australia: effects of fertilizer and plantation stocking. Australian Forestry DOI: 10.1080/00049158.2014.970742

Downes GM, Touza M, Harwood C, Wentzel-Vietheer M (2014b) NIR detection of non-recoverable collapse in sawn boards of *Eucalyptus globulus*. European Journal of Wood and Wood Products **72**, 563-570.

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McGavin, R. L, Bailleres, H., Lane, F., Fehrmann, J. and Ozarska, B. (2014b) Veneer grade analysis of early to mid-rotation plantation *Eucalyptus* species in Australia, *Bioresources* 9(4), 6565-6581.

McGavin RL, Bailleres H, Hamilton M, Blackburn D, Vega M, Ozarska B (2015) Variation in rotary veneer recovery from Australian plantation *Eucalyptus globulus* and *Eucalyptus nitens*. Bioresources 10(1), 313-329.

Ozarska (2014). Suitability of veneers for the production of various products and their potential applications. The University of Melbourne. Research Report. 63 pp.

Vega M, Hamilton M, Downes G, Harwood C, Adams P, Potts B (2013) Near-infrared calibrations for wood density and modulus of elasticity for *Eucalyptus nitens* from Tasmania (Australia). Poster presentation. In: 18th International Nondestructive Testing and Evaluation of Wood Symposium, Madison, USA, p No. 121

Wentzel-Vietheer M, Washusen R, Downes GM, Harwood C, Ebdon N, Ozarska B, Baker T (2013) Prediction of non-recoverable collapse in *Eucalyptus globulus* from near infrared scanning of radial wood samples. European Journal of Wood and Wood Products 71, 755-768.

<u>Presentations</u>

Bailleres H (2014) Mechanical qualities of plantation hardwood veneer and veneer-based products. Presentation to National Centre for Future Forest Industries Delivery Workshop, November 25th - 27th. (University of Tasmania, Hobart)

Blackburn D and Nolan G (2014) The potential for rotary peeling veneer in regional Tasmania. Presentation to National Centre for Future Forest Industries Delivery Workshop, November 25th - 27th. (University of Tasmania, Hobart)

	Downes G. (2013) Utilisation of NIR in forest management. Forests and Wood Products Australia Webinar. http://www.fwpa.com.au/rd-and-e/r-and-dworks-webinars/266-utilisation-of-nir-in-forest-management.html Downes G & Harwood C (2014) Using NIR spectroscopy to describe radial variation in wood properties and detect collapse prone trees. Presentation to National Centre for Future Forest Industries Delivery Workshop, November 25th - 27th. (University of Tasmania, Hobart) Hamilton M, McGavin R, Baillères H, Blackburn D, Vega M, Potts B, Ozarska B, Harwood C, Hunt M (2014) NCFFI *Eucalyptus glob*ulus and *E. nitens* rotary peeling study. Presentation to National Centre for Future Forest Industries Delivery Workshop, November 25th - 27th. (University of Tasmania, Hobart) McGavin R (2014) Veneer processing and recovery of plantation hardwoods. Presentation to National Centre for Future Forest Industries Delivery Workshop, November 25th - 27th. (University of Tasmania, Hobart) Ozarska B (2014) The veneers suitability for the production of various products and their potential applications. Presentation to National Centre for Future Forest Industries Delivery Workshop, November 25th - 27th. (University of Tasmania, Hobart)
Ongoing Activity:	<u>Articles/reports in preparation</u> Downes G et al. (in prep) The effect of thinning of wood property variation in a 10 year old E. globulus plantation growing at Rennick in south-west Victoria. McGavin et al. (in prep) Stiffness and density analysis of rotary veneer recovered from six species of Australian plantation hardwoods McGavin R, Bailleres H, Adams P, Williams D and Hickey J (2014). Quality analysis of veneer produced from mid to late rotation Tasmanian grown plantation *Eucalyptus nitens*. Technical Report. Nolan G & Leggate B (2014) Opportunities for using Tasmanian wood processing residues. Draft Report. NCFFI Project. December 10th 2014. 51 pp. Vega M., Hamilton M., Blackburn D., McGavin R., Bailleres H., Potts B. (in prep) Influence of site, storage and steaming on Eucalyptus nitens log-end splitting Mario Vega's PhD thesis will be completed in 2015

Project Title: Residues and processing solutions Subproject Title: Building with low grade timber	
Project ID:	1.2 a
Leader:	Greg Nolan
Project Outcomes	
Outline:	This subproject project aimed to develop mass-timber floor and wall panels from low-grade timber for immediate use in building design, procurement and construction in Tasmania. A number of floor and wall panels were fabricated and tested to determine compliance with the required system performance requirements in building. Design, specification and engineering analysis for the panels was developed to allow immediate uptake by industry. The project was undertaken in collaboration with the University of Tasmania School of Engineering and CIS, and included industry support from TimberLink, Clennetts Mitre 10, Island Workshop, and Aldanmark engineers.
Deliverables:	A final report. Engagement with industry has led to interest in adopting the technology developed through this project.
Conclusions:	Low-grade mass timber wall and floor prototype panels have been developed for fabrication with low-tech equipment. Panels have been shown to satisfy the structural performance requirements for residential construction. Panels can be potentially cost comparable to commonplace construction systems currently in use. Industry partners have expressed an interest in fabricating the floor panels developed.
Outputs:	**Dissertations** Baxter, S., 2014, *Low-grade solid-timber systems for residential construction,* Bachelor of Engineering dissertation, University of Tasmania. Hamilton, J., 2014, *Use of Low Grade Timber in Residential Flooring Systems*, Bachelor of Engineering dissertation, University of Tasmania. Stockwin, F., 2014, *Developing and designing cross-laminated timber panels suitable for the Tasmanian building industry*, Bachelor of Engineering dissertation, University of Tasmania. **Presentations** Gee M (2014) Partnership with UTAS in R&D. Presentation to National Centre for Future Forest Industries Delivery Workshop, November 25th - 27th. (University of Tasmania, Hobart) Morgan A (2014) Hydrowood – seeing the forests and the trees, even if they are underwater! Presentation to National Centre for Future Forest Industries Delivery Workshop, November 25th - 27th. (University of Tasmania, Hobart) Nolan G (2014) Matching market performance requirements with the resource. Presentation to National Centre for Future Forest Industries Delivery Workshop, November 25th - 27th. (University of Tasmania, Hobart)

	Nolan G and Leggate B (2014) Getting values from wood residues. Presentation to National Centre for Future Forest Industries Delivery Workshop, November 25th - 27th. (University of Tasmania, Hobart) Shanks J (2014) Building with low grade timber. Presentation to National Centre for Future Forest Industries Delivery Workshop, November 25th - 27th. (University of Tasmania, Hobart) Shanks, J and Nolan, G (2014) Building with low grade timber. University of Tasmania, Centre for Sustainable Architecture with wood, National Centre for Future Forest Industries. 278 pp.
Ongoing Activity:	Expanding the project to investigate the use of plantation E. nitens in the low grade systems developed through this project using mainly radiata pine (to be completed November 2015). Continuing to support the construction sector and building design professionals to adopt the technology developed through this project (support will be ongoing).

Project Title: Residues and processing solutions Subproject Title: NRAS Inveresk: A technology transfer case study	
Project ID:	1.2 b
Leader:	Greg Nolan
Project Outcomes	
Outline:	This subproject project aimed to use the design, costing, and construction of 120 unit NRAS development in Tasmania as a technology transfer case study; using intellectual support and risk management to help realize a timber framed solution for the 120 unit development, rather than precast concrete which is the predominant form of construction. This subproject was in collaboration with Morrison Breytenbach Architects, Circa Morris-Nunn, Birelli Architecture, Aldanmark engineers and Island Workshop.
Deliverables:	A final report. A timber framed solution for the building being tendered (November 2014). A full-scale prototype of a prefabricated unit module constructed in timber frame using Tasmanian supply chain and constructors.
Conclusions:	Through the design development, costing, detailed design, and prototyping process the timber framed solution developed has proven to be competitive against the status quo of concrete construction. The consortium of design professionals involved in the project is strongly encouraged by the solution developed.
Outputs:	A 120 unit timber framed building being tendered for construction which would otherwise be concrete. A 1:1 prototype of a prefabricated, prefinished timber framed room-sized module. Nolan G and Shanks J (2014) NRAS Inveresk: A technology transfer case study. Presentation to National Centre for Future Forest Industries Delivery Workshop, November 25th - 27th. (University of Tasmania, Hobart)
Ongoing Activity:	Provide support to the design and construction team for the 120 unit development through construction (completed early 2016).

Project Title: Peeling and sawing of plantation *E. nitens* (Kamona trial)	
Project ID:	1.3
Leader:	Paul Adams and Greg Nolan
Project Outcomes	
Outline:	In March 2014, two studies were undertaken to evaluate the quality of peeled-veneer and sawn-timber from 30-year-old *E. nitens* trees sourced from a genetics trial at Kamona in north-eastern Tasmania. This work is part of a larger project which aims to improve our understanding of the wood quality from *E. nitens* and *E. globulus* plantations.
Deliverables:	For the veneer trial, 50 trees were harvested, with two logs from each tree prepared for peeling by Ta Ann Tasmania's Southwood mill. A further 140 sawlogs were harvested for the sawing study at Neville Smith Forest Products, also at Southwood. Both sets of logs were carefully labelled and tracked through the veneering and sawing processes so final product quality and value could be traced back to the original tree with its known pedigree and measurement history, and to ultimately inform the *E. nitens* breeding program. Veneer study - Veneer was tested at the QDAFF wood testing facilities in Queensland and results delivered in presentations at the NCFFI workshop on 25th Nov 2014 and a final Technical report. Sawing study – sawn timber was packaged and delivered to Launceston for air drying and grading. This material will be available for future product development projects.
Conclusions:	The results indicate that wood from older *E. nitens* plantations is denser and stiffer than wood from younger *E. nitens* plantations that are typically used for pulpwood. The older plantation wood is also demonstrating properties that could make it a viable alternative to native forest regrowth timber for sawing and peeling. These studies, and other like them, are beginning to build a more detailed picture of what uses and values the plantation estate will have to offer as it matures and becomes ready to harvest.
Outputs:	Draft technical report – Quality analysis of veneer produced from mid to late rotation Tasmanian grown plantation *Eucalyptus nitens.* McGavin, Bailleres, Adams, Williams and Hickey **Presentations:** Adams P, Williams D and Marunda C (2014) Product Recovery from mature, unmanaged *Eucalyptus nitens*. Veneer quality study, Kamona, NE Tasmania. National Centre for Future Forest Industries Delivery Workshop, November 25 – 27th 2014. Bailleres B (2014) Mechanical qualities of plantation hardwood veneer and veneer-based products. National Centre for Future Forest Industries Delivery Workshop, November 25 – 27th 2014. McGavin R (2014) Veneer processing and recovery of plantation hardwoods. National Centre for Future Forest Industries Delivery Workshop, November 25 – 27th 2014.

	Media releases: North East timber being put to the test. North Eastern Advertiser. May 7th 2015 News item on Southern Cross Television 6:30 News. Thursday 13th March 2015 The Examiner – 'Studies to put timber potential in spotlight' **Products/material** Veneer study – 600 veneer sheets tested at QDAFF and available for further testing and or product development. A further 2000 sheets (8 m^3) are stored in southern Tasmania and are also available for further projects. Sawing study – approximately 50 m^3 of sawn boards and large section material available for product development and projects.
Ongoing Activity:	The Technical report on veneer quality from the Kamona trial will be finalised by December 19th. Ongoing discussions between stakeholders regarding the use and product development opportunities for the remaining veneer and sawn timber produced from the two studies.

Project Title: Systems optimisation for multi-rotation plantation systems	
Project ID:	2.1 Systems optimisation for multi-rotation plantation systems
Leader:	Daniel Mendham
Project Outcomes	
Outline:	This project was designed to integrate the best available knowledge on multi-rotation sustainable plantation management, with harvesting systems optimisation tools and knowledge. It has produced a range of scientific papers and a spreadsheet-based economic optimisation tool that can be applied at stand scale and multiplied to estate scale as an aggregate of stands. It is appropriately transparent and constrained and can be modified for application by individual users.
Deliverables:	The project has delivered 2 key deliverables: an Excel spreadsheet, the 'System Optimisation Tool' and associated report, and 7 scientific publications (see below).
Conclusions:	This project has demonstrated that plantations can be suitably managed for sustainable productivity and profitability, and it has produced an excel-based tool (the 'System Optimisation Tool') to facilitate industry in exploring the financial and biophysical impacts of potential management choices around harvest and into the following rotation. It is requires a range of inputs, many of which need further testing and validation, but it can help managers to understand the benefits of investing more into conservative harvesting options. The hypothetical case studies in the report showed that cut to length harvesting with slash retained at site tended to be the best option for both productivity and profitability, but we recommend that individual companies use the tool to explore their own circumstances.
Outputs:	**Published papers** Drake, P. L., Mendham, D. S., White, D. A., Ogden, G. N. & Dell, B. (2012). Water use and water-use efficiency of coppice and seedling *Eucalyptus globulus* Labill.: A comparison of stand-scale water balance components. *Plant and Soil*, *350*(1-2), 221–235. Drake, PL, Mendham, DS, Ogden, GN (2013). Plant carbon pools and fluxes in coppice regrowth of *Eucalyptus globulus*. Forest Ecology and Management 306, 161–170. Eyles, A., Worledge, D., Sands, P., Ottenschlaeger, M. L., Paterson, S. C., Mendham, D. S. & O'Grady, A. P. (2012). Ecophysiological responses of a young blue gum (*Eucalyptus globulus*) plantation to weed control. *Tree Physiology*, *32*(8), 1008–1020. Eyles, A, Mendham, DS, Drake, PL, Pinkard, EA and White, DA. Gas exchange and water relations of *Acacia mangium* and *A. crassicarpa*. Trees, Structure and Function. (submitted) Mendham, D. S., Ogden, G. N., Short, T., O'Connell, A. M., Grove, T. S. & Rance, S. J. (2014). Repeated harvest residue removal reduces *E. globulus* productivity in the

	3rd rotation in south-western Australia. *Forest Ecology and Management*, *329*, 279–286. Rance, S. J., Mendham, D. S., Cameron, D. M. & Grove, T. S. (2012). An evaluation of the conical approximation as a generic model for estimating stem volume, biomass and nutrient content in young *Eucalyptus* plantations. *New Forests*, *43*(1), 109–128. Rance, S. J., Mendham, D. S. & Cameron, D. M. (2014). Assessment of leaf mass and leaf area of tree crowns in young *Eucalyptus grandis* and *E. globulus* plantations from measurements made on the stems. *New Forests*, 45:523-543. Walden, L., Harper, R., Mendham, D., Henry, D. & Fontaine, J. (2014). Eucalyptus reforestation induces soil water repellency. *Soil Research*. *In press* White, D. A., McGrath, J. F., Ryan, M. G., Battaglia, M., Mendham, D. S., Kinal, J., Downes, G. M., Crombie, D. S. & Hunt, M. E. (2014). Managing for water-use efficient wood production in *Eucalyptus globulus* plantations. *Forest Ecology and Management*, *331*, 272–280. **DSS** The System Optimisation Tool (draft) – an excel spreadsheet **Report** Mendham, D.S., White, D.A., Hunt, M.E. (2014). The System Optimisation Tool – a spreadsheet tool for hardwood plantation growers to optimise the harvest and inter-rotation management for future productivity and prosperity (Draft). November 2014. NCFFI **Presentations** Mendham D (2014) Maintaining profitability over multiple rotations. Presentation to National Centre for Future Forest Industries Delivery Workshop, November 25th - 27th. (University of Tasmania, Hobart)
Ongoing Activity:	The only outstanding task is to finalise the System Optimisation Tool and report, and submit. This is anticipated to be before end of December, 2014

Project Title: Potential and actual yield	
Project ID:	2.2 & 2.3 Combined project
Leader:	Don White and Mark Brown
Project Outcomes	
Outline:	Compare actual and potential productivity of the existing second rotation *Eucalyptus globulus* estate in southern Australia and identify key site and climatic attributes affecting productivity. From this, the extent, severity and causes of any changes in productivity between rotations can be quantified.
Deliverables:	Development of empirical growth curves that allow second rotation site index, basal area and volume to be calculated as a function of a standardised precipitation evaporation index and, where first rotation site index is known, to develop growth for the second rotation. Presentation of strategies to maintain productivity across successive rotations. Report on outcomes available via the FWPA website.
Conclusions:	The empirical growth curves were applied to depict the relationship between first and second rotation productivity for current management. In dry environments and on deep soils the decline can be as great as 50%. A process-based modelling analysis showed that some of the observed decline was due to variation in rainfall and plant available soil water between rotations. After accounting for the effect of water there was still a substantial residual, particularly on drier sites, and this was related to a qualitative measure of insect damage. Strategies that reduce second rotation water stress such as a fallow, selection of drought avoiding material and variation in stocking density are prospective for managing second rotation decline. Management of harvest residue will also be important in the longer term.
Outputs:	Mendham DS (2014). 2nd Rotation Decline in E. globulus – a presentation given to the Forest Systems Program Workshop. May 2014. White, D, Musk, R, Battaglia, M, Short, T, Bruce, J, Weidemann, J and Edwards, J (2013). The extent and causes of decline in productivity from first to second rotation blue gum plantations. Australia, FWPA. 29 pp
Ongoing Activity:	Project is complete

Project Title: Matching germplasm to site, management and desired products	
Project ID:	2.4
Leader:	Prof. Brad Potts
Project Outcomes	
Outline:	This project aims to enhance plantation productivity and profitability of Australia's main plantation species by better matching their genotypes to sites, silviculture and products. The project will determine: i) the extent to which genotype performance changes across different abiotic and biotic environments to better define germplasm deployment zones; ii) the sustainability of genotype performance under multi-rotation coppice regimes; and iii) the genetic opportunities and tradeoffs amongst traits affecting industrial objectives and risk traits;
Deliverables:	16 journal articles were published on *E. globulus* genetics (see below) over this period. A highlight was the publication of genome sequence paper in Nature which included NCFFI staff (Potts, Vaillancourt and Steane) amongst the 80 co-authors . This paper, with its 44 supplementary figures and 16 supplementary files, is mega-science – involving a collaboration of scientists from 10 countries, which extended over a decade. It reports on the Eucalyptus grandis genome sequence - the first Australian plant and second forest tree genome to be sequenced and assembled. This major international effort has placed the Australian eucalypts as a model plant system for genomic studies and will provide the foundation for international research efforts for decades to come. Two ARC Linkage grants and one ARC Discovery grant were successful and will extend this research field until 2017 1. Prof. B.M. Potts, Dr. Hamilton, M, Costa e Silva J, McRae T and Williams D Quantitative genetic control of economic traits in *Eucalyptus globulus*. ARC Linkage Grant LP140100506 (distributed over 2014 July, 2015, 2016, 2017 June) 2. Dr JM O'Reilly-Wapstra, Prof BM Potts, A/Prof NW Davies, Mr D Aurik, Dr HS Dungey, Dr PA Jefferson, Mr SR Elms Linking plant genetics and chemistry to maximise tree production in the softwood industry. ARC Linkage Grant LP140100602 (distributed over 2014 July, 2015, 2016, 2017 June) 3. Prof RE Vaillancourt, Prof BM Potts. The role of recombination in eucalypt evolution. ARC DP14 DP140102552 *Two NCFFI PhD projects started* One new PhD student has just started under DP140102552 and funding for 2 PhD scholarships are included in the other successful grants.
Conclusions:	1. Stem straightness is becoming increasing recognised as a selection trait for solid wood objectives and can be readily assessed using subjective methods.

	2. AWV can be used as an indirect measure to assess standing trees for MOE (ie wood stiffness). We have now shown this is heritable in *E. globulus*, and highly correlated with pulp yield - thus no trade-off for solid wood and pulpwood breeding objectives. 3. Wild browsing of pedigreed *E. globulus* seedlings was not influenced by genetics, but did impact tree development, morphology and survival, resulting in reductions in survival, height and basal area, an increase proportion in multiple stems, delays in flowering as well as delays in phase change from juvenile to adult foliage. Fitness impacts were minimal in response to a once-off browsing event, but effects were exacerbated when trees suffered repeated browsing. 4. While the growth performance of clonal propagules tested was inferior to seedling propagation, genotype performance was shown to be highly correlated across propagation type (clone versus seedling), arguing that their genetic evaluations can combined provided account is made the main effect of propagation type. 5. 24% of wood property QTLs and 38% of growth QTLs exhibited significant genotype-by-environment interaction. Nevertheless, despite markedly different environments and pedigrees, many QTLs were stable, providing promising targets for the application of marker-assisted selection. 6. Susceptibility to Mycosphaerella leaf disease (MLD) damage is genetically based and significantly correlated across different sites or natural outbreak. The approach of planting field trials in high risk sites seems a viable means of screening, although a better trait to select on may be growth on a site of infection (being tested). If outbreaks do not occur when plants are still in the juvenile stage there is the option of coppicing to return trees to the juvenile state. 7. Plant secondary compounds are intimately linked to protection of plants against herbivory and diseases. Genetic differences were shown to exist for the pattern of change in these chemicals through early seedling development, but remain relatively stable across field sites as well as experimentally induced drought stress. While chemicals are inherited in an additive manner, several key defensive chemicals were inherited in a non-additive manner in interspecific hybrids with *E. globulus*. 8. We showed that susceptibility of *E. globulus* to the introduced myrtle rust was under strong additive genetic control and that significant genetic variation resides with and between races of *E. globulus*. Both resistant and susceptible trees can be found in most races. 9. We showed that with one exception, genetic based susceptibility to key disease, insect and marsupial pests of *E. globulus* was independent, arguing that selection for resistance to one enemy will not impact on susceptibility to the others. 10. A study of the genetic relationship between standing tree acoustic wave velocity (AWV; indirect measure of MOE and thus wood stiffness) showed that this trait was under significant genetic control and was highly positively genetically correlated with pulp yield. This indicated that firstly there has not been adverse effects from selection based on a pulpwood breeding objective and, secondly there is the possibility these traits are genetically related and pulp yield can be indirectly selected from standing tree AWV (opening the way for mechanical assessments using harvesting heads).

	11. A collaborative study of harvesting logistics of two genetics trials showed that harvesting productivity was affected by genetics, this was mainly due to a strong positive genetic correlation with tree size (large stems increased productivity). While no significant genetic control of stem forking was detected, at the phenotypic level forking was shown to adversely affect harvesting productivity. 12. The coppicing of the genetics trials following their harvest was monitored at 8 months post-harvest. Inbreeding depression for survival and height growth of the unthinned coppice shoots of the survivors was amplified by harvesting/coppicing cycle. The extent to which the inbreeding depression in coppice vigour is maintained post- stem thinning will be determined following an 2015 assessment. However, it is possible that inbreeding effects in plantations grown from open pollinated seed may be confounded with the phenomenon of 2R productivity decline.
Outputs:	**Published journal articles** 1. Blackburn D, Hamilton M, Harwood CH, Baker T and Potts BM (2013) Assessing genetic variation in *Eucalyptus globulus* stem straightness. *Annals of Forest Science* 70, 461-470. 2. Blackburn D, Hamilton M, Harwood CH, Williams D and Potts BM (2014) Acoustic wave velocity as a selection trait in *Eucalyptus nitens*. *Forests* (Special Edition) 2014, *5*, 744-762. 3. Borzak C, O'Reilly-Wapstra J & Potts BM (2013) Direct and indirect effects of mammal browsing on a eucalypt species. Oikos (DOI: 10.1111/oik.01538 14/10/2014) 4. Borzak C, Potts BM, Noel W. Davies NW and O'Reilly-Wapstra J (2014) Population divergence in the ontogenetic trajectories of foliar terpenes of a *Eucalyptus* species. *Annals of Botany* (in press 31 Sept 2014). 5. Costa e Silva J, Potts BM, and Lopez G (2014) Heterosis may result in selection favouring the products of long-distance pollen dispersal in *Eucalyptus*. *PLoS One* **9**, e93811. 6. Costa e Silva J, Potts BM, Bijma P, Kerr RJ and Pilbeam DJ (2013) Genetic control of interactions amongst individuals: Contrasting outcomes of indirect genetic effects arising from neighbour disease infection and competition in a forest tree. *New Phytologist* 197: 631–641. 7. Costa e Silva JC, Potts BM and Tilyard P (2013) Stability of genetic effects across clonal and seedling populations of *Eucalyptus globulus* with common parentage. *Forest Ecology and Management* 291, 427 - 435. 8. Freeman JS, Potts BM, Downes GM, Pilbeam D, Thavamanikumar S, Vaillancourt RE (2013) Stability of QTL for growth and wood properties across multiple pedigrees and environments in *Eucalyptus globulus*. *New Phytologist* 198, 1121–1134. **9.** Hamilton MG,Williams DR, Tilyard PA, Pinkard EA,Wardlaw TJ, Glen M, Vaillancourt, RE, Potts, BM (2013) A latitudinal cline in disease resistance of a host tree. *Heredity* **110, 372-379.** 10. Hudson CJ, Freeman JS, Jones RC, Potts BM, Wong ML, Weller JL, Hecht VFG, Poethig RS, Vaillancourt RE. (2014) Genetic control of heterochrony in *Eucalyptus globulus*. *G3: Genes, Genomes, Genetics* 4:1235-1245. 11. McKiernan A.B., Hovenden M.J., Brodribb T.J., Potts B.M., Davies N.W. and O'Reilly-Wapstra J. (2014). Effect of limited water availability on foliar plant secondary metabolites of two *Eucalyptus* species. *Journal of Environmental*

and Experimental Botany 105, 55–64
12. Myburg AA, Grattapaglia D, Tuskan GA, Hellsten U, Hayes RD, Grimwood J, Jenkins J, Lindquist E, Tice H, Bauer D, Goodstein DM, Dubchak I, Poliakov A, Mizrachi E, Kullan ARK, van Jaarsveld I, Hussey SG, Pinard D, van der Merwe K, Singh P, Silva-Junior OB, Togawa RC, Pappas MR, Faria DA, Sansaloni CP, Petroli CD, Yang X, Ranjan P, Tschaplinski TJ, Ye C, Li T, Sterck L, Vanneste K, Murat F, Soler M, San Clemente H, Saidi N, Cassan-Wang H, Dunand C, Hefer CA, Bornberg-Bauer E, Kersting AR, Vining K, Amarasinghe V, Ranik M, Naithani S, Elser J, Boyd AE, Liston A, Spatafora JW, Dharmwardhana P, Raja P, Sullivan C, Romanel E, Alves-Ferreira M, Külheim C, Foley W, Carocha V, Paiva J, Kudrna D, Brommonschenkel SH, Pasquali G, Byrne M, Rigault P, Tibbits J, Spokevicius A, Jones RC, Steane DA, Vaillancourt RE, Potts BM, Joubert F, Barry K, Pappas Jr GJ, Strauss SH, Jaiswal P, Grima-Pettenati J, Salse J, Van de Peer Y, Rokhsar DS, Schmutz J. The genome of *Eucalyptus grandis*. *Nature* **510**, 356-362.
13. O'Reilly-Wapstra JM, Freeman JS, Barbour RC, Vaillancourt RE and Potts BM (2013) Genetic analysis of the near infrared spectral phenome of a global *Eucalyptus* species. *Tree Genetics and Genomes* 9, 943–959.
14. O'Reilly-Wapstra JM, Miller A, and Potts BM (2014) Variable patterns of inheritance of plant secondary metabolites in inter-specific eucalypt hybrids. *Forest Ecology and Management* 318, 71-77.
15. O'Reilly-Wapstra JM, Miller AM, Hamilton MG, Williams D, Glancy-Dean N and Potts BM (2013) Chemical variation in a dominant tree species: population divergence, selection and stability. *PLoS One* **8**, e58416
16. O'Reilly-Wapstra JOR, Hamilton MG, Gosney BJ, Whiteley C., Bailey JK, Williams DR, Wardlaw TJ, Vaillancourt RE, Potts BM (2014) Genetic correlations in multi-species plant/herbivore interactions at multiple genetic scales: implications for eco-evolutionary dynamics. *Advances in Ecological Research Vol. 50'. (Eds* Moya-Laraño J, Rowntree J and Woodward G) pp. 267-295 *(*Academic Press, Oxford).
17. Senior JK, Schweitzer JA, O'Reilly-Wapstra J, Chapman SK, Steane D, Langley A, Bailey, JK. (2013) Phylogenetic Responses of Forest Trees to Global Change. PLoS ONE 8(4): e60088. doi:10.1371/journal.pone.0060088.

Under consideration

1. Rix KD, Gracie AJ, Potts BM, Brown PH, Spurr CJ, Gore PL (2014) Genetic control of *Eucalyptus globulus* seed germination. *Annals Forest Science* (in review)
2. Hudson CJ, Freeman JS, Myburg AA, Potts BM, Vaillancourt RE (2014) Genomic patterns of species diversity and divergence in *Eucalyptus*. *New Phytologist* (resubmitted 15/10/2014)
3. Hamilton M Acuna M, Wiedemann J, Pilbeam D, Brown, M and Potts BM Genetic control of *Eucalyptus globulus* harvest traits. *Canadian Journal of Forest Research* (submitted 1st Oct)
4. McKiernan AB, Potts BM, Hovenden MJ, Brodribb TJ, Davies NW, Rodemann T, McAdam S and O'Reilly-Wapstra J submitted) Soil water deficit and recovery affect *Eucalyptus* leaf chemical traits and leaf ignitability, yet the duration of water deficit has no impact. Annals of Botany (submitted 31/10/2014)

Book Chapters

1. Potts BM, Hamilton M and Pilbeam DJ (2014) Capítulo 22. Mejoramiento genético de eucaliptos de zonas templadas en Australia [Genetic improvement of temperate eucalypts in Australia]. In 'Mejoramiento Genético de Eucaliptos de en Chile' (Eds. Roberto Ipinza, Santiago Barros A., Braulio Gutiérrez C. and Nuno Borralho) (INFOR Instituto Forestal, Chile) (chapter translated into Spanish by editors) (CD version of book released May 2014)

Reports

1. Miller A, O'Reilly-Wapstra J, Potts BM (2014). Genetic variation in bark stripping among *Pinus radiata*. Internal Report to the National Centre for Future Forest Industries (NCFFI) and Timberlands Pacific Pty Ltd (October 15th 2014). Pp 28.

2. Miller A, O'Reilly-Wapstra J, Potts BM (2014). Genetic variation in bark stripping among *Pinus radiata*. Internal Report to the National Centre for Future Forest Industries (NCFFI) and Timberlands Pacific Pty Ltd (November 2014). Pp 30.

Conference Presentations

1. Borzak C, Potts B, BarryK, Pinkard L & O'Reilly-Wapstra JM (2013). Genetic stability of physiological and plant secondary metabolite induced responses to defoliation in a eucalypt. Gordon's Research Conference on Plant-Herbivore Interactions, Ventura, 24th February – 1st March. California.
2. Costa e Silva J, Kerr RJ, Bijma P and Potts BM (2012) Indirect genetic effects in trees change the heritable variance available for selection and our perception of their genetic architecture. Abstract for short talk and poster at Final Conference and Workshops of Noveltree Project. Tree Breeding, Genomics and Evolutionary Biology: New Synergies to Tackle the Impact of Climate Change in the 21st Century. p 55-56. 16th-18th October 2012, Helsinki and Vantaa, Finland
3. Dutkowski G, Potts B, Pilbeam D, Holz G and Edwards J (2014) *Eucalyptus globulus* genotype by environment iteraction. Presentation to National Centre for Future Forest Industries Delivery Workshop, November 25th - 27th. (University of Tasmania, Hobart)
4. Dutkowski GW, Kerr RJ, Tier B, Li L, Costa e Silva J, Ivković M**,** Potts BM and McRae TA (2012). Next Generation Breeding Values. Invited talk at the AdapCAR Conference on 'Genetic Aspects of Adaptation and Mitigation: Forest Health , Wood Quality and Biomass Production', Riga, Latvia, 3-5 October 2012.
5. Freeman J, Lee D, Pegg G, Brawner J, Hamilton M, Potts B (2014) Matching genetics to environment and management. Presentation to National Centre for Future Forest Industries Delivery Workshop: November 25th – 27th 2014 (University of Tasmania, Hobart)
6. Harrison, PA, Worth, JRP, Vaillancourt, RE, Potts, BM (2013). Predicting the distribution of *Eucalyptus ovata* under past, current, and future climates. Presented at the Graduate Research – Sharing Excellence in Research (SEiR)

Conference, Hobart, Tasmania, 6th September.

7. Larcombe MJ, Barbour R, Vaillancourt, RE and Potts, BM (2012) Gene flow from Australia's eucalypt plantations. Invited presentation at the Australian Forest Growers National Conference: Diverse sub-tropical forestry, 14th – 17th October 2012, Gympie, Queensland.
8. Larcombe MJ, Silva JS, Vaillancourt RE, Potts BM (2013) Quantification of wildling establishment from Australian *Eucalyptus globulus* plantations. Presentation at the VII Southern Connection Congress: Southern lands and southern oceans - life on the edge? 21st - 25th January 2013, Dunedin, New Zealand.
9. McKiernan AB, Hovenden MJ, Brodribb TJ, Potts BM, Davies NW & O'Reilly-Wapstra JM (2013). Effects of water limitation on plant secondary metabolite concentrations in *Eucalyptus* leaves: inter- and intra-specific plant responses. INTECOL, 8th – 23rd August, London.
10. O'Reilly-Wapstra, J.M.(2013) Forest systems in Tasmania: addressing ecological and management questions in production forests. METLA (Finnish Forest Research Institute), Suonenjoki, Finland. August 27th 2013.
11. O'Reilly-Wapstra, J.M., Gosney, B., Whiteley, C., Hamilton, M., Bailey, J.K., Forster, L and Potts, B.M. (2013). Tree genetics shapes community trajectories in planted forests. INTECOL, 18th-23rd August, London.
12. Potts B, Hamilton M, Dutkowski G, Pilbeam D, Freeman J, Blackburn D, Tilyard P, Vaillancourt R, Wiedemann J, Downes G, Acuna M, Mitchell R and Brown M (2014) Matching genetics to environment and management. Presentation to National Centre for Future Forest Industries Delivery Workshop: November 25th – 27th 2014 (University of Tasmania, Hobart)
13. Potts BM (2014) Discovering Tasmania's eucalypts. Invited talk to the Royal Society of Tasmania 4/3/2014. (Associated with awarding of Clive Lord medal).
14. Potts BM (2014) Eucalypt reproductive biology and applications in breeding. Invited presentation to the '*Eucalyptus* workshop' of Colombian Corporación Nacional de Investigación y Fomento Forestal (CONIF), 13-14th May 2014, Bogotá, Colombia.
15. Potts BM (2014) Quantitative genetic control of economic traits in *Eucalyptus globulus*. Presentation to the STBA Technical committee meeting, 11th Nov, University of Melbourne, Victoria.
16. Potts BM (2014) The use of molecular tools to address population genetics and conservation issues: the case of *Eucalyptus*. Invited presentation to the '*Eucalyptus* workshop' of Colombian Corporación Nacional de Investigación y Fomento Forestal (CONIF), 13-14th May 2014, Bogotá, Colombia.
17. Potts BM, Larcombe MJ, Leaman T, Vaillancourt RE (2014). Assessing the risk of gene flow from plantation to native eucalypts: A long-term partnership in biodiversity management. Conference Program & Abstracts of '10th Australasian Plant Conservation Conference'. Hobart, Australia. 12-13 November 2014. p. 37 (Australian Network for Plant Conservation; Hobart).
18. Potts BM, Larcombe MJ, Leaman T, Vaillancourt RE (2014). Assessing the risk of gene flow from plantation to native eucalypts: A long-term partnership in biodiversity management. Conference Program & Abstracts of '10th Australasian Plant Conservation Conference'. Hobart, Australia. 12-13 November 2014. p. 37 (Australian Network for Plant Conservation;

	Hobart). 19. Steane DA, Potts BM, McLean E, Prober SM, Stock WD, Vaillancourt RE, Harrison PA, Byrne M (2014). Detecting signals of local adaptation in widespread species. 'Phylomania 2014'. University of Tasmania, Hobart, Australia. 5-7 November 2014. **Award** 1. The Royal Society of Tasmania's Clive Lord medal in recognition of B. Potts' substantial contributions to Tasmanian science in the field of eucalypt genetics (4th March 2014).
Ongoing Activity:	1. GxE in E. globulus June 2015 – report and genetic evaluation of the National *E. globulus* breeding population that implements the result of this work and associated analytical tools. 2. Indirect genetic effects in *E. globulus* June 2015 – report. 3. Ongoing study of genetic architecture of *E. globulus* as defined by work program in ARC linkage grant LP140100506. Dec 2017

Project Title: Australian Forestry Operations Research Alliance - AFORA	
Project ID:	2.5
Leader:	Mark Brown
Project Outcomes	
Outline:	The research priorities of the AFORA are: (a) understanding, managing and controlling operational costs for existing, evolving and new harvest systems; (b) planning and managing value recovery within harvest operations; and (c) optimising system and supply chain efficiency.
Deliverables:	Delivery of improved industry understanding of forest operations productivity and value recovery drivers with current operational technology as the foundation of optimised transport and biomass supply chain planning. The program produced and updated a number of industry decisions support models including a logging productivity model and a forest chipping model in partnership with European partners. The program also developed an industry optimised transport planning model and an optimised biomass supply chain planning model both engaged in industry application in Australia and collaborative research overseas.
Conclusions:	Continue to have strong industry collaboration around research that makes a direct impact on their operations and business outcomes.
Outputs:	**Industry Bulletins** AFORA Industry Bulletin 1. Brown, M, Mitchell, R & Wiedemann, J (2013) Productivity and utilisation of an in-field chipping harvest system in an unmanaged blue gum coppice stand in Western Australia. AFORA Industry Bulletin 2. Ghaffariyan, MR (2013) The natural drying process of logs and harvesting residues - preliminary results. AFORA Industry Bulletin 3. Mitchell, R (2013) Comparison of different flail chains operating in *Eucalyptus globulus* plantations in Western Australia. AFORA Industry Bulletin 4. Ghaffariyan, MR, Spinelli, R, Brown, M, Mirowski, L (2013) Chipping model: a tool to predict the productivity and cost of chipping operations. AFORA Industry Bulletin 5. Strandgard, M, Mitchell, R and Walsh, D (2013) Productivity and cost of two *Eucalyptus nitens* harvesting systems when bark is retained on logs. AFORA Industry Bulletin 6. Strandgard, M, Mitchell, R and Walsh, D (2013) Quantity of *Eucalyptus nitens* bark retained on logs at roadside following harvest, infield drying, processing and infield transport by two harvesting systems. AFORA Industry Bulletin 7. Murphy, G, Passicot, P and Strangard, M (2014) Effect of daily working hours on productivity of mechanised harvesting operations. AFORA Industry Bulletin 8. Ghaffariyan, MR, Acuna, M and Brown, M (2014) Natural drying and optimising a forest residue supply chain to reduce the total operating costs: A case study in Western Australia. AFORA Industry Bulletin 9. Acuna, M, Mitchell, R and Wiedemann, J (2014)

Evaluation of genetic-related tree traits and work method on *E. globulus* harvesting productivity – A case study in Western Australia.

AFORA Industry Bulletin 10. Alam, M, Strandgard, M and Brown, M (2014) Using LiDAR slope estimates to predict the productivity of a self-levelling feller-buncher.

AFORA Industry Bulletin 11. Ghaffariyan, MR, Spinelli, R, Magagnotti, N, Brown, M and Mitchell, R (2014) Harvesting residual woody biomass in pine plantations in south west Western Australia.

AFORA Industry Bulletin 12. Ghaffariyan, MR, Acuna M and Brown M (2014) Analysing the effect of five operational factors on the operating costs of a biomass supply chain: A case study in Western Australia.

AFORA Industry Bulletin 13. Ghaffariyan, MR and Brown M (2014) Payload management of forestry trucks.

AFORA Industry Bulletin 14. Acuan M and Wiedemann J (2014) Effects of different stocking densities on harvesting of bluegum stands in Western Australia – Ayres 00 case study.

Peer Reviewed Publications

Acuna, M., Ghaffariyan, MR, Mirowski, L. and Brown, M. (2014) A simulated annealing algorithm to solve the log truck scheduling problem. Proceedings of the 2014 Precision Forestry Symposium. Stellenbosch University, South Africa, March 2014.

Acuna, M and Sessions, J (2014) A simulated annealing algorithm to solve the log-truck scheduling problem. In: Simulated Annealing: Strategies, Potential Uses and Advantages. Chapter 8. Nova Science Publishers, NY, USA.

Acuna, M (2014) Integrated transportation tools to optimise timber and biomass supply logistics. FEC/FORMEC 2014. September 23 – 26. Gerardmer, France.

Alam, M., Walsh, D. Strangard, M. and Brown, M. (2014) A log-by-log productivity analysis of two Valmet 475EX harvesters. International Journal of Forest Engineering 25: 14-22.

Alam, M, Acuna, M, Strandgard, M and Brown, M (2014) Harvester productivity model development using LiDAR and multispectral imagery. European Journal of Remote Sensing (in review).

Brown, M., Ghaffariyan, MR and Acuna, M. (2013) Forest biomass supply chain optimisation using BIOPLAN in Western Australia. Bioenergy Australia 2013 Conference. Building the future – Biomass for the Environment, Economy and Society, Hunter Valley, NSW, November 2013.

Ghaffariyan, M. R. (2013). Remaining slash in different harvesting operation sites in Australian plantations. Silva Balcanica, 14(1): 83-93.

Ghaffariyan, MR, Acuna, M. and Brown, M. (2013) Analysing the effect of five operational factors on forest residue supply chain costs: A case study in Western Australia. Biomass and Bioenergy 59: 486 – 493.

Ghaffariyan, MR, Brown, M. and Spinelli, R. (2013) Evaluating efficiency, chip quality and harvesting residues of a chipping operation with flail and chipper in Western Australia. Croatian Journal of Forest Engineering 34: 189-199.

Ghaffariyan, MR, Sessions, J. and Brown, M. (2013) Roadside chipping in a first thinning operation for radiata pine in South Australia. Croatian Journal of Forest Engineering 34: 91-101.

Ghaffariyan, MR, Spinelli, R. and Brown, M. (2013) A model to predict productivity of different chipping operations. Southern Forests 75: 129-136.

Ghaffariyan, MR and Brown, M. (2014) Comparing four harvesting methods using multiple criteria analysis in Western Australia. Proceedings of the 2014 Precision Forestry Symposium. Stellenbosch University. South Africa, March 2014.

Ghaffariyan, MR, Acuna, M and Brown, M (2014) Biomass harvesting residue supply chain optimisation and verifying the effect of major parameters affecting the supply chain cost in Western Australia. FEC/FORMEC 2014. September 23 – 26. Gerardmer, France.

Hamilton,M, Acuna, M, Wiedemann, J, Mitchell, R, Pilbeam, D, Brown, M and Potts, B (2014) Genetic control of *Eucalyptus globulus* harvest traits. Canadian Journal of Forest Research (in review).

Meadows, J., Coote, D. and Brown, M. (2014) The potential supply of biomass for energy from hardwood plantations in the Sunshine Coast Council region of southeast Queensland Australia. Small Scale Forestry (*2014*). DOI 10.1007/s11842-014-9265-7

Mirowski, L., Smith, A., Ghaffariyan and Acuna, M. (2014) Integrating ubiquitous computing design into forestry information and communication technology: a case study in designing a forestry transportation system. Seventh IEEE International Conference on Ubi-Media Computing. Ulaanbaatar, Mongolia, January 2014.

Mitchell, R and Strandgard, M (2014) Comparison of harvester time consumption and productivity in Eucalyptus globulus planted and second rotation coppice plantations in south west Western Australia. Croatian Journal of Forest Engineering (in review).

Sosa, A, Acuna, M, McDonnell, K and Devlin, G (2014) Managing the moisture content of wood biomass for the optimisation of Irelands transport supply strategy to bioenergy markets and competing industries. Energy (accepted for publication).

Sosa, A, Acuna, M, McDonnell, K and Devlin, G (2015) Controlling moisture content and truck configurations to model and optimise biomass supply chain logistics in Ireland. Applied Energy, 137: 338 – 351.

Sosa, A, Devlin, G and Acuna, M (2014) The use of truck tracking systems to optimise forest biomass planning in Ireland. In: 2014 Precision Forestry Symposium, 3 – 5 March 2014, Stellenbosch, South Africa.

Spinelli, R., Brown, M., Giles, R., Huxtable, D., Relaño, R. L., & Magagnotti, N. (2014). Harvesting alternatives for mallee agroforestry plantations in Western Australia. Agroforestry Systems, 88: 479 – 487.

Strandgard, M, Alam, MT and Mitchell, R (2014) Impact of slope on productivity of a self-levelling processor. Croatian Journal of Forest Engineering, 35(2): 193 – 200.

Strandgard, M and Mitchell, R (2014) Monitoring long-term forwarder productivity using onboard computer data. FEC/FORMEC 2014. September 23 – 26. Gerardmer, France.

Walsh, D., & Strandgard, M. (2014). Productivity and cost of harvesting a stemwood biomass product from integrated cut-to-length harvest operations in Australian *Pinus radiata* plantations. Biomass and Bioenergy, 66: 93-102.

Walsh, D, Strandgard, M and Carter, P (2014) Evaluation of the Hitman PH330 acoustic assessment system for harvesters. Scandinavian Journal of Forest Research, 29(6): 593 – 602.

Presentations

Acuna M (2014) Integrated transport planning and moisture content management to optimise the wood supply chain. Presentation to National Centre for Future Forest Industries Delivery Workshop, November 25th - 27th. (University of Tasmania, Hobart)

Ghaffariyan MR and Brown M (2014) Payload management of timber trucks. Presentation to National Centre for Future Forest Industries Delivery Workshop, November 25th - 27th. (University of Tasmania, Hobart)

Mitchell R (2014) An overview of AFORA harvest system comparison studies. Presentation to National Centre for Future Forest Industries Delivery Workshop, November 25th - 27th. (University of Tasmania, Hobart)

Strandgard M (2014) Harvest planning tools. Presentation to National Centre for Future Forest Industries Delivery Workshop, November 25th - 27th. (University of Tasmania, Hobart)

Models & Tools

Australian Logging Productivity and Costing Assessment (ALPACA) model (machine productivity)

Chipcost (chipper productivity mode)

Fast Truck - An optimised transportation planning model

	Bioplan / MCplan - A biomass supply chain planning model
Ongoing Activity:	Ongoing operational trial to understand knowledge that can enhance supply chain management Application for an extended funding opportunity to leverage ongoing industry investment towards enhanced knowledge of new technology performance, improved knowledge capture within the supply chain and extending optimised planning and management to the entire supply chain.

Project Title: Linking genetics and chemistry to decrease bark stripping	
Project ID:	2.6
Leader:	Julianne O'Reilly-Wapstra
Project Outcomes	
Outline:	The softwood (conifer) plantation estate forms a major component of Australia's forestry industry, with more than a million hectares of *Pinus radiata* trees. Bark stripping by native mammalian herbivores in *Pinus* forests is a major threat to this industry. The damage decreases productivity and is a significant economic burden for forestry companies. One possible solution is to examine natural plant resistance as a strategy to reduce the incidence and severity of bark stripping. In this project UTas will examine the degree of variation in bark stripping in genetics trials provided by Timberlands Pacific (TPPL). Defensive chemical profiles of the bark will be examined to address the following questions: 1) Is variation in bark stripping genetically based? 2) Is variation in bark stripping correlated with variation in bark chemistry?
Deliverables:	1) Analysed TPPL data for genetic variation in bark stripping damage. 2) Developed a chemical extraction procedure to assess plant secondary chemistry of bark samples. 3) Assessed trees for variation in bark chemistry. 4) Examined the relationship between variation in bark chemistry and variation in damage. 5) Written a report detailing the approach and results. 6) Prepared a manuscript for publication
Conclusions:	For field sites exhibiting measureable amounts of bark stripping: - evidence of genetic-based field variation in bark stripping by mammals existed. - between-site variation was large and accounted for the majority of variation in stripping. - some variation was also explained by tree size (height and/or DBH) and bark texture. Smaller trees received more damage than larger ones, smooth barked trees received more damage than rough barked trees. Variation in browsing pressure between sites resulted in different aspects of genetic variation being expressed: low browsing highlighted highly susceptible treatments while high browsing highlighted the more resistant treatments. Animal damage appeared to be largely stable over time.
Outputs:	Miller A, O'Reilly-Wapstra J and Potts B (2014). Genetic variation in bark striping among *Pinus radiata*. Confidential Report. Internal report to the National Centre for Future Forest Industries and Timberlands Pacific Pty Ltd. October 15th 2014. 28 pp. Miller A, O'Reilly-Wapstra J and Potts B (2014). Genetic variation in bark striping among *Pinus radiata*. Confidential Report. Internal report to the National Centre for Future Forest Industries and Timberlands Pacific Pty Ltd. November 2014. 30 pp.

	O'Reilly-Wapstra J, Aurik D, Miller A and Potts B (2014) Genetic variation in bark stripping among *Pinus radiata*. Presentation to National Centre for Future Forest Industries Delivery Workshop, November 25th - 27th. (University of Tasmania, Hobart)
Ongoing Activity:	This project is closed

Project Title: Supply chain logistics and transport	
Project ID:	2.7
Leader:	Paul Turner
Project Outcomes	
Outline:	The project aims to investigate intelligent information use across forestry supply chain operations to achieve safety and productivity outcomes within chain of responsibility constraints. Specifically, practical tools and techniques will be investigated, developed and evaluated with industry partners in order to improve the monitoring, management and support of such things as fatigue and mass management for demonstration of compliance in organisations and between supply chain partners.
Deliverables:	Presentations to Worksafe Tasmania and to the NCFFI Delivery Workshop Milestone reports to Worksafe Tasmania Applications for mobile devices installed and tested by industry
Conclusions:	The use of mobile devices and appropriate 'apps' has many advantages over traditional pen and paper systems for managing fatigue reduction in the transport part of the forestry and forest products sector. There are very significant advances in efficiency and safety to be derived through developing and using these tools.
Outputs:	Presentations 'Fatigue Reduction Technologies for a Safer Tasmanian Transport Sector', WorkSafe Tasmania Safe Work Month – October 2013, Hobart Australia October, 2013. 'Fatigue Reduction Technologies for a Safer Australian Transport Sector', University of Sunshine Coast Research Week – 2014, Sunshine Coast Australia, 2014. 'Fatigue Reduction Technologies for a Safer Australian Transport Sector', National Centre for Future Forest Industries (NCFFI) Annual Workshop – 2014, University of Tasmania, Hobart Australia, 2014. Ross I (2014) CSG Logistics safety code of practice – Delivery Supply chain compliance. Presentation to National Centre for Future Forest Industries Delivery Workshop, November 25th - 27th. (University of Tasmania, Hobart) Publications/Non-peer reviewed Mirowski, L., Acuna, M., Almond, I., Kang, BH., and Turner, P., (2014) Fatigue Reduction Technologies for a Safer Tasmanian Transport Sector: Milestone One Report – **Structured Stakeholder Consultation**, eLogistics Research Group, University of Tasmania, Australia (on behalf of WorkCover Tasmania, Department of Justice, Tasmanian Government). Mirowski, L., Acuna, M., Almond, I., Kang, BH., and Turner, P., (2014) Fatigue Reduction Technologies for a Safer Tasmanian Transport Sector: Milestone Two Report – **Implementation of Fatigue Management System and Initial Data Collection**, eLogistics Research Group, University of Tasmania, Australia (on behalf of WorkSafe Tasmania, Department of Justice, Tasmanian Government).
Ongoing Activity:	Second phase of testing with industry partners focussing on fleet level rather than truck/driver level applications requires completion and reporting during 2015

Project Title: Linking productivity and risk to traits, genes and environment	
Project ID:	3.1
Leader:	Dr Anthony O'Grady and Prof. Brad Potts
Project Outcomes	
Outline:	For target native tree species, the project will determine: 1. the extent to which provenance/genotype choice impacts productivity and survival, traits associated with survival and drought tolerance and, where relevant, product quality; 2. the genetic variability, plasticity and environmental drivers of functional trait variation; and 3. the extent to which site adaptation and species biophysical limitations can be modelled from functional trait, genetic and environmental data.
Deliverables:	Eight journal articles were published and a major report *Two grant submissions (e.g. ARC Linkage)* One grant submission was successful and contributed to the outcomes of this project: Potts, Vaillancourt & O'Reilly-Wapstra (2012); Providing a genetic framework to enhance the success and benefits from forest restoration and carbon plantings in rural landscapes. ARC Linkage Grant over 3 years (LP120200380). Three grant applications have been submitted but not funded. O'Grady A, Atkin O, Potts B, Steane D (2013) Heat waves and the limits to forest function. CSIRO OCE Postdoctoral Fellowships 2013-14 (Round 1) (unsuccessful-potential opportunity to resubmit this in December) O'Grady A, Arndt S, Bossinger G, Tissue D, Potts B, Trueman S (2013) A climatic risk assessment tool for carbon farmers and policy makers. Australian Department of Agriculture, Fisheries and Forestry, "Clean Energy Future - Filling the Research Gap" Round 2 (unsuccessful). Steane DA (2013) Genomic approaches to understanding eucalypt adaptation to climate change. ARC Future Fellowship for funding commencing in 2014 (unsuccessful). One PhD awarded: Archana Gauli (2014) Genetic diversity and adaptation in *Eucalyptus pauciflora.* PhD Thesis Univ. of Tasmania One Hons degree awarded: Ally Pasanen (2014) Genetic variation in the phenotypic plasticity of *Eucalyptus pauciflora* subsp. *pauciflora* Sieb. ex Spreng. Honours thesis, School of Biological Sciences, University of Tasmania. Three PhDs currently in progress: Ben Grosney, Peter Harrison, Stuart MacDonald

Conclusions:	1. We found that seed collected from fragmented forest of *Eucalyptus pauciflora* does not necessarily have high levels of self fertilisation although seed quantity may be reduced (Gauli et al. 2013). Thus in the case studied we concluded that seedlings grown from seed collated from remnant trees in fragmented landscapes are suitable for restoration plantings. 2. We have used molecular markers and quantitative genetics provide an estimate of the size of a local population to help guide seed collectors (Gauli et al. 2014, Gauli 2014) and have established field experiments of restoration eucalypt species to test whether local provenances are best (Bailey et al. 2013; Gauli 2014). 3. We have shown significant genetic variation in functional traits exists amongst populations of the restoration species *E. pauciflora* and the strongest climatic correlate is maximum temperature of the warmest month. Exposure of one of the field trials to a record extreme hot temperatures, combined with very dry conditions revealed significant differences between populations in foliage damage that was best predicted based on a home-site moisture index (Gauli 2014). 4. We showed that trait plasticity may have a genetic basis and be an important way in which local eucalypt populations adapt to aridity gradients (McLean et al. 2014). We have also developed a novel approach for using genome wide DNA scans to develop indices of holistic adaptation to environmental gradients which can be used to guide seed choices for climatically resilient tree plantings (Steane et al. 2014). Collaboration between UTAS/NCFFI and the Western Australian Department of Parks and Wildlife, CSIRO Ecosystem Sciences and Edith Cowen University resulted in the production of one manuscript on *E. tricarpa* physiology across an aridity gradient a second on using genomic techniques to bypass reciprocal transplant experiments (in *E. tricarpa*), and one discovering a cryptic lineage of another arid adapted eucalypt.
Outputs:	**Published journal articles** 1. Bailey T, Davidson N, Potts B, Gauli A, Hovenden M, Burgess S, Duddles J (2013) Plantings for carbon, biodiversity and restoration in dry Tasmanian rural landscapes. *Australian Forest Grower* 35 (4), 39-41. 2. Gauli A, Vaillancourt RE, Steane DA, Bailey T, Potts BM (2013) The effect of forest fragmentation and altitude on the mating system of *Eucalyptus pauciflora* (Myrtaceae). *Australian Journal of Botany* **61**, 622–632. 3. Gauli A, Vaillancourt RE, Steane DA, Potts BM (2014). Molecular genetic diversity and population structure in *Eucalyptus pauciflora* subsp. *pauciflora* on the island of Tasmania. *Australian Journal of Botany* **62**, 175-188. 4. Harrison PA, Bailey TG, Vaillancourt RE, Potts BM (2014) Provenance and seed mass determines the seed germination success of *Eucalyptus ovata* (Myrtaceae). *Seed Science and Technology* **42**, 1-7. 5. Kremer A, Potts BM, Delzon S (2014) Genetic divergence in forest trees: understanding the consequences of climate change. *Functional Ecology* 28, 22–36 (invited review) DOI: 10.1111/1365-2435.12169 6. McLean EH, Steane DA, Prober SM, Stock WD, Potts BM, Vaillancourt RE, Byrne M. (2014) Plasticity of functional traits varies clinally along a rainfall gradient in *Eucalyptus tricarpa*. *Plant Cell & Environment* **37**, 1440–1451 doi: 10.1111

7. Myburg AA, Grattapaglia D, Tuskan GA, Hellsten U, Hayes RD, Grimwood J, Jenkins J, Lindquist E, Tice H, Bauer D, Goodstein DM, Dubchak I, Poliakov A, Mizrachi E, Kullan ARK, van Jaarsveld I, Hussey SG, Pinard D, van der Merwe K, Singh P, Silva-Junior OB, Togawa RC, Pappas MR, Faria DA, Sansaloni CP, Petroli CD, Yang X, Ranjan P, Tschaplinski TJ, Ye C, Li T, Sterck L, Vanneste K, Murat F, Soler M, San Clemente H, Saidi N, Cassan-Wang H, Dunand C, Hefer CA, Bornberg-Bauer E, Kersting AR, Vining K, Amarasinghe V, Ranik M, Naithani S, Elser J, Boyd AE, Liston A, Spatafora JW, Dharmwardhana P, Raja P, Sullivan C, Romanel E, Alves-Ferreira M, Külheim C, Foley W, Carocha V, Paiva J, Kudrna D, Brommonschenkel SH, Pasquali G, Byrne M, Rigault P, Tibbits J, Spokevicius A, Jones RC, Steane DA, Vaillancourt RE, Potts BM, Joubert F, Barry K, Pappas Jr GJ, Strauss SH, Jaiswal P, Grima-Pettenati J, Salse J, Van de Peer Y, Rokhsar DS, Schmutz J. The genome of *Eucalyptus grandis*. *Nature* **510**, 356-362.
8. O'Grady A, Battaglia M, Bruce J and Zhang L (2014) What will be the hydrological consequences of elevated CO? Presentation to National Centre for Future Forest Industries Delivery Workshop, November 25th - 27th. (University of Tasmania, Hobart)
9. Steane DA, Potts BM, McLean EH, Prober SM, Stock WD, Vaillancourt RE, Byrne M. (2014) Genome wide scans detect adaptation to aridity in a widespread forest tree species. *Molecular Ecology* **23**, 2500–2513.
10. Worth JRP, Harrison PA, Williamson GJ, Jordan GJ (2014) Whole range and regional-based ecological niche models predict differing exposure to 21st century climate change in the key cool temperate rainforest tree southern beech (*Nothofagus cunninghamii*). *Austral Ecology*.

Under consideration

5. Gauli A, Vaillancourt RE, Bailey T, Steane DA, Potts BM (2014). Evidence for climate adaptation in early-life traits of a widespread eucalypt. Ecology and Evolution (submitted 16/7/2014).
4. Steane DA, Potts BM, McLean EH, Collins, L, Prober SM, Stock WD, Vaillancourt RE, Byrne M. (2014) Genome wide scans reveal cryptic lineages in a dry-adapted mallee eucalypt. Tree Genetics and Genomes (submitted 7/11/2014)

Reports

1. Byrne M, Prober S, McLean L, Steane D, Stock W, Potts B and Vaillancourt R (2013) Adaptation to climate in widespread eucalypt species: Climate-resilient revegetation of multi-use landscapes: exploiting genetic variability in widespread species. pp. 86 Report Published by the National Climate Change Adaptation Research Facility.

Theses

1. Archana Gauli (2014) Genetic diversity and adaptation in *Eucalyptus pauciflora.* PhD Thesis University of Tasmania
2. Ally Pasanen (2014) Genetic variation in the phenotypic plasticity of *Eucalyptus pauciflora* subsp. *pauciflora* Sieb. ex Spreng. Honours thesis, School of Biological Sciences, University of Tasmania.

Conference Presentations

20. Bailey TG, A Gauli, Tilyard P, Davidson NJ, Potts BM (2014). Feral deer

	damage in Tasmanian biodiverse restoration plantings. Conference Program & Abstracts of '10th Australasian Plant Conservation Conference'. Hobart, Australia. 12-13 November 2014. p. 19 (Australian Network for Plant Conservation; Hobart). 21. Bailey TG, Gauli A, Harrison P, Davidson NJ, Steane DA, Vaillancourt RE, Potts BM (2014). Providing a genetic framework to enhance the success and benefits from forest restoration and carbon plantings in the rural midlands of Tasmania, Australia. Abstracts of '2nd Conference of Ecological Restoration Australasia'. Noumea, New Caledonia. 17-21st November 2014. 22. Davidson NJ, Bailey TG, Gauli A, Harrison PA, Steane DA, Vaillancourt RE, Potts BM (2014) Providing a genetic framework to enhance the success and benefits from forest restoration and carbon plantings in the rural Midlands of Tasmania, Australia. '2nd Conference of Society for Ecological Restoration Australasia'. Noumea, New Caledonia. 17-21 November 2014. 23. Gauli A, Bailey T, Steane D, Davidson N, Vaillancourt R and Brad Potts B (2012) Evidence for genetic-based climate adaptation in *Eucalyptus pauciflora*. Annual Conference, Melbourne, July 2012 Oral Presentation Genetics Society of Australia. 24. Harrison PA, Bailey TG, Vaillancourt RE, Potts BM (2014). The effects of fragmentation, geography and climate on forest tree reproduction. '10th Australasian Plant Conservation Conference'. Hobart, Australia. 12-13 November 2014. p. 37 (Australian Network for Plant Conservation; Hobart). 25. Larcombe MJ, Holland B, Steane D, Jones RC, Nicolle D, Vaillancourt RE, Potts BM (2014). The search for the missing snowball in *Eucalyptus*. Presentation to Phylomania 2014, University of Tasmania, School of Physical Sciences, 5-7 November 2014. 26. Lee D, Pegg G and Brawner J (2014) Impact of myrtle rust on key Australian commercial Myrtaceous crop species. Presentation to National Centre for Future Forest Industries Delivery Workshop, November 25th - 27th. (University of Tasmania, Hobart) 27. O'Reilly-Wapstra, J.M. (2013) Genetic influences of Australia's iconic eucalypt trees: biotic interactions, extended effects and stability in variable environments. Invited seminar, Department of Zoology, Gothenburg University, Sweden, May 2013. 28. Pegg G, Carnegie A, Giblin F and Perry S (2014) Myrtle rust: current and future impacts on myrtaceous diversity in Australia. Presentation to National Centre for Future Forest Industries Delivery Workshop, November 25th - 27th. (University of Tasmania, Hobart) 29. Southerton S (2014) The molecular basis of myrtle rust resistance in eucalypts. Presentation to National Centre for Future Forest Industries Delivery Workshop, November 25th - 27th. (University of Tasmania, Hobart) 30. Steane D, Potts B, Vaillancourt R, Prober S, William Stock W, McLean E, Byrne M (2012) Climate-resilient revegetation of multi-use landscapes: exploiting genetic variability in widespread species. Annual Conference, Melbourne, July 2012 Oral Presentation Genetics Society of Australia 31. Tibbits J (2014) Determining the genetic resistance response potential of eucalypts to *Puccinia psidii* s.l. rust. Presentation to National Centre for Future Forest Industries Delivery Workshop, November 25th - 27th. (University of Tasmania, Hobart)
Ongoing Activity:	12/2015 Completion of ARC Linkage grant, 2 PhD theses, 1 Honours thesis & 4 papers.

Project Title: Modelling forest production in response to climate change	
Project ID:	3.2
Leader:	Patrick Mitchell
Project Outcomes	
Outline:	This project will tackle key aspects of forest functioning that help to define tree productivity and survival under a changing climate. It is expected that this project will provide a better understanding of what characteristics will be suitable for establishment of forests for a suite of purposes i.e. wood production, biofuels, biodiversity or carbon sequestration. It will help to clarify those underlying mechanisms that control risks associated with a changing climate and can eventually inform decision-making tools for species or genotype-site matching under a range of climate scenarios
Deliverables:	This project is only in its first 6 months and will continue until December 2015. Key highlights: - One manuscript currently in review entitled 'Foliar-derived ABA regulates gas exchange in *Pinus radiata*' submitted to Plant Physiology. - One manuscript in prep entitled 'The significance of polyploidy for drought resistance in *Acacia mangium'* - Presentation at the NCFFI annual conference in November 2014. - Improved understanding of the phytohormone ABA in regulating gas exchange in trees. This will affect how we model growth and drought responses in forest trees. - Established close ties with researchers at UTas Plant Sciences – Assoc. Prof. Tim Brodribb. Difficulties: - International conference presentation/attendance (planned for June 2014) did not eventuate as the conference was cancelled.
Conclusions:	This work is ongoing. The main conclusion to be drawn from the project thus far is that we may need to reformulate approaches to modelling drought and growth responses in forest species – particularly *Pinus radiata.*
Outputs:	- One manuscript in prep entitled 'The significance of polyploidy for drought resistance in *Acacia mangium'* Mitchell, Patrick et al (2014) Foliar-derived ABA regulates gas exchange in *Pinus radiata*. Plant Physiology (in review). Mitchell P, Pinkard L, Bruce J, Battaglia M and O'Grady A (2014) Evaluating climate-based risk in Australian forest systems. Presentation to National Centre for Future Forest Industries Delivery Workshop, November 25th - 27th. (University of Tasmania, Hobart)
Ongoing Activity:	- Continuing experiments on the role of hydraulic and hormonal responses in forest species in response to drought to June 2015. - Finish manuscripts stated above from December 2014 - 2015. - Complete industry/government report on drought risk assessment – March 2015.

Project Title: Forest Water Use	
Project ID:	3.3
Leader:	Don White
Project Outcomes	
Outline:	Provide the forest industry with a review and summary of the plantation water use and drought research that has been undertaken over the last 25 years. The project is a collaboration between the University of Tasmania, CSIRO and Whitegum FNRM under the NCFFI partnership, with contributions from *Eucalyptus globulus* forest growers.
Deliverables:	A range of high impact publications and a series of technical papers
Conclusions:	Management of plantation water use is a significant issue for Australian plantations and native forests as well as those internationally. A relatively simple approach to determining the pattern of potential water deficits over the course of a year or rotation can be useful for determining where plantations may have unwanted consequences for other land/water use but may also assist with determining where wood productivity can be maximised for unit water used.
Outputs:	Papers 1. White, D.A., McGrath, J.F., Ryan, M.G., Battaglia, M., Mendham, D.S., Kinal, J., Downes, G.M., Crombie, D.S., Hunt, M.A. (2014). Managing for water-use efficient wood production in Eucalyptus globulus plantations. Forest Ecology and Management 331, 272-280. 2. White, D.A., Beadle, C.L.,Honeysett, J.L., Worledge, D. 2015. Water productivity was increased by irrigation in plantations of *Eucalyptus globulus* and *E. nitens*. New Forests (in press). 3. White, DA, O'Grady, A, Battaglia, M, Carter, J, Ryan, MG, Hunt, MA, and Pinkard, EA. Leaf water relations and hydraulic regulation of water status in *E. globulus* and *E. smithii* exposed to mild, moderate and lethal water stress (Submitted to Tree Physiology) Reports 1. White, DA 2014. Water use effective plantations as a basis for optimum growth and a sustained social license - application of techniques in ecophysiology and ecohydrology. Confidential Client Report, Bioforest SA, Chile. 2. White, DA, Heymell and Hunt, MA. Plantation water productivity in rural landscapes, principles and opportunities. FAO Technical Series. In Press. 3. White, D.A.,Mendham, D.S., Battaglia, M., O[1]Grady, A.P., Arnold, R., Mounlamai, K., Almeida, A.C., Midgley, S., Apeng, D., Ren, S., Dong, T.L., Wongprom, J., Xiang, D., Short, T.M., Hunt M.A.(2015). Water use and water productivity of Eucalyptus plantations in SE Asia. Report Prepared for ACIAR - currently under review Abstract 1. White, D.A., Ryan, M.G., McGrath, J.F., Battaglia, M., Mendham, D.S., Hunt, M.A., Montes, C. 2015. Managing the trade-off between productivity and risk principles - a case study from south western Australia (a mediterranean climate region). Extended Abstract for Invited Presentation at IUFRO Symposium on Dryland Plantations, Stellenbosch, March 2015
Ongoing Activity:	Project is complete

Project Title: Education and Training	
Project ID:	Theme 4.1
Leader:	Julianne O'Reilly-Wapstra
Project Outcomes	
Deliverables:	Key Activities in addition to student research projects: • Development and advertisement of 11 new PhD projects • Development of NCFFI PhD student grants • Investigated Student Industry Placement Program – University of York
Conclusions:	• NCFFI students were productive and worked across a diverse range of topics across all themes. • The NCFFI Education and Training Program carried on the strong education & training ethos of the CRCs • Strong linkages between UTAS and USC were developed. • Strong linkages between UTAS/USC and industry partners were maintained and new linkages were developed. • Eleven new PhD projects were designed during the course of the NCFFI. While these projects did not eventuate (primarily due to the short timeframes of the NCFFI), these are evidence that there is a future in forestry and wood products research for research institutions and industry partners.
Outputs:	**Refereed Journal Articles** Borzak C, O'Reilly-Wapstra J & Potts BM (2013) Direct and indirect effects of mammal browsing on a eucalypt species. Oikos (DOI: 10.1111/oik.01538 14/10/2014) Borzak C, Potts BM, Noel W. Davies NW and O'Reilly-Wapstra J (2014) Population divergence in the ontogenetic trajectories of foliar terpenes of a *Eucalyptus* species. *Annals of Botany* (in press 31 Sept 2014). Gauli A, Vaillancourt RE, Steane DA, Bailey T, Potts BM (2013) Effect of forest fragmentation and altitude on the mating system of *Eucalyptus pauciflora* (Myrtaceae). *Australian Journal of Botany* **61**, 622–632. Gauli A, Vaillancourt RE, Steane DA, Potts BM (2014). Molecular genetic diversity and population structure in *Eucalyptus pauciflora* subsp. *pauciflora* on the island of Tasmania. *Australian Journal of Botany* **62**, 175-188. Gosney BJ, O'Reilly-Wapstra JM, Forster LG, Barbour RC and Potts BM (2014). Genetic and ontogenetic variation in an endangered tree structures dependent arthropod and fungal communities. PLos One 9(12) e114132. doi:10.1371/journal.pone.0114132 Hamilton M, Blackburn D, McGavin Rl, Bailleres H, Vega, M and Potts BM Factors affecting log traits and green rotary-peeled veneer recovery from temperate eucalypt plantations. *Annals of Forest Science* (submitted 9/7/2014; in press 3rd Oct)

Harrison PA, Bailey TG, Vaillancourt RE, Potts BM (2014) Provenance and seed mass determines the seed germination success of *Eucalyptus ovata* (Myrtaceae). *Seed Science and Technology* **42**, 466 - 472.

Harrison, P, Jones, R, Wiltshire R, Vaillancourt, RE and Potts, BM (2014). Unravelling the evolutionary history of *Eucalyptus cordata* (Myrtaceae) using molecular markers. *Australian Journal of Botany* **62**, 114-131

Larcombe M, Barbour RC, Vaillancourt RE and Potts BM (2014) Assessing the risk of exotic gene flow from *Eucalyptus globulus* plantations to native *E. ovata* forests. *Forest Ecology and Management* 312, 193 – 202.

Larcombe M, Silva JS, Vaillancourt RE and Potts BM (2013) Assessing the invasive potential of *Eucalyptus globulus* in Australia: quantification of wildling establishment from plantations. *Biological Invasions* 15: 2763–2781.

Larcombe M, Vaillancourt RE, Jones RC and Potts BM (2014) Assessing a Bayesian approach for detecting exotic hybrids between plantation and native eucalypts. *International Journal of Forestry Research* Article **2014**, ID 650202, 13 pages

McKiernan A.B., Hovenden M.J., Brodribb T.J., Potts B.M., Davies N.W. and O'Reilly-Wapstra J. (2014). Effect of limited water availability on foliar plant secondary metabolites of two *Eucalyptus* species. *Journal of Environmental and Experimental Botany* **105**, 55 – 64.

PhD Theses

Archana Gauli (2014) Genetic diversity and adaptation in *Eucalyptus pauciflora.* PhD Thesis Univ. of Tasmania (supervisors Potts, Vaillancourt and Steane)

Matthew Larcombe (2014) Managing gene flow from *E. globulus* plantations to native eucalypts (supervisors Potts and Vaillancourt

Conferences

Borzak C, Potts B, Barry K, Pinkard L & O'Reilly-Wapstra JM (2013). Genetic stability of physiological and plant secondary metabolite induced responses to defoliation in a eucalypt. Gordon's Research Conference on Plant-Herbivore Interactions, Ventura, 24th February – 1st March. California.

Gauli A, Bailey T, Steane S, Davidson N, Vaillancourt R and Brad Potts B (2012) Evidence for genetic-based climate adaptation in *Eucalyptus pauciflora*. Annual Conference, Melbourne, July 2012 Oral Presentation Genetics Society of Australia.

Harrison PA, Bailey TG, Vaillancourt RE, Potts BM (2014). The effects of fragmentation, geography and climate on forest tree reproduction. '10th Australasian Plant Conservation Conference'. Hobart, Australia. 12-13 November 2014. p. 37 (Australian Network for Plant Conservation; Hobart).

Larcombe MJ, Barbour R, Vaillancourt, RE and Potts, BM (2012) Gene flow from Australia's eucalypt plantations. Invited presentation at the Australian Forest Growers National Conference: Diverse sub-tropical forestry, 14th – 17th October

	2012, Gympie, Queensland. Larcombe MJ, Silva JS, Vaillancourt RE, Potts BM (2013) Quantification of wildling establishment from Australian *Eucalyptus globulus* plantations. Presentation at the VII Southern Connection Congress: Southern lands and southern oceans - life on the edge? 21st - 25th January 2013, Dunedin, New Zealand. Larcombe MJ, Steane D, Jones RC, Nicolle D, Holland B, Vaillancourt RE, Potts BM. Phylogenetic patterns of reproductive isolation in *Eucalyptus*. Presentation to *Phylomania 2013*, University of Tasmania, School of Maths and Physics, 6-8 November 2013. McKiernan AB, Hovenden MJ, Brodribb TJ, Potts BM, Davies NW & O'Reilly-Wapstra JM (2013). Effects of water limitation on plant secondary metabolite concentrations in *Eucalyptus* leaves: inter- and intra-specific plant responses. INTECOL, 8th – 23rd August, London. O'Reilly-Wapstra, J.M. (2013) Eucalypt genetic influences: biotic interactions, stability in variable environments and extended effects. Invited seminar, Department of Zoology, Aberdeen University, U.K, June 2013. O'Reilly-Wapstra, J.M., Gosney, B., Whiteley, C., Hamilton, M., Bailey, J.K., Forster, L and Potts, B.M. (2013). Tree genetics shapes community trajectories in planted forests. INTECOL, 18th-23rd August, London. O'Reilly-Wapstra J (2014) A summary of activity and student projects in the NCFFI Education Program. Presentation to National Centre for Future Forest Industries Delivery Workshop, November 25th - 27th. (University of Tasmania, Hobart) Vega, M Near infrared calibrations for wood density and modulus of elasticity for *Eucalyptus nitens* from Tasmania. 18th International Non-destructive Testing and Evaluation of Wood Symposium, Madison, USA.
Ongoing Activity:	Seven NCFFI affiliated PhD students will complete and submit their theses in the next two years. There will be additional refereed journal articles and conference presentations from these students.

Project Title: Communication Project	
Project ID:	4.2
Leader:	Justine Edwards
Project Outcomes	
Outline:	The project aim is to collate the outputs of the CRC for Temperate Hardwood Forestry, CRC for Sustainable Production Forestry, CRC for Forestry and the National Centre for Future Forest Industries. Outputs are to be collated and stored on a live legacy website to facilitate ongoing security and access by the wider forest based industry and research providers. A comprehensive analysis of postgraduate student profiles for the four centres will also be undertaken.
Deliverables:	NCFFI Website: central website for the ongoing storage and access of outputs from the four research centres. Publication database: collation of all outputs (publications, presentations, tools) into a searchable database to be accessible on the NCFFI website. Publication access: download options for all non-copyright restricted material from the NCFFI website. Student Profile Analysis: collation of all postgraduate students who studied under the four centres, including publication outputs and career profiles.
Conclusions:	The project highlighted the contribution that the CRCs and NCFFI have made to the research and development of the forest sector. It has demonstrated their leadership in the education and training of students who have gone on to fulfil key roles with the forestry sector. The project has documented the large amount of work that has been achieved through the CRCs/NCFFI and has recognised the need to access this information online to aid further industry development.
Outputs:	Baker, T.P (2014) The contribution of the CRCs and NCFFI to post-graduate education. Presentation to the NCFFI Delivery Workshop 25-27th November, UTAS, Hobart. Hunt, MA (2013) National forestry centre to inject vision, direction and innovation, Australian Forest Grower, Vol 36(1): 4.
Ongoing Activity:	Website completion. End of February 2015.

(C) Highlights, breakthroughs or difficulties encountered

Highlights

1. The value chain collaboration from genetics to building systems that was developed in a number of projects, but particularly in Project 1.1, exceeded anything that has been achieved previously. We were able to engage architects, engineers and builders with wood processors and foresters to develop an understanding about how wood could be considered more as a specified material. This has enabled us to identify ways in which wood being derived from hardwood plantations, or currently considered as residues, can be used for higher value purposes in the construction sector.

2. Industrial process transfer from production to restoration component of landscape management also proceeded very well. There has been an artificial dichotomy between those interested in producing timber (or other primary products) from the forested landscape and those interested in restoring or sustainably maintaining the landscape/forest. Underpinning activities such as site preparation, tree establishment and much of forest management are largely independent of management objective. In NCFFI the degree of interaction between industrial growers and organisations like Greening Australia has been excellent and provides a terrific platform for future work.

3. The degree of industry participation has been a highlight. More than 35 industry organisations (from multi-nationals to SMEs) have been formally engaged in NCFFI projects and these projects have had activities in all states, and in both hardwood and softwoods plantations.

4. In a shrinking funding environment, it is extraordinarily difficult to generate collaborations – it is a zero sum game. The NCFFI grant altered that situation and the response by key research providers to very modest revenue gains has been excellent. In the spirit of the National R,D&E framework, the collaborating group identified where each organisation had core expertise and then designated lead organisations and supporting organisations for various disciplines or segments of the value chain. This resulted in an efficient use of the resources available nationally and minimised if not eliminated any duplication of effort. This has resulted in a much greater return on investment for government and industry.

5. Scientists working within the NCFFI produced an extraordinary number of outputs over the 2.5 years including papers in the highest ranking international journals (see bibliography). Of particular note is the paper by Myburg et al (2014) in the journal *Nature*.

Difficulties

1. Expectations from industry and other research providers at the commencement of the NCFFI were unrealistic for the amount of money involved. Many thought that this was a continuation of the CRC program and did not understand the change in scope, the difference in contract requirements and the fact that it only involved a tenth of the resources. This made development of projects and gaining industry buy-in challenging in the first year.

2. Industry member and industry organisation desire for a national centre to be based somewhere other than Tasmania was an impediment to gaining momentum. The desire at a national level to have a bricks and mortar national institute somewhere in NSW or Victoria remains an obstacle for NCFFI developing a pathway forward.

3. There was much feedback initially about the desire to have governance and board arrangements independent of the University sector – i.e. an approach that reflected later CRC governance. Perceived inadequacies or inappropriateness of university governance created some obstacles to industry buy-in during the first year.

(D) Conclusions or recommendations arising from the Project

As certification of forests and forest products has become the 'norm' – and there have been very significant moves in this direction in Australian even in the two and a half year life of the NCFFI – so has the recognition that management of non-productive parts of an estate or of a production landscape are critical to the sustainable economic performance and market access of the forest products sector. This emerging recognition provides an opportunity for those working on restoration and production aspects of forest and landscape management to integrate their operations much more completely and particularly for the restoration (including carbon farming) activities to apply industrial processes and techniques to greatly increase efficiencies – i.e. reducing the cost of these activities per unit land area or conversely increasing the land area able to be addressed for the same investment. This integration is nascent and needs support.

Looking further along the value chain and past the forest, the opportunities for the Australian forestry and forest products sector are many. Whilst the "future bioeconomy" is an overused term, few can argue that biological sources of products such as fuels and manufacturing and construction materials are likely to play an increasingly important role. In particular, there are tremendous opportunities for new building systems that use engineered wood products rather than other materials such as concrete and steel. Whilst Australia cannot compete with the technologically advanced manufacturing approaches of the Europeans and North Americans, we can take those technologies, apply them to our resources and develop new systems and processes that target expanding Asian markets where cold Northern hemisphere climates do not present the same challenges as the tropical and subtropical environments that are well represented in Australia and typify those of our Asian neighbours. Underpinning these opportunities is a need to focus on a full value chain approach to the Australian Forestry and Forest Products sector, to review the regulatory environment around the use of wood products, and for the sector to engage more fully with end user – builders and designers. Moreover, there is a need to cease thinking about stick-frame construction as the only solution to building and to progress towards seeing building as manufacturing and fabrication systems.

However, these opportunities will not be realised without a very significant investment in innovation and unfortunately in the face of this evident need such investment is declining rather than increasing. There has been much written recently about the decline in Forestry and Forest Products R&D capacity in Australia over the past two decades, particularly in the last five years or so and I will not repeat it here except to say that Australia has now plunged below critical mass. There remains a core of forestry and forest products research and development expertise in Australia but it has become increasingly difficult to support dedicated researchers focussing on industrial problems

without investment from the sector itself. State governments have progressively withdrawn from R&D activities, particularly in primary industries and CSIRO has taken a similar pathway. This leaves the university sector to meet the majority of the industry's R&D needs. However, very little undergraduate education in forestry and forest products at the bachelor degree level is now undertaken in Australia. Universities rely on their coursework enrolments to support a cadre of academic teaching staff who are then available to support research needs relevant to their expertise. Hence without substantial academic programs, researchers are not available on a 'part-time' or *ad hoc* basis but must be maintained by specific R&D investment *per se*. Thus in a traditionally poor and now further declining private sector funding environment, a declining government funding environment, and within a university system where block funding is entirely associated with teaching and not research (unlike most other OECD countries), it is difficult to see a mechanism for future coordinated domestic research and development to support the Forestry and Forest Products sector. We will continue to see researchers drift away from R&D altogether or focus their attentions on areas of investigation for which there is a demonstrated funding source.

In light of the above, I would recommend that the Commonwealth review the way it supports, or may in future support, R&D investment in the sector. *Ad hoc* investment on a project by project basis without recourse to notions of capacity maintenance and enhancement needs to be avoided. Universities should be recognised as the appropriate (and only viable) mechanism for investment and a distributed network approach to supporting and building on the present capacity should trump grandiose ideas of National Institutes.

Section (vii): Published reports, promotional material, media publicity, pamphlets or other documentation relevant to the Project

Journal Papers

Alam, M., Walsh, D. Strangard, M. and Brown, M. (2014) A log-by-log productivity analysis of two Valmet 475EX harvesters. International Journal of Forest Engineering 25: 14-22.

Alam, M, Acuna, M, Strandgard, M and Brown, M (2014) Harvester productivity model development using LiDAR and multispectral imagery. European Journal of Remote Sensing (in review).

Bailey T, Davidson N, Potts B, Gauli A, Hovenden M, Burgess S, Duddles J (2013) Plantings for carbon, biodiversity and restoration in dry Tasmanian rural landscapes. Australian Forest Grower 35 (4), 39-41.

Blackburn D, Hamilton M, Harwood CH, Baker T and Potts BM (2013) Assessing genetic variation in *Eucalyptus globulus* stem straightness. Annals of Forest Science 70, 461-470.

Blackburn DP, Hamilton MG, Williams D, Harwood CE and Potts BM. (2014). Acoustic wave velocity as a selection trait in *Eucalyptus nitens*. Forests 5:744-762

Borzak C, O'Reilly-Wapstra J & Potts BM (2013) Direct and indirect effects of mammal browsing on a eucalypt species. Oikos (DOI: 10.1111/oik.01538 14/10/2014)

Borzak C, Potts BM, Noel W. Davies NW and O'Reilly-Wapstra J (2014) Population divergence in the ontogenetic trajectories of foliar terpenes of a *Eucalyptus* species. Annals of Botany (in press).

Costa e Silva J, Potts BM, Bijma P, Kerr RJ and Pilbeam DJ (2013) Genetic control of interactions amongst individuals: Contrasting outcomes of indirect genetic effects arising from neighbour disease infection and competition in a forest tree. New Phytologist 197: 631–641.

Costa e Silva JC, Potts BM and Tilyard P (2013) Stability of genetic effects across clonal and seedling populations of *Eucalyptus globulus* with common parentage. Forest Ecology and Management 291, 427 - 435.

Costa e Silva J, Potts BM, and Lopez G (2014) Heterosis may result in selection favouring the products of long-distance pollen dispersal in *Eucalyptus*. *PLoS One* **9**, e93811.

Downes G.M., Harwood C.E., Washusen R., Ebdon N., Evans R., White D.A. and Dumbrell I. (2014) Wood properties of *Eucalyptus globulus* at three sites in Western Australia: effects of fertilizer and plantation stocking. Australian Forestry DOI: 10.1080/00049158.2014.970742.

Downes G.M., Touza M., Wentzel-Vietheer M. and Harwood C.E. (2014) NIR detection of non-recoverable collapse in sawn boards of *Eucalyptus globulus* European Journal of Wood and Wood Products 72: 563 – 570.

Downes G et al. (in prep) The effect of thinning of wood property variation in a 10 year old E. globulus plantation growing at Rennick in south-west Victoria.

Drake, P. L., Mendham, D. S., White, D. A., Ogden, G. N. & Dell, B. (2012). Water use and water-use efficiency of coppice and seedling *Eucalyptus globulus* Labill.: A comparison of stand-scale water balance components. *Plant and Soil*, *350*(1-2), 221–235.

Drake, PL, Mendham, DS, Ogden, GN (2013). Plant carbon pools and fluxes in coppice regrowth of *Eucalyptus globulus*. Forest Ecology and Management 306, 161–170.

Eyles, A., Worledge, D., Sands, P., Ottenschlaeger, M. L., Paterson, S. C., Mendham, D. S. & O'Grady, A. P. (2012). Ecophysiological responses of a young blue gum (*Eucalyptus globulus*) plantation to weed control. *Tree Physiology*, *32*(8), 1008–1020.

Eyles, A, Mendham, DS, Drake, PL, Pinkard, EA and White, DA. Gas exchange and water relations of *Acacia mangium* and *A. crassicarpa*. Trees, Structure and Function. (submitted)

Freeman JS, Potts BM, Downes GM, Pilbeam D, Thavamanikumar S, Vaillancourt RE (2013) Stability of QTL for growth and wood properties across multiple pedigrees and environments in *Eucalyptus globulus*. New Phytologist 198, 1121–1134.

Gauli A, Vaillancourt RE, Steane DA, Bailey T, Potts BM (2013) Effect of forest fragmentation and altitude on the mating system of *Eucalyptus pauciflora* (Myrtaceae). Australian Journal of Botany 61, 622–632.

Gauli A, Steane DA, Vaillancourt RE, Potts BM (2014). Molecular genetic diversity and population structure in *Eucalyptus pauciflora* subsp. *pauciflora* (Myrtaceae) on the island of Tasmania. Australian Journal of Botany 62: 175 – 188.

Gauli A, Vaillancourt RE, Bailey T, Steane DA, Potts BM (2014). Evidence for climate adaptation in early-life traits of a widespread eucalypt. Ecology and Evolution (submitted 16/7/2014).

Ghaffariyan, M. R. (2013). Remaining slash in different harvesting operation sites in Australian plantations. Silva Balcanica, *14*(1), 83-93.

Ghaffariyan, MR, Acuna, M. and Brown, M.(2013) Analysing the effect of five operational factors on forest residue supply chain costs: A case study in Western Australia. Biomass and Bioenergy 59, 486 – 493.

Ghaffariyan, MR, Brown, M. and Spinelli, R. (2013) Evaluating efficiency, chip quality and harvesting residues of a chipping operation with flail and chipper in Western Australia. Croatian Journal of Forest Engineering 34, 189-199.

Ghaffariyan, MR, Sessions, J. and Brown, M. (2013) Roadside chipping in a first thinning operation for radiata pine in South Australia. Croatian Journal of Forest Engineering 34, 91-101.

Ghaffariyan, MR, Spinelli, R. and Brown, M. (2013) A model to predict productivity of different chipping operations. Southern Forests 75, 129-136.

Gosney BJ, O'Reilly-Wapstra JM, Forster LG, Barbour RC and Potts BM (2014). Genetic and ontogenetic variation in an endangered tree structures dependent arthropod and fungal communities. PLos One 9(12) e114132. doi:10.1371/journal.pone.0114132

Hamilton MG,Williams DR, Tilyard PA, Pinkard EA,Wardlaw TJ, Glen M, Vaillancourt, RE, Potts, BM (2013) A latitudinal cline in disease resistance of a host tree. Heredity 110, 372-379**.**

Hamilton M, Blackburn D, McGavin Rl, Bailleres H, Vega, M and Potts BM (2014) Factors affecting log traits and green rotary-peeled veneer recovery from temperate eucalypt plantations. Annals of Forest Science (in press)

Hamilton,M, Acuna, M, Wiedemann, J, Mitchell, R, Pilbeam, D, Brown, M and Potts, B (2015) Genetic control of *Eucalyptus globulus* harvest traits. Canadian Journal of Forest Research (in review).

Harrison PA, Bailey TG, Vaillancourt RE, Potts BM (2014) Provenance and seed mass determines the seed germination success of *Eucalyptus ovata* (Myrtaceae). Seed Science and Technology **42**, 1-7.

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Baker TP (2014) The contribution of the CRCs and NCFFI to post-graduate education. Presentation to National Centre for Future Forest Industries Delivery Workshop, November 25th - 27th. (University of Tasmania, Hobart)

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Gauli A, Bailey T, Steane S, Davidson N, Vaillancourt R and Brad Potts B (2012) Evidence for genetic-based climate adaptation in *Eucalyptus pauciflora*. Annual Conference, Melbourne, July 2012 Oral Presentation Genetics Society of Australia.

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Ghaffariyan, MR, Acuna, M and Brown, M (2014) Biomass harvesting residue supply chain optimisation and verifying the effect of major parameters affecting the supply chain cost in Western Australia. FEC/FORMEC 2014. September 23 – 26. Gerardmer, France.

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Lee D, Pegg G and Brawner J (2014) Impact of myrtle rust on key Australian commercial Myrtaceous crop species. Presentation to National Centre for Future Forest Industries Delivery Workshop, November 25th - 27th. (University of Tasmania, Hobart)

Mendham D (2014) Maintaining profitability over multiple rotations. Presentation to National Centre for Future Forest Industries Delivery Workshop, November 25th - 27th. (University of Tasmania, Hobart)

McGavin R (2014) Veneer processing and recovery of plantation hardwoods. Presentation to National Centre for Future Forest Industries Delivery Workshop, November 25th - 27th. (University of Tasmania, Hobart)

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Mirowski, L., Smith, A., Ghaffariyan and Acuna, M. (2014) Integrating ubiquitous computing design into forestry information and communication technology: a case study in designing a forestry transportation system. Seventh IEEE International Conference on Ubi-Media Computing. Ulaanbaatar, Mongolia, January 2014.

Mirowski L, Turner P, Kang B, Acuna M and Almond I (2014) Fatigue reduction technologies for a safer Tasmanian transport sector. Presentation to National Centre for Future Forest Industries Delivery Workshop, November 25th - 27th. (University of Tasmania, Hobart)

Mitchell R (2014) An overview of AFORA harvest system comparison studies. Presentation to National Centre for Future Forest Industries Delivery Workshop, November 25th - 27th. (University of Tasmania, Hobart)

Mitchell P, Pinkard L, Bruce J, Battaglia M and O'Grady A (2014) Evaluating climate-based risk in Australian forest systems. Presentation to National Centre for Future Forest Industries Delivery Workshop, November 25th - 27th. (University of Tasmania, Hobart)

Morgan A (2014) Hydrowood – seeing the forests and the trees, even if they are underwater! Presentation to National Centre for Future Forest Industries Delivery Workshop, November 25th - 27th. (University of Tasmania, Hobart)

Nolan G (2014) Matching market performance requirements with the resource. Presentation to National Centre for Future Forest Industries Delivery Workshop, November 25th - 27th. (University of Tasmania, Hobart)

Nolan G and Leggate B (2014) Getting values from wood residues. Presentation to National Centre for Future Forest Industries Delivery Workshop, November 25th - 27th. (University of Tasmania, Hobart)

Nolan G and Shanks J (2014) NRAS Inveresk: A technology transfer case study. Presentation to National Centre for Future Forest Industries Delivery Workshop, November 25th - 27th. (University of Tasmania, Hobart)

O'Grady A, Battaglia M, Bruce J and Zhang L (2014) What will be the hydrological consequences of elevated CO? Presentation to National Centre for Future Forest Industries Delivery Workshop, November 25th - 27th. (University of Tasmania, Hobart)

O'Reilly-Wapstra, J.M.(2013) Forest systems in Tasmania: addressing ecological and management questions in production forests. METLA (Finnish Forest Research Institute), Suonenjoki, Finland. August 27th 2013.

O'Reilly-Wapstra, J.M., Gosney, B., Whiteley, C., Hamilton, M., Bailey, J.K., Forster, L and Potts, B.M. (2013). Tree genetics shapes community trajectories in planted forests. INTECOL, August 18th-23rd, London.

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O'Reilly-Wapstra J, Aurik D, Miller A and Potts B (2014) Genetic variation in bark stripping among *Pinus radiata*. Presentation to National Centre for Future Forest Industries Delivery Workshop, November 25th - 27th. (University of Tasmania, Hobart)

Ozarska B (2014) The veneers suitability for the production of various products and their potential applications. Presentation to National Centre for Future Forest Industries Delivery Workshop, November 25th - 27th. (University of Tasmania, Hobart)

Pegg G, Carnegie A, Giblin F and Perry S (2014) Myrtle rust: current and future impacts on myrtaceous diversity in Australia. Presentation to National Centre for Future Forest Industries Delivery Workshop, November 25th - 27th. (University of Tasmania, Hobart)

Potts BM (2014) Eucalypt reproductive biology and applications in breeding. Invited presentation to the '*Eucalyptus* workshop' of Colombian Corporación Nacional de Investigación y Fomento Forestal (CONIF), 13-14th May 2014, Bogotá, Colombia.

Potts BM (2014) The use of molecular tools to address population genetics and conservation issues: the case of *Eucalyptus*. Invited presentation to the '*Eucalyptus* workshop' of Colombian Corporación Nacional de Investigación y Fomento Forestal (CONIF), 13-14th May 2014, Bogotá, Colombia.

Potts BM, Larcombe MJ, Leaman T, Vaillancourt RE (2014). Assessing the risk of gene flow from plantation to native eucalypts: A long-term partnership in biodiversity management. Conference Program & Abstracts of '10th Australasian Plant Conservation Conference'. Hobart, Australia. 12-13 November 2014. p. 37 (Australian Network for Plant Conservation; Hobart).

Potts B, Hamilton M, Dutkowski G, Pilbeam D, Freeman J, Blackburn D, Tilyard P, Vaillancourt R, Wiedemann J, Downes G, Acuna M, Mitchell R and Brown M (2014) Matching genetics to environment and management. Presentation to National Centre for Future Forest Industries Delivery Workshop: November 25th – 27th 2014 (University of Tasmania, Hobart)

Ross I (2014) CSG Logistics safety code of practice – Delivery Supply chain compliance. Presentation to National Centre for Future Forest Industries Delivery Workshop, November 25th - 27th. (University of Tasmania, Hobart)

Shanks J (2014) Building with low grade timber. Presentation to National Centre for Future Forest Industries Delivery Workshop, November 25th - 27th. (University of Tasmania, Hobart)

Sosa, A, Devlin, G and Acuna, M (2014) The use of truck tracking systems to optimise forest biomass planning in Ireland. In: 2014 Precision Forestry Symposium, 3 – 5 March 2014, Stellenbosch, South Africa.

Southerton S (2014) The molecular basis of myrtle rust resistance in eucalypts. Presentation to National Centre for Future Forest Industries Delivery Workshop, November 25th - 27th. (University of Tasmania, Hobart)

Steane D, Potts B, Vaillancourt R, Prober S, William Stock W, McLean E, Byrne M (2012) Climate-resilient revegetation of multi-use landscapes: exploiting genetic variability in widespread species. Annual Conference, Melbourne, July 2012 Oral Presentation Genetics Society of Australia.

Steane DA, Potts BM, McLean E, Prober SM, Stock WD, Vaillancourt RE, **Harrison PA**, Byrne M (2014). Detecting signals of local adaptation in widespread species. 'Phylomania 2014'. University of Tasmania, Hobart, Australia. 5-7 November 2014.

Strandgard M (2014) Harvest planning tools. Presentation to National Centre for Future Forest Industries Delivery Workshop, November 25th - 27th. (University of Tasmania, Hobart)

Strandgard, M and Mitchell, R (2014) Monitoring long-term forwarder productivity using onboard computer data. FEC/FORMEC 2014. September 23 – 26. Gerardmer, France.

Tibbits J (2014) Determining the genetic resistance response potential of eucalypts to *Puccinia psidii* s.l. rust. Presentation to National Centre for Future Forest Industries Delivery Workshop, November 25th - 27th. (University of Tasmania, Hobart)

Vega M, Hamilton M, Downes G, Harwood C, Adams P, Potts B (2013) Near-infrared calibrations for wood density and modulus of elasticity for *Eucalyptus nitens* from Tasmania (Australia). Poster

presentation. In: 18th International Nondestructive Testing and Evaluation of Wood Symposium, Madison, USA, p No. 121.

White, D.A., Ryan, M.G., McGrath, J.F., Battaglia, M., Mendham, D.S., Hunt, M.A., Montes, C. 2015. Managing the trade-off between productivity and risk principles - a case study from south western Australia (a mediterranean climate region). Extended Abstract for Invited Presentation at IUFRO Symposium on Dryland Plantations, Stellenbosch, March 2015

Book Chapters

Acuna, M and Sessions, J (2014) A simulated annealing algorithm to solve the log-truck scheduling problem. In: Simulated Annealing: Strategies, Potential Uses and Advantages. Chapter 8. Nova Science Publishers, NY, USA.

Potts BM, Hamilton M and Pilbeam DJ (2014) Capítulo 22. Mejoramiento genético de eucaliptos de zonas templadas en Australia [Genetic improvement of temperate eucalypts in Australia]. In 'Mejoramiento Genético de Eucaliptos de en Chile' (Eds. Roberto Ipinza, Santiago Barros A., Braulio Gutiérrez C. and Nuno Borralho) (INFOR Instituto Forestal, Chile)

Reports

Blackburn, D and Nolan, G. (2014). The potential for regional rotary veneer peeling in Tasmania. A feasibility study. University of Tasmania, Centre for Sustainable Architecture with Wood and the National Centre for Future Forest Industries. 66 pp.

Byrne M, Prober S, McLean L, Steane D, Stock W, Potts B and Vaillancourt R (2013) Adaptation to climate in widespread eucalypt species: Climate-resilient revegetation of multi-use landscapes: exploiting genetic variability in widespread species. pp. 86 Report Published by the National Climate Change Adaptation Research Facility.

McGavin R, Bailleres H, Adams P, Williams D and Hickey J (2014). Quality analysis of veneer produced from mid to late rotation Tasmanian grown plantation *Eucalyptus nitens*. Technical Report.

Mendham, D.S., White, D.A., Hunt, M.E. (2014). The System Optimisation Tool – a spreadsheet tool for hardwood plantation growers to optimise the harvest and inter-rotation management for future productivity and prosperity (Draft). November 2014. NCFFI

Miller A, O'Reilly-Wapstra J, Potts BM (2014). Genetic variation in bark stripping among *Pinus radiata*. Internal Report to the National Centre for Future Forest Industries (NCFFI) and Timberlands Pacific Pty Ltd (October 15th 2014). Pp 28.

Miller A, O'Reilly-Wapstra J, Potts BM (2014). Genetic variation in bark stripping among *Pinus radiata*. Confidential Report. Internal Report to the National Centre for Future Forest Industries (NCFFI) and Timberlands Pacific Pty Ltd (November 2014). Pp 30.Nolan G & Leggate B (2014) Opportunities for using Tasmanian wood processing residues. Draft Report. NCFFI Project. December 10th 2014. 51 pp.

Ozarska (2014) Suitability of veneers for the production of various products and their potential applications. The University of Melbourne. Research Report. 63 pp.

Shanks, J and Nolan, G (2014) Building with low grade timber. University of Tasmania, Centre for Sustainable Architecture with wood, National Centre for Future Forest Industries. 278 pp.

Sascha Wise & René Vaillancourt. 2014. Development and use of microsatellite markers for clove (*Syzygium aromaticum*). Confidential report on a contract between NCFFI and Griffin Tree Improvement Pty Ltd. October 27, 2014 University of Tasmania, Hobart, Tasmania.

White, D, Musk, R, Battaglia, M, Short, T, Bruce, J, Weidemann, J and Edwards, J (2013). The extent and causes of decline in productivity from first to second rotation blue gum plantations. Australia, FWPA. 29 pp

White, DA 2014. Water use effective plantations as a basis for optimum growth and a sustained social license – application of techniques in ecophysiology and ecohydrology. Confidential Client Report, Bioforest SA, Chile

White, DA, Heymell and Hunt, MA. Plantation water productivity in rural landscapes, principles and opportunities. Report for publication by FAO. Currently under FAO review

White, D.A.,Mendham, D.S., Battaglia, M., O'Grady, A.P., Arnold, R., Mounlamai, K., Almeida, A.C., Midgley, S., Apeng, D., Ren, S., Dong, T.L., Wongprom, J., Xiang, D., Short, T.M., Hunt M.A.(2015). Water use and water productivity of Eucalyptus plantations in SE Asia. Report Prepared for ACIAR - currently under review

Industry Bulletins

AFORA Industry Bulletin 1. Brown, M, Mitchell, R & Wiedemann, J (2013) Productivity and utilisation of an in-field chipping harvest system in an unmanaged blue gum coppice stand in Western Australia.

AFORA Industry Bulletin 2. Ghaffariyan, MR (2013) The natural drying process of logs and harvesting residues - preliminary results.

AFORA Industry Bulletin 3. Mitchell, R (2013) Comparison of different flail chains operating in *Eucalyptus globulus* plantations in Western Australia.

AFORA Industry Bulletin 4. Ghaffariyan, MR, Spinelli, R, Brown, M, Mirowski, L (2013) Chipping model: a tool to predict the productivity and cost of chipping operations.

AFORA Industry Bulletin 5. Strandgard, M, Mitchell, R and Walsh, D (2013) Productivity and cost of two *Eucalyptus nitens* harvesting systems when bark is retained on logs.

AFORA Industry Bulletin 6. Strandgard, M, Mitchell, R and Walsh, D (2013) Quantity of *Eucalyptus nitens* bark retained on logs at roadside following harvest, infield drying, processing and infield transport by two harvesting systems.

AFORA Industry Bulletin No 7. Murphy, G, Passicot, P and Strangard, M. (2014) Effect of daily working hours on productivity of mechanised harvesting operations.

AFORA Industry Bulletin No 8. Ghaffariyan, MR, Acuna, M and Brown, M. (2014) Natural drying and optimising a forest residue supply chain to reduce the total operating costs: A case study in Western Australia.

AFORA Industry Bulletin 9. Acuna, M, Mitchell, R and Wiedemann, J (2014) Evaluation of genetic-related tree traits and work method on *E. globulus* harvesting productivity – A case study in Western Australia.

AFORA Industry Bulletin 10. Alam, M, Strandgard, M and Brown, M (2014) Using LiDAR slope estimates to predict the productivity of a self-levelling feller-buncher.

AFORA Industry Bulletin 11. Ghaffariyan, MR, Spinelli, R, Magagnotti, N, Brown, M and Mitchell, R (2014) Harvesting residual woody biomass in pine plantations in south west Western Australia.

AFORA Industry Bulletin 12. Ghaffariyan, MR, Acuna M and Brown M (2014) Analysing the effect of five operational factors on the operating costs of a biomass supply chain: A case study in Western Australia.

AFORA Industry Bulletin 13. Ghaffariyan, MR and Brown M (2014) Payload management of forestry trucks.

AFORA Industry Bulletin 14. Acuna M and Wiedemann J (2014) Effects of different stocking densities on harvesting of bluegum stands in Western Australia – Ayres 00 case study.

Presentations

Downes G. (2013) Utilisation of NIR in forest management. Forests and Wood Products Australia Webinar. http://www.fwpa.com.au/rd-and-e/r-and-dworks-webinars/266-utilisation-of-nir-in-forest-management.html

Mendham, DA "2nd rotation decline in *E. globulus*" – a presentation given to the Forest Systems Program workshop, May 2014

O'Reilly-Wapstra, J.M. (2013) Genetic influences of Australia's iconic eucalypt trees: biotic interactions, extended effects and stability in variable environments. Invited seminar, Department of Zoology, Gothenburg University, Sweden, May 2013.

O'Reilly-Wapstra, J.M. (2013) Eucalypt genetic influences: biotic interactions, stability in variable environments and extended effects. Invited seminar, Department of Zoology, Aberdeen University, U.K, June 2013.

Potts BM (2014) Discovering Tasmania's eucalypts. Invited talk to the Royal Society of Tasmania 4/3/2014. (Associated with awarding of Clive Lord medal).

Potts BM (2014) Quantitative genetic control of economic traits in *Eucalyptus globulus*. Presentation to the STBA Technical committee meeting, 11th Nov, University of Melbourne, Victoria.

Media Releases

North East timber being put to the test. North Eastern Advertiser. May 7th 2014

News item on Southern Cross Television 6:30 News. Thursday 13th March 2014

The Examiner – 'Studies to put timber potential in spotlight'

Dissertations

Baxter, S., 2014, *Low-grade solid-timber systems for residential construction,* Bachelor of Engineering dissertation, University of Tasmania

Yiping Chen (2014). Developing a genotyping technique for *Eucalyptus dunnii*. Honours Thesis in the School of Biological Sciences, University of Tasmania.

Archana Gauli (2014) Genetic diversity and adaptation in *Eucalyptus pauciflora.* PhD Thesis. University of Tasmania (supervisors Potts, Vaillancourt and Steane)

Hamilton, J., 2014, *Use of Low Grade Timber in Residential Flooring Systems*, Bachelor of Engineering dissertation, University of Tasmania.

Matthew Larcombe (2014) Managing gene flow from *Eucalyptus globulus* plantations to native eucalypts. PhD Thesis. University of Tasmania (supervisors Potts and Vaillancourt)

Ally Pasanen (2014) Genetic variation in the phenotypic plasticity of *Eucalyptus pauciflora* subsp. *pauciflora* Sieb. ex Spreng. Honours thesis, School of Biological Sciences, University of Tasmania.

Stockwin, F (2014) Developing and designing cross-laminated timber panels suitable for the Tasmanian building industry, Bachelor of Engineering dissertation, University of Tasmania.

Appendix 1: Audit report and signed financial statement

UNIVERSITY of TASMANIA

Department of Industry

National Centre for Future Forest Industries (NCFFI)

STATEMENT OF INCOME AND EXPENDITURE
for the period 29 June 2012 to 31 October 2014

		$	$
Income			
	Department of Industry	2,500,000.00	
	External Contributions	743,805.00	
	Interest	113,891.97	
	UTAS Contribution	98,356.00	
	Conference Registration Income	8,200.00	
			3,464,252.97
Expenditure			
	Salaries	1,353,802.40	
	Consultancy and Advisory Costs	742,250.00	
	Consumable Products and Services	227,553.52	
	Travel	108,064.28	
	Sundry Payments	35,497.30	
	Equipment and Tools	31,712.56	
	Scholarships	10,316.50	
	Printing and Photocopying	7,685.28	
	IT Infrastructure and Related Costs	6,798.31	
	Staff Training and Conference Costs	6,335.96	
	Infrastructure Charges	4,941.00	
	Communication Costs	4,221.69	
	Recruitment Costs	4,194.83	
	Special Events, Catering, Food & Drink	2,758.39	
	Reference Materials	999.65	
	Administration Costs	872.08	
			2,548,003.75
Surplus / (Deficit)			**916,249.22**
Balance at 31 October 2014			**916,249.22**

Funds expected to be expended/(received) between 1 November 2014 and the estimated project end date of 27 January 2016

	Salaries	641,607.97
	Consultancy and Advisory Costs	353,971.00
	Special Events, Catering, Food & Drink	15,000.00
	Scholarships	7,000.00
	Consumable Products and Services	250.00
	External Contributions (Forestry SA)	(15,000.00)
	External Contributions (Forestry Tas)	(15,000.00)
		(987,828.97)
		(71,579.75)

Certifications

I certify that this report has been prepared in accordance with information held in the University's Financial Management System. All grant funds received in respect of the service have been used or appropriated for the purpose for which they were approved. The amounts included in the statement of income and expenditure funds expected to be expended/(received) are exclusive of GST.

J.Bot

Jane Botica
Senior Manager - Financial Analysis and Strategy
University of Tasmania

11/12/14
Date

Ref: 103476

Linked Projects: 103477, 104367, 104840, 104841, 104843, 104844, 104845, 104846, 104847, 104848, 104899, 105207, 105394, 105519, 105523, 105524, 105826, 105938, 106243

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Independent Auditor's Report to the University of Tasmania and Department of Industry, Innovation, Science, Research and Tertiary Education (the "Department")

We have audited the accompanying income and expenditure statement, including commitments, which comprises details of the grant monies received and expended, the "commitments" being committed revenues and expenditure, and management's declaration (the "Report") of the University of Tasmania ("the Recipient"). The Report has been prepared by the management of the University of Tasmania in accordance with the financial reporting requirements of the National Centre of Future Forest Industries Project (the "Program") for the funding period from 29 June 2012 to 31 October 2014 and the commitments for the period 1 November to the estimated project end date of 27 January 2016.

Management's Responsibility for the Report

Management is responsible for compliance with the Program and the preparation and fair presentation of the Report and has determined that the cash basis of accounting is appropriate to meet the financial reporting requirements of the Program and the needs of the University of Tasmania and the Department. Management's responsibility also includes such internal control as management determines is necessary to enable compliance with the Program and the preparation and fair presentation of the Report that is free from material misstatement, whether due to fraud or error.

Auditor's Responsibility

Our responsibility is to express an opinion on the Report and whether the grant monies were expended in accordance with the Program based on our audit. We conducted our audit in accordance with Australian Auditing Standards. Those standards require that we comply with relevant ethical requirements relating to audit engagements and plan and perform the audit to obtain reasonable assurance whether the Report is free from material misstatement and whether the grant monies were expended in accordance with the Program.

An audit involves performing procedures to obtain audit evidence about the amounts and disclosures in the Report and whether the grant monies were expended in accordance with the Program. The procedures selected depend on the auditor's judgement, including the assessment of the risks of material misstatement of the Report, whether due to fraud or error. In making those risk assessments, the auditor considers internal control relevant to the Recipient's preparation and fair presentation of the Report in order to design audit procedures that are appropriate in the circumstances, but not for the purpose of expressing an opinion on the effectiveness of the Recipient's internal control. An audit also includes evaluating the appropriateness of accounting policies used and the reasonableness of

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accounting estimates made by management, as well as evaluating the overall presentation of the Report.

We believe that the audit evidence we have obtained is sufficient and appropriate to provide a basis for our audit opinion.

Opinion

In our opinion, the Report presents fairly, in all material respects, the grant monies received and expended and commitments by the Recipient, in accordance with the cash basis of accounting and the grant monies were expended in accordance with the Program for the funding period from 29 June 2012 to 31 October 2014 and the commitments for the period 1 November to the estimated project end date of 27 January 2016.

Basis of Accounting and Restriction on Distribution and Use

Without modifying our opinion, we draw attention to the "Management's Responsibility for the Report" paragraph above which states that the Report has been prepared in accordance with the cash basis of accounting. The Report is prepared to assist the University of Tasmania to meet the financial reporting requirements of the Program. As a result the Report may not be suitable for another purpose. Our report is intended solely for the University of Tasmania and the Department and should not be distributed to or used by parties other than the University of Tasmania and the Department.

DELOITTE TOUCHE TOHMATSU

Carl Harris
Partner
Chartered Accountants
Hobart December 2014

Registered Company Auditor Number: 315792

Appendix 2: NCFFI Delivery Workshop (Industry Research Symposium) Registration list

Speaker	Surname	First name	Title	Affiliation	Role
Y	Mitchell	Rick	Mr	AFORA	Project Scientist
	Hill	Peter	Dr	AusIndustry	Funder
Y	Mendham	Daniel	Dr	CSIRO	Project Leader
Y	Mitchell	Patrick	Dr	CSIRO	Speaker
Y	O'Grady	Anthony	Dr	CSIRO	Speaker
Not dinner	Pinkard	Libby	Dr	CSIRO	Guest
	Read	Steve	Dr	DAFF	Guest
	Ruscoe	Ian	Mr	Department of Agriculture	Guest
	Smith	Sue		Department of State Growth	Guest
	Verrier	James		Department of State Growth	Guest
	Wells	Penny		Department of State Growth	Guest
Y	Downes	Geoff	Dr	ForestQuality	Project Scientist
Y	Adams	Paul	Dr	Forestry Tasmania	Research Scientist
	Marunda	Cris	Dr	Forestry Tasmania	
	Neyland	Mark	Dr	Forestry Tasmania	Research Manager
	Whiteley	Steve	Mr	Forestry Tasmania	CEO
	Williams	Dean	Dr	Forestry Tasmania	Research Scientist
	Davis	Darren	Mr	Forico Pty Ltd	Guest
	Hayes	Bryan	Mr	Forico Pty Ltd	Guest
	Herd	Darren	Mr	Forico Pty Ltd	Guest
	Wilson	Jim	Dr	Forico Pty Ltd	Guest
	Lafferty	Chris	Dr	FWPA	Chair
Y	Southerton	Simon	Dr	Gondwana Genomics Pty Ltd / CSIRO	Speaker
	Griffin	Rod	Dr	GTI Pty Ltd	Guest
	Elms	Stephen	Mr	HVP	Guest
	MacDonald	Cameron	Mr	HVP Plantations	Advisory Board
Wed only	Bienefelt	Shani	Ms	Island Workshop	Guest
	Gee	Matthew	Dr	Island Workshop	Speaker
	McKay	Brett	Mr	McKay Timber	Industry Collaborator
	Cook	Lachlan	Mr	Mitsui	Guest
	Edwards	Justine	Ms	NCFFI	Communications
	Last	Ken	Mr	Neville-Smith Forest Products	Industry Collaborator
	Hetherington	Sandra	Mrs	Norske Skog	Guest
	Creak	Kim	Mr	Office of Paul Harris	Guest
Y	Ross	Ian	Mr	Origin Energy	Speaker
	Lacy	Phil	Dr	PF Olsen	Industry Partner
	Parker	Mal	Mr	PF Olsen	Industry Partner
Y	Dutkowski	Greg	Dr	PlantPlan Genetics	Guest
	Fisk	Tom	Mr	Private Forests Tasmania	Guest
	Ravenwood	Ian	Mr	Private Forests Tasmania	Guest
Y	Pegg	Geoff	Dr	QDAFF	Speaker
Y	Lee	David	Assoc Prof	QDAFF/USC	Project Scientist
Y	Bailleres	Henri	Dr	QLD DAFF	Speaker
Tues & Wed day only	Lane	Vicki	Ms	QLD DAFF	Guest
Y	McGavin	Rob	Mr	QLD DAFF	Speaker
Wed only	Crook	Darryn		SFM Forest Products	Speaker
	Morgan	Andrew	Mr	SFM Forest Products	Speaker
	McRae	Tony	Dr	STBA	Guest
	Henty	Steve	Mr	Tasmanian Kiln Dried Timbers	Guest
	Ruzicka	Pavel		Tasmanian Special Timbers Alliance	MAC Forestry
Y	Ozarska	Barbara	Assoc Prof	UMELB	Project Scientist
Y	Strandgard	Martin	Dr	UMELB	Project Scientist
Y	Tibbits	Josquin	Dr	UniMelb	Speaker
Y	Acuna	Mauricio	Dr	USC	Project Scientist
Y	Brown	Mark	Prof	USC	Advisory Board
Dinner only	Duff	Gordon	Prof	USC	Advisory Board
Y	Ghaffariyan	Mohammad	Dr	USC	Project Scientist
	Nahrung	Helen	Dr	USC	Guest
Y	Baker	Thomas	Mr	Utas	Speaker
	Blackburn	David	Dr	Utas	Speaker
	Blacklow	Phillip	Mr	Utas	Guest
Y	Freeman	Jules	Dr	Utas	Project Scientist
Y	Hunt	Mark	Prof	Utas	Director
Thurs only	Jennings	Sarah	Dr	Utas	Advisory Board
Y	Larcombe	Matt	Dr	Utas	PhD student
	Macdonald	Stuart	Mr	Utas	Guest
Y	Mirowski	Luke	Dr	Utas	Project Scientist
Y	Nolan	Greg	A/Prof	Utas	Speaker
Y	O'Reilly-Wapstra	Julianne	Dr	Utas	Speaker
Y	Potts	Brad	Prof	Utas	Theme Leader
Y	Reid	Jim	Prof	Utas	Advisory Board
Y	Shanks	Jon	Dr	Utas	Project Leader
	Steane	Dot	Dr	Utas	Project Scientist
	Tilyard	Paul	Mr	Utas	Project Technician
	Turner	Paul	Assoc Prof	Utas	Project Leader
	Vaillancourt	Rene	Prof	Utas	Project Leader
	Vega	Mario	Mr	Utas	PhD student
Y	Hamilton	Matt	Dr	Utas/CSIRO	Project Leader

Appendix 3: NCFFI Delivery Workshop (Industry Research Symposium) Program

National Centre for Future Forest Industries

Delivery Workshop: November 25th – 27th 2014

Program of Speakers

0930 Tuesday 25th November

Session 1: Welcome and overview of the NCFFI

Mark Hunt- University of Tasmania

1030: Morning tea

1100 Tuesday 25th November

Session 2: Product recovery from plantation hardwoods – Part 1

Chair: *Cameron MacDonald – HVP Plantations*

- Introducing the NCFFI *E. globulus* and *E. nitens* rotary peeling study
  Matt Hamilton – University of Tasmania
- Veneer processing and recovery of plantation hardwoods
  Rob McGavin – Queensland Department of Agriculture, Fisheries and Forestry
- Mechanical qualities of plantation hardwood veneer and veneer-based products
  Henri Bailleres - Queensland Department of Agriculture, Fisheries and Forestry
- The veneers suitability for the production of various products and their potential applications
  Barbara Ozarska – The University of Melbourne

1300: Lunch

1400 Tuesday 25th November

Session 3: Product recovery from plantation hardwoods – Part 2

Chair: *Stephen Elms - HVP Plantations*

- Stand characteristics and product recovery from an unimproved *Eucalyptus nitens* plantation in Tasmania – initial results
  Paul Adams – Forestry Tasmania
- Getting value from wood residues
  Greg Nolan – University of Tasmania
- The potential for regional rotary veneer peeling in Tasmania
  David Blackburn - University of Tasmania

1530: Afternoon tea

1600 Tuesday 25th November

Session 4: Genetics x Environment x Management interactions for plantation *Eucalyptus globulus*

Chair: *Steve Read - ABARES*

- Matching genetics to environment and management
  Brad Potts – University of Tasmania & Greg Dutkowski – PlantPlan Genetics
- NIR spectroscopy to describe radial variation in wood properties & detect collapse prone trees
  Geoff Downes - ForestQuality

1700: Close

0900 Wednesday 26th November

Session 5: Plantation sustainability – risks and new opportunities

Chair: *Justine Edwards – University of the Sunshine Coast*

- Maintaining profitability over multiple rotations
  Daniel Mendham - CSIRO
- The hydrological consequences of elevated CO_2: a case study using *E. globulus* plantations
  Tony O'Grady - CSIRO
- Evaluating climate-based risk in Australian forest systems
  Pat Mitchell - CSIRO
- Genetic variation in bark stripping among *Pinus radiata*
  Julianne O'Reilly Wapstra – University of Tasmania

1030: Morning tea

1100 Wednesday 26th November

Session 6: Timber in construction – architectural and engineering considerations

Chair: *Chris Lafferty - FWPA*

- Matching market performance requirements with the resource
  Greg Nolan – University of Tasmania
- Building with low grade timber
  Jon Shanks - University of Tasmania
- NRAS Inveresk: A technology transfer case study
  Greg Nolan & Jon Shanks - University of Tasmania
- Partnership with UTAS in R&D – advancing timber technology merging with digital fabrication
  Matt Gee – Island Workshop

1230: Lunch

1330 Wednesday 26th November

Session 7: AFORA – Australian Forest Operations Research Alliance

Chair: *Mark Brown – University of the Sunshine Coast*

- Harvesting systems comparisons, an overview
  Rick Mitchell – University of the Sunshine Coast
- Integrated transport planning and moisture content management to optimise the wood supply chain
  Mauricio Acuna – University of the Sunshine Coast
- Payload management of timber trucks
  Mohammad Ghaffariyan - University of the Sunshine Coast
- Harvest planning tools
  Martin Strandgard - University of the Sunshine Coast

1530: Afternoon tea

1600 Wednesday 26th November

Session 8: Supply chains and their integration

Chair: *Paul Turner – University of Tasmania*

- Fatigue reduction technologies for a safer Australian Transport Sector: A case study from the Australian Forest Industry
  Luke Mirowski - University of Tasmania
- CSG Logistics safety code of practice – Delivering Supply chain compliance
  Ian Ross – Origin Energy
- Hydrowood – an innovative approach to salvaging timber from the Hydro dams of Tasmania
  Andrew Morgan – SFM Environmental Solutions

1730: Close

Workshop Dinner - Wednesday 26th November - University Club
Dobson Road, University of Tasmania, Sandy Bay
(Map reference AO20 No. 18)

Drinks at 7pm followed by a 3 course menu at 7.30pm

0900 Thursday 27th November

Session 9: Myrtle rust

Chair: *René Vaillancourt – University of Tasmania*

- Myrtle rust: current and future impacts on Myrtaceous diversity in Australia
  Geoff Pegg - Queensland Department of Agriculture, Fisheries and Forestry
- Impact of myrtle rust on key Australian commercial Myrtaceous crop species
  David Lee- University of the Sunshine Coast
- Genetics of Eucalyptus / Corymbia disease susceptibility: The relationship between susceptibility to native pathogens and the introduced myrtle rust
  Jules Freeman – University of Tasmania
- Screening for myrtle rust resistance in the National *Eucalyptus globulus* breeding program
  Josquin Tibbits – The University of Melbourne
- The molecular basis of myrtle rust resistance in eucalypts
  Simon Southerton – Gondwana Genomics

1030: Morning tea

1100 Thursday 27th November

Session 10: Education through the CRCs and NCFFI – examples & summaries

Chair: *Mark Hunt – University of Tasmania*

- A summary of activity and student projects in the Education Program
  Julianne O'Reilly Wapstra – University of Tasmania
- The contribution of the CRCs and the NCFFI to post-graduate education
  Tom P. Baker – University of Tasmania
- Managing exotic gene flow from plantation to native eucalypts
  Matt Larcombe – University of Tasmania

1230: Lunch

1330 Thursday 27th November

Session 11: Future activities, discussion and Close

Chair: *Jim Reid – University of Tasmania*

- Where to from here?
  Mark Hunt – University of Tasmania and Mark Brown – University of the Sunshine Coast

1500: Close

Workshop Location:

Centenary Lecture Theatre
Grosvenor Crescent, University of Tasmania, Sandy Bay
(Map reference AR15 No. 10)