Full Business Case Response to Selection Criteria

Selection criterion 1. The outcomes will contribute substantially to Australia's industrial, commercial and economic growth.

1.1 The forestry and timber industries

In 2002-03, wood with a mill door value of $1.4b was produced from Australia's forests and plantations (Table 1). Over 60% was processed domestically for timber, plywood and veneers, with the rest for the local and international woodchip market.

Table 1: Australian Forestry Production 2002-03 [ABARE 2004a]

	Unit	Quantity	Mill Door Value $m
Sawnwood	'000 m^3	4,049	837
Wood based panels	'000 m^3	2,030	97
Paper and paperboard	kt	3,061	217
Woodchips	kt	5,437	239
Total			1,390

Some 78,500 people were employed across the forestry and forest product industries in 2002-03 with salary and wages totalling $2.4b pa [ABARE 2004a].

The nation imports $4b pa worth of timber and pulp and paper products [ABARE 2004a]. The strategic partnership between Australian governments and the industry *Plantations for Australia - The 2020 Vision* projects potential private investment of $2b pa in establishing new plantations, input of up to $660m pa to rural incomes from farm forestry, and eventual transition to a trade surplus via value-adding processing. CRC research will substantially and practically contribute to the realisation of this reversal of the trade imbalance.

The CRCSFL will service the same industry as the CRC for Sustainable Production Forestry (CRCSPF), but with a stronger focus on the production of fibre and solid wood from hardwood plantations. It will achieve quicker and stronger returns on research investment (Table 2). It is estimated that, over a twenty-year period, CRCSFL will deliver a total benefit or increase in industry profitability of $827m in present value terms. Also it will help to provide the high quality raw material wood for novel applications in the construction and furniture industries such as those being developed by the CRC for Wood Innovations.

Significant developments in the industry since the 1990s, including more than $6.5b in domestic and foreign investment [ABARE 2004b], impact both on the time over which returns on R&D can be realised, and on the research priorities that have been identified by the industry members. For example the availability of hardwood pulpwood will increase from the current 2 million m^3 pa to a sustainable cut of 10 million m^3 pa from the time that the CRC ends in 2012, presenting immediate opportunities to profit from adoption of improvements in harvesting and transportation systems.

Table 2: Estimated CRCSFL Economic Benefit [BDA Group 2004]

	Access	Silviculture	Breeding	Harvesting	Total
CRC Benefit $m (over 20 yrs)	**$361**	**$1,192**	**$107**	**$130**	**$1,790**
Present Value of Benefit $m	**$169**	**$546**	**$53**	**$59**	**$827**

1.2 Outcomes

The CRCSFL consortium includes 14 members from the forest industry in Tasmania, Victoria, WA and NSW. Research providers are the CSIRO, state forest research organisations, and all major Universities providing forestry education and research in these regions. The goal is to develop new science and technology that will improve management capability, productivity, wood resource quality, and profitability across the forestry business chain from selection of planting sites to delivery of wood at mill gate. Flow-on benefits to end users of wood – the processors and manufacturers of fibre, solid and

engineered wood products – will be an increased supply of wood of known quality and quantity. The goal is based on industry needs identified during extensive consultation over a 12-month period.

The remainder of the national forest industry represents a commercial market for CRC products and a platform for the exploration of the potential for international commercialisation.

CRCSFL activity will deliver the following Industry-Level Outcomes:

1. Reliability of supply of an expanding resource of high-value wood and increased profitability for national and international processors. *CRCSFL will deliver research and commercialisation results across the wood production business chain, from choice of planting site to delivery at the mill gate.*
2. Greater market competitiveness for Australian wood products through an improved ability to grow a higher quality, more uniform resource from plantations of certified sustainability. *CRCSFL research will increase confidence in the quality and availability of the wood resource needed to underpin capital investment in new processing infrastructure.*
3. Enhanced rates of plantation establishment across Australia. *CRCSFL will develop tools for planning and risk management that will improve the environment for private sector investment*.
4. Adoption by wood producers of practices which conform to certification standards and help to maintain their licenses-to-operate. *CRCSFL research will provide guidelines, which will increase growers' ability to manage and monitor the interactions between wood production systems and their environmental and social landscape, contributing to the attainment of triple bottom line goals for the forest industry and the wider community*.
5. Increased community understanding of the role of the forest industry as a significant contributor to the sustainable development of regional Australia, emulating the ability of other industries with comparable or greater environmental impacts, such as intensive agriculture and mining, to achieve wide community acceptance. *CRCSFL research will assist all stakeholders to engage in constructive dialogue and to resolve conflict, so contributing to the long-term development of viable forest industries.*

1.3 Outcomes at Research Programme Level

From **Research Programme 1 - Managing and Monitoring for Growth and Health**: Reduced costs of wood production, decreased risk for investment, and reduced off-site effects of tree plantation management, through adaptation of currently available and emerging technologies for assessment and inventory of forest condition.

From **Research Programme 2 - High-Value Wood Resources**: Increased profitability and investor confidence in planting eucalypts for production of fit-for-purpose timber, through the development and use of improved germplasm and silvicultural practices.

From **Research Programme 3 - Harvesting and Operations**: Competitive advantage through improvement in harvesting and transport efficiency and reduction in operational and wood delivery costs.

From **Research Programme 4 - Trees in the Landscape**: Sustained wood production within a managed environmental footprint, through development and application of practices which meet agreed certification criteria and foster constructive community engagement.

Outcomes at the Sub-Programme Level are listed in Table 5 with related adoption outputs, and again in Table 7 with the research outputs that contribute to their eventual delivery. The relationship of the Programme and Sub-Programme Level Outcomes with the five Industry-Level Outcomes are shown in Table 3.

Table 3: Industry-Level Outcomes From Programmes and Sub-Programmes

✓	**Major focus**	✓	**Significant additional impact**

	Industry-Level Outcome				
Programme / Sub-Programme	**1**	**2**	**3**	**4**	**5**
1. Managing and Monitoring for Growth and Health			✓		
1.1 Monitoring and Measuring	✓		✓		
1.2 Managing and Sustaining	✓	✓	✓	✓	
1.3 Modelling and Information Integration	✓	✓	✓	✓	✓
2. High-Value Wood Resources		✓			
2.1 Breeding	✓	✓	✓		
2.2 Silviculture	✓	✓	✓		
2.3 Wood Value in Planning and Management	✓				
3. Harvesting and Operations	✓				
3.1 Automating Data Capture	✓			✓	
3.2 Optimising Harvesting Systems	✓	✓		✓	
3.3 Optimising Operator Performance	✓				
3.4 Supply Chain Structure	✓	✓			
4. Trees in the Landscape				✓	✓
4.1 Water				✓	✓
4.2 Biodiversity – Monitoring and Managing				✓	✓
4.2 Biodiversity – Sustainable Pest Management	✓	✓		✓	✓
4.3 Communities				✓	✓
4.4 Plantation Estate Design	✓	✓	✓	✓	✓
Number of the Research Programmes Contributing to Each Industry-Level Outcome	**4**	**4**	**4**	**3**	**2**
Number of the Research Sub-Programmes Contributing to Each Industry-Level Outcome	**12**	**8**	**6**	**9**	**6**

1.4 Needs and Opportunities

The national and international markets for Australian grown hardwood fibre and timber are well established, and projected to expand, with demand from China in particular doubling over the decade from 2003 [Meynink 2003]. The opportunity for growth in this sector of the economy has been recognised through *The 2020 Vision*, the target of which is to treble the area of commercial tree crops between 1997 and 2020 from 1.1m to 3.3m ha. The current area is 1.6m ha, and expansion has averaged 85,000 ha pa since 1997 [Plantations 2020]. Appropriately located, well-managed, plantations will also address land degradation, but will only be planted if there are clear commercial drivers.

CRCSFL brings a well-established national network of industry members, responsible for managing over 50% of the nation's tree plantations and 60% of native production forests, and includes major promoters of Managed Investment Schemes, which have demonstrated through significantly increased sales figures for 2004 that they will continue to be the primary sources of the private capital required to translate *The 2020 Vision* into a commercial reality. The CRC is therefore well placed to contribute to the sustained R&D effort required to underpin plantation profitability through improved management practices and to reduce risks to levels acceptable to investors.

The Plantation Timber Association of Australia [Juniper 2003] has identified removal of land-use impediments and demonstration of environmental performance among the key strategic imperatives for plantation industry development. Increasingly, certification of sustainability is also a condition for successful international marketing of forest products. The CRCSFL will respond to this need through a programme of science underpinning the process of certification. Community concerns about expanding plantations will be researched, as a contribution to development of sound policy.

1.5 Contribution to National Research Priorities

The Outcomes are closely aligned with six of the seventeen National Research Priorities Goals, especially 1-2 and 3-4:

NRP 1 An Environmentally Sustainable Australia

Goals 1-1 Water – a critical resource. CRCSFL research will improve the capacity to optimise plantation estate design in terms of water yield and quality targets.

Goal 1-2 Transforming Existing Industries. A core tenet of the CRC, reflected in the choice of name *Sustainable Forest Landscapes*, is that the innovations will improve efficiency and profitability of wood production while maintaining or improving environmental values.

Goal 1-5 Sustainable use of Australia's biodiversity. The Eucalypts grown by the CRC's industry members represent by far the greatest contribution of Australia's native flora to world economic activity. CRCSFL scientists are world leaders in the breeding and use of this germplasm. A significant biodiversity research effort will ensure the integrity of native forests in conjunction with plantations, and will underpin improved gene pool management strategies.

NRP 3 Frontier Technologies for Building and Transforming Australian Industries

Goal 3-4 Smart Information Use. Developments in Information and Communications Technology provide many new opportunities for improving efficiency of forest management practices. The CRC will develop and commercialise applications of remote sensing and data processing storage and retrieval to forest inventory, health monitoring, harvest and transport scheduling and estate design.

Goal 3-5 Promoting an innovation culture and economy. CRC research into community perceptions of the forest industry will enhance prospects for acceptance of changing land use practices. The CRC will also take the approach, novel for the forest industry in Australia, of working closely with operations contractors to apply automated performance analysis and reporting systems for enhancement of productivity.

NRP 4 Safeguarding Australia

Goal 4.3 Protecting Australia from invasive diseases and pests. CRCSFL research on application of remote sensing to the monitoring of forest health, and methodologies for monitoring and managing the impact of pests and diseases, will make a strategic contribution to protection of Australia's indigenous eucalypt gene resources from the many invasive organisms associated with cropping in other countries.

1.6 Contribution to Economic Growth

Economic Evaluation of CRCSFL: Economic and Environmental Analysts, BDA Group, have evaluated the economic impact of the proposed R&D programme. In consultation with CRCSPF staff, a number of key economic outcomes were identified that were consistent with the Industry-Level Outcomes of CRCSFL and considered achievable in light of the successes of the current CRC. Economic benefits of these outcomes were then quantified.

BDA estimated that the key outcomes would 'deliver a total benefit or increase in industry profitability of $827m in present value terms.' and noted the 'significant implications of the forest industry for employment and profitability in regional areas of Australia.' Further, 'it was estimated that the total increase in forest production as a result of achieved CRC outcomes, over the twenty-year period considered, would be $1,275m in present value terms. This increase in forest output would generate value-added growth of $573m for the national economy. The additional demand for intermediate goods and services was estimated at $700m, with additional employment of $357m.'

Value Creation by CRCSFL: The BDA analysis was based on the uptake of CRCSFL outputs generating value for the industry and the community as a whole, including:

1. *'Increase in value of forest products* - R&D outputs that increase product quality, create new products or features, improve market access, reduce processing risk or that increase product use efficiency will stimulate demand and lead to an increase in the demand for wood and wood products. In turn, this leads to an increase in the price received for wood and wood products.'

2. *'Lower Costs of Production* - Outputs that improve the efficiency of wood and wood product production or associated transport or marketing expenses will decrease unit costs and increase industry profitability.'
3. *'Enhanced Environment* – Outputs that protect the natural resource base from degradation will decrease the unit costs of wood production in the future. Outputs that reduce the environmental damage caused by wood production will enhance forest resource access, increase the profitability of other forest using or dependent industries (such as through better water quality or less weed and pest migration) and provide broader community benefits through an enhanced environmental value of Australian landscapes.'
4. *'Social Benefits* – Outputs that increase scientific knowledge or industry understanding of social and occupational health and safety issues will improve the effectiveness of future R&D and overall social well being. Investment and benefit generation in disadvantaged areas will also create value to Australia as a whole through promoting national regional development objectives.'

Quantification of Benefits: For analytical purposes, BDA deemed that CRC SFL would add these values by changing practices and providing business improving opportunities in four key areas of concern to forest management – Silviculture, Breeding, Harvesting and Logistics and Environmental Management.

In total over the 20-year period from 2005, the present value of benefits, using a 6% discount rate, was estimated to be $827m. The breakdown by activities was:

'Silviculture - Development of more robust site selection methods and on-going stand management. The impact of R&D in this area will be to increase the profitability of plantation operations through higher timber yields and lower costs of production.' *Increased production and reduced risk of loss from application of CRCSFL outputs, with an assumed penetration of 25% of new plantation estate, will result in benefit of $546m.*

'Breeding - Increased forest output value from genetic improvement of plantation grown eucalypts and improved silviculture techniques.' *A combination of improved planting stock from breeding and use of improved silvicultural treatments will deliver an estimated higher revenue stream of $53m.*

'Harvesting and Logistics - Major advances in data collection and analysis of forest growth through time to enable more cost effective harvesting of trees and transport of logs to mills.' *Savings of $5 per m^3 are achievable from improved harvesting and wood flow management systems to be developed by CRCSFL, delivering an estimated saving of $59m.*

'Environment - Provision of objective information on water and biodiversity impacts of forest operations and development of, where appropriate, strategies to enhance environmental outcomes. The impact of research in this field will be to moderate reductions in access to forest resources'. *Profit on the percentage of productive forest area notionally attributable to CRCSFL outputs was estimated at $169m.*

Flow-on Benefits to Australia: 'Flow-on benefits will also be realised across the Australian economy as forest operations adjust to increased profits earned.' 'Input-output data were sourced from the ABS (1996-97) and used to describe flow-on impacts from projected increased forest production to other sectors of the economy.'

'The estimated $827m benefit was separated into direct profit impacts and profit gains from increased access for forest operations. This split (in present value terms) was $169m for access and $658m in profit increases. A profit increase of this magnitude was estimated to stimulate forest output by $68m over the twenty-year period considered. The corresponding output value of the increased access was estimated at $1,207m, assuming that gross operating surplus or profit represents 14 cents in every dollar of output. Therefore, the total increase in forest production as a result of proposed CRC outcomes was estimated at $1,275m (over the twenty year period examined).'

'Using input-output multipliers the increased value-added to the Australian economy of the proposed CRC outcomes was estimated at $573m, with employment effects accounting for $357m of that value added. The increased demand for intermediate goods and services was estimated at $700m.'

Selection criterion 2. The path to adoption (commercialisation/utilisation) will achieve the identified outcomes.

2.1 Users of CRC Outputs

There are a number of different User Groups in the wood production business chain which will be serviced by CRCSFL, each valuing CRC outputs in different ways:

User Group 1: Corporate and government-owned wood producers.

User Group 2: Small-scale private wood producers.

User Group 3: Forestry contractors.

User Group 4: End users of the wood resource.

User Group 5: Policy developers, other non-business stakeholders, and the general public.

2.2 Utilisation and Commercialisation Strategies for User Groups

The User Groups have different needs and strategies will be tailored accordingly.

Experience from CRCSPF is that tree growers (User Groups 1 and 2) – whether major or small players – wish for early and direct access to know-how and to developing technology. Outputs, such as plantation management prescriptions and know-how generated in the course of commercial product development, will be shared with these users on an on-going basis. The interaction with User Group 1 also provides an opportunity for the CRC to pilot the use of those planning and management products amenable to licensing or sale to a wider market. Examples are: models for assessing the impact of tree planting in water catchments; applications of remote sensing for inventory and in prescribing interventions for pest control or nutrition management; new generation harvest scheduling software; and resource quality mapping technology for log segregation. For User Group 2, organisations such as the Australian Forest Growers and Private Forests Australia, with whom CRCSPF has a long-standing relationship, will provide channels for communication.

User Group 3, whose main business is to harvest and transport the national wood resource, are capital-intensive SMEs employing a skilled labour force. They will take value from the CRC via improved efficiency from application of new planning tools, and from operative training programmes developed with external providers such as the Tasmanian Forest Industry Training Board. The initial channel of communication will be through the various State and National Contractors Associations.

User Group 4 is not an immediate beneficiary of CRCSFL research, but the needs of end users drive all industrial wood production and therefore provide the ultimate test of value of CRC outputs. The rationale for Research Programme 2 in particular is that better breeding and silviculture can directly enhance the value, which processors derive from the wood resource. The CRC will draw on experience of those members with vertically integrated growing and processing operations, in planning this research. The Forest and Wood Products R&D Corporation, a core member in the CRC, is investing in research into new processing technologies for plantation grown eucalypt timber. The CRC will develop a formal link with the Steering Committee of this FWPRDC research, and will also explore opportunities for project level collaboration with the CRC for Wood Innovations.

User Group 5 comprises a diverse range of stakeholders interested in the development and application of forestry policy. An improved process of communication and engagement is a specific output of research from Sub-Programme 4.3. The methodologies developed will guide the activities of the utilisation programme for community stakeholders. Organisations involved in setting or auditing certification standards are not CRC members, but in the interests of their clients (User Group 1) the CRC will engage and promote adoption of outputs on a fee-for-service basis. In general, by acting as a science reference point and knowledge broker for User Group 5, the CRC will contribute to the development of sound state and national forest policy.

2.3 Market and Other End-user Opportunities

The objectives of the CRCSFL programme were based on industry needs identified during extensive consultation over a 12-month period and also by reference to the Priorities identified in the FWPRDC R&D Plan for 2003-2008. There are strong prospects that members in all User Groups will utilise successful research outputs that offer cost-effective improvements to their businesses.

Experience in servicing the CRC members will provide a sound platform for marketing to the rest of the Australian and international forest industry. The national market is expected to expand in proportion to the number of active businesses as *The 2020 Vision* is implemented. Structural changes in the forest industry are also tending to reduce in-house capacity for R&D in the private sector, providing an opportunity for the CRC to capture contract business. CRCSFL will be a significant research provider through which approximately 13% of the national forestry R&D budget will be channelled.

Since Australia produces less that 5% of the world's plantation-grown wood resource, much relevant technology is developed elsewhere. The CRC will seek linkages which will fast-track uptake of overseas innovation for the national benefit, and will also explore export potential for new products. The CRC will also support the growing market in forest science education and technical services, capturing a greater market share for Australia.

A significant number of CRCSFL research outputs address the needs of forest growers for internationally recognised certification of the sustainability of their operations. Two of the CRC's core industry members have achieved certification during the past year, using either the Forest Stewardship Council or Australian Forestry Standard process, and another six are seeking to do so. The primary business of one of the CRC's Supporting Members (the Forest Practices Board of Tasmania) is to administer codes of environmental practice during conduct of forestry operations. The CRC will draw on this collective experience to ensure that the research remains focussed on delivering outputs of practical value in this area of management.

2.4 Commercialisation Strategy

The commercialisation strategy for CRCSFL will be significantly different from CRCSPF. Outputs with potential for commercial development are indicated in Table 4. A priority activity on start-up will be to undertake market research to test these assumptions. The CEO will take initial responsibility for this process, drawing on expertise offered as an in-kind contribution by the Tasmanian Department of Economic Development; services contracted from the University of Tasmania Commercialisation Unit; links through the TasInformatics Centre of Excellence; and early involvement of potential commercialisation members, for example the Hobart-based company Sonardata, an SME with international business in the visualisation and interpretation of multi-beam echo location data relevant remote sensing of forest condition. On the basis of this market research, the Board will determine whether employment of in-house commercialisation expertise is warranted. Recognising the costs of IP protection and commercialisation, the CRC will expect to transfer much of this risk to the Project and commercialisation members who will receive the major share of returns from exploitation of Project IP.

As an integral part of the management process, commercialisation options will be kept under review throughout the life of the CRC.

2.5 Utilisation and Commercialisation

Knowledge transfer activities will be based on successful processes developed by CRCSPF, with senior staff remaining engaged. The different strategies for each user group will be built on an understanding of their needs and based on the following principles:

- Utilisation pathways will be identified and agreed during the initial project planning stage.
- Users will be actively involved in research planning, management and pilot projects.
- Outcomes will be structured to allow easy, and where possible phased and/or partial, adoption.

- The process will be backed with an effective communication and support system.

The research planning process will require a clearly identified Path to Adoption before any activity is funded. All project scientists and industry collaborators will be expected to be involved in implementation of the utilisation programme, and the Education and Training Programme will specifically foster a culture in which students understand and participate in commercialisation and utilisation processes.

Table 4: Key Staff Involved in Commercialisation &Utilisation/Education & Training

	Name	***Role***	***Member Org***	***% Time***
Utilisation and Commercialisation	Mr G.W. Dutkowski	Programme Manager	UTAS	100
	Prof. F. Vanclay	Training and Extension Processes	UTAS	10
Education and Training	Prof. P. Kanowski	Co-ordinator of Education Committee	ANU	30
	Dr N. Davidson	Education and Training Manager	UTAS	50

2.6 Communication

User groups will be targeted through:

- Regional best practice groups, which will meet on a regular basis to allow sharing of experience in adopting CRC innovations.
- Extension focal points identified within each core industry member organisation whose job is to stay abreast of CRC activities, evaluate them for their own organisation, and facilitate appropriate links with researchers.
- Distributed knowledge management systems for document and event information to complement regional activities such as field days, seminars, courses and workshops.
- An annual meeting with all researchers, knowledge brokers and users that will focus on activities to support utilisation.

The CRCSFL will inherit a proven and highly functional Members Website from CRCSPF, which will play a central role in communication between members and as a tool for management of interactions between the geographically dispersed CRC nodes. As new IT options become available (e.g. cheaper and more effective video-conferencing) they will be adopted for both management and extension purposes.

Communication with external stakeholders will be essential if the CRC is to achieve acceptance as a knowledge broker, and also for marketing purposes. A position within the Utilisation and Commercialisation Programme will have responsibility for communications and media relations and will be expected to make full use of the media capabilities of organisations such as the Forests and Forest Industry Council of Tasmania and the National Association of Forest Industries, and to develop communication channels with NGOs such as Greening Australia.

2.7 Intellectual Property Management

The CRC will be guided by the intellectual property principles developed through the Australian Institute of Commercialisation/CRC Association Project. In summary:

- The Company will be responsible for protecting and enforcing Centre and Project IP.
- The Company will have beneficial and legal ownership of Centre IP, created through the operations of the company, but not addressed in a project agreement.

- Beneficial interest in Centre IP will be shared between participants in accordance with their equity in the Company.
- The Company will own all legal interest and a specified percentage of the beneficial interest in Project IP addressed in the project agreements.
- Beneficial interest in Project IP will be shared between participants in each project, and also the Company, in accordance to their respective contributions to the project.
- Legal interest in Project IP will be owned by the Company and held on trust for the project participants.
- Core participants will have non-exclusive royalty-free licence to use all Centre and Project IP, but not for commercialisation.
- Supporting participants will have non-exclusive royalty-free licence to use IP generated though the Programme in which they are participating, but not for commercialisation.
- Each participant in a project will have a non-exclusive royalty-free licence to use the Project IP, but not for commercialisation.
- No core participant is compelled to make any particular IP available, but it may choose to do so in a project so the other parties to the project may use the Background IP for the purposes of carrying on the project.
- A participant may place restrictions on use of Background IP.
- Background IP may be used for commercialisation of the Project IP on reasonable terms to be agreed with the owner.

2.8 End-users Including SMEs

Industry end-user participants have driven development of the proposal and are thus clearly committed to the CRC vision. Reflecting this industry focus, Ms K. Carnell, CEO of the National Association of Forest Industries, is Acting Chair. Continued engagement will be fostered through the right of core participants to sit on the CRC's Strategic Policy Committee and on each of the Programme Co-ordinating Committees, which will oversee research implementation.

Five of the Supporting Members of the CRC are SMEs, of which two, the Southern Tree Breeding Association and the Forest Practices Board of Tasmania, will play leading roles on the paths to adoption. The same is true of likely commercialisation partners such as Sonardata. In general, the CRC would expect that most of its products would be more amenable to commercialisation through small companies rather than large established organisations.

Primary engagement of the CRC with small growers will be through Associate Members such as Australian Forest Growers and Private Forests Tasmania. These extension links are proven and effective in CRCSPF. Associates will engage with the CRCSFL on a user-pays basis.

Commercialisation management will be charged with exploring opportunities to market to the rest of the national industry, once product development has advanced with the major industry members.

2.9 Examples of Utilisation and Commercialisation Strategy

These four case studies illustrate likely processes for commercialising products involving different CRCSFL research outputs and markets.

From Research Programme 1:

Output 1.1: A 3D GIS visualisation system that incorporates soil assessment, pedo-transfer functions and digital terrain models to visualise below ground forest conditions and remotely-sensed multi-spectral, hyper-spectral, and LIDAR imagery to carry out inventories and sense the above-ground forest condition.

Market: This technology is of potential value to forest managers worldwide, irrespective of the species, management objectives, or geographic location. Commercialisation success will depend on:

- Demonstration to users that the technology will enhance management ability at an acceptable cost compared to conventional technology.
- The technical performance of the CRCSFL product relative to alternatives under development by other research providers, and the terms under which it is marketed.

Commercialisation studies are required to scope the potential national and international markets and prioritise targets, to review competitive products, and to determine strategy for successful marketing outcomes.

Primary Developer/Commercialisation Member: Sonardata, a Hobart-based SME with a track record in international commercialisation of technology for the visualisation and interpretation of multi-beam echo location data for the fisheries industry, and are potential commercial members**.**

Pathway to Adoption: The chosen commercialisation member will be involved in research planning and oversight and in definition of the piloting and market development strategies.

Piloting: With the assistance of the commercialisation member, the product will be tested with at least one core industry member in each State. National and international market appraisal will continue in a time frame dictated by progress with the pilot applications. The CRC will consider seeking funds from the Commonwealth Commercial Ready Programme to assist this process.

Benefit to CRSFL: CRC members will acquire rights to the product for own use and will share in income generated from licensing.

From Research Programme 2:

Output 2.1: Solid-wood breeding objectives and assessment techniques available to industry through co-operatives and service providers.

Market: Breeders for the national eucalypt plantation industry, especially blue gums, with a possibility of international interest, especially in Chile. Value of the technology for these breeders is that they will make more efficient/rapid progress than otherwise possible, to their own commercial benefit. This market is well known to the CRC. Commercialisation studies will concentrate on determining how best to extract value.

It may also be possible to license assessment methodologies to laboratories who will directly service clients of the STBA and other breeders.

Primary Development/Commercialisation Member: The Southern Tree Breeding Association (STBA), a Supporting Member of the CRC, is a company which runs the national co-operative breeding programme for *Eucalyptus globulus.* A spin-off of the STBA, SeedEnergy Ltd., an Associate Member of the CRC, markets improved STBA germplasm to national growers. STBA also offers Breeding Services to national and international forestry companies.

Pathway to Adoption: CRCSFL researchers will develop outputs, with involvement of the STBA which has the technical expertise to contribute to research planning and execution and also direct knowledge of market needs. Since the practical application of integrated quantitative and molecular genetic information will be a world first in tree breeding, the international market will be explored thoroughly once national uptake is established.

Piloting: STBA progeny trials will be used for large scale testing of assessment and information management protocols. STBA owned IP, TREEPLAN®, will be the vehicle for effective use the economic and trait information. CRC will license laboratories for use of testing procedures.

Benefit to CRCSFL: Benefit in terms of faster access to more highly improved germplasm, will accrue directly to those companies who are members in both the CRCSFL and the STBA and obtain planting stock via SeedEnergy Ltd. A modest income stream may also be generated from licensing assessment protocols.

From Research Programme 3:

Output 3.2: Company and regional wood-flow systems, supported by new operational planning and control procedures and software tools, adopted by 30% of industry.

Market: Survey required. In general established multi-national forestry companies in the Australian industry have in-house systems and will only be interested if CRC technology is proved superior. Newer and smaller growers are the primary target. Interest from regional infrastructure planning authorities will be explored.

Primary Adoption/Commercialisation Partners: Core industry partners will collaborate in the research and participate in development. A commercialisation partner will be sought at an early stage – either from existing forest machinery manufacturers or an SME will skills in integrating the necessary hardware and software.

Pathway to Adoption via Piloting: Methods and software tools will be pilot tested within the operations of a core members within each region, with active involvement of staff from other local members. Proven technology will be commercialised externally with timing to be determined by the Board.

Benefit to CRCSFL: Core members will benefit from access for early adoption, and from input into the system development to suit their own needs. Income will be derived from sale of service applications or licenses, and from fees paid for training in its use.

From Research Programme 4:

Output 4.2: Tools and prescriptions for monitoring and managing biodiversity used by 50% of industry in temperate Australia.

Market: All organisations with native or plantation resource management responsibilities – hardwood or softwood – will benefit from use of this CRC output. Support of major certification systems such as the Australian Forestry Standard (AFS) and the Forest Stewardship Council (FSC) will be sought, and their certification auditors targeted.

Primary Adoption Partners: A core member, Forestry Tasmania, manages two-thirds of the production forests in Tasmania and is committed to the research. The Tasmanian Forest Practices Board formalises and polices standards and procedures for the management of forests and is also actively involved in development.

Pathway to Adoption: Application of research outputs will be piloted by Forestry Tasmania. One core member in each of the other regions will be involved in pilot applications in their own ecosystems.

Adoption – The Forest Practices Board will develop draft guidelines under the Tasmanian Forest Practices Code through its normal consultative mechanisms. Modified prescriptions will be promulgated under the Forest Practices Code for use by all of the State industry. Linkages will be established with certification auditors to validate the prescriptions for compliance with major certification standards and to provide a sound base from which to market services

Benefits to CRCSFL: This is in part a public-good activity, so information will be placed in the public domain. The CRC can expect contract business as a result of interaction with a wide range of government and other stakeholders. These products are suited to commercialisation by small contractors or licensing to larger auditing businesses.

Table 5: Summary of Outcomes & Key Commercialisation/Utilisation Outputs & Milestones (Related to Research Outputs and Milestones in Table 7 – Criterion 3)

Sub-Programme Outcome 1.1 From Research Programme (RP) 1	**Improved productivity and investment security arising from better site and stand measurement and assessment.**	
Output 1.1	Penetration of 25% of the national market with a 3D GIS visualisation system that incorporates soil assessment, pedo-transfer functions and digital terrain models to visualise below ground forest conditions and remotely-sensed multi-spectra, hyper-spectral, and LIDAR imagery to inventory and sense the above-ground forest condition. *Delivery Targets: 2007, 2010, 2012*	
Milestone 1.1.1 *ex Research Milestone RM 1.1.1.*	Commercial product and licensed service providers available for airborne LIDAR and large format aerial photography.	*Achievement date:* 2007
Milestone 1.1.2 *RM 1.1.2*	EM rapid assessment technology available as licensed commercial service.	*Achievement date:* 2010
Milestone 1.1.3 *RM 1.1.3*	Commercial product and licensed service providers available for forest condition indices from remotely sensed imagery.	*Achievement date:* 2012
Milestone 1.1.4 *RM 1.1.3*	Commercial product and licensed service providers available for 3D visualisation systems.	*Achievement date:* 2012

SP Outcome 1.2 From RP 1	**Location and management of plantations with reduced risk of disease, insect attack and drought death risk and management strategies that sustaining production through multiple rotation cycles while minimising costs of management intervention.**	
Output 1. 2	Adoption by 25% of industry of management systems for predicting impacts, consequences and best-bet intervention strategies to minimize the risks of growing plantations, maximizing production through the management cycle and predicting the spatial distribution of hazards. *Delivery Targets: 2009, 2010, 2012*	
Milestone 1.2.1 *RM 1.2.1*	Adoption of climate and site-specific strategies for intra- and inter-rotational management to maximise sustainable production from blue gum plantations.	*Achievement date:* 2009
Milestone 1.2.2 *RM 1.2.2*	Models for predicting rotation length impacts of damage from disease and insects available as software.	*Achievement date:* 2010

Milestone 1.2.3 *RM 1.2.2*	Commercial product and licensed service providers available for site hazard ratings for major plantation risks.	*Achievement date:* 2012

SP Outcome 1.3 From RP 1	**Production of more uniform wood products from plantations, with reduced risk and increased profitability, from application of a decision support system that integrates the effects of genetic stock, site variability and plantation management history, to predict the size class distribution (stem sizes, clear log length) and survival of trees.**	
Output 1.3	Adoption by 15% of market of modules of licensed software for integrating effects of genetic stock and site variability, plantation history and plantation management to predict the size class distribution (stem sizes, clear log length) and survival of trees. *Delivery Targets: 2009, 2010*	
Milestone 1.3.1 *RM 1.3.1/1.3.2*	Plantation and forest water use software modules available for testing by industry members.	*Achievement date:* 2009
Milestone 1.3.2 *RM 1.3.2/1.3.3*	Licensed modular software available for industry.	*Achievement date:* 2010

SP Outcome 2.1 From RP 2	**Methodology for efficient selection and breeding for high value wood traits adopted and applied by managers of Australia's Eucalypt breeding programmes, positioning for supply of improved stock for plantation establishment.**	
Output 2.1	Solid-wood breeding objective and assessment techniques available to industry through co-operatives and service providers. *Delivery Targets: 2008, 2009, 2010*	
Milestone 2.1.1 *RM 2.1.1/2.1.2*	Solid-wood breeding objective and assessment techniques incorporated into *E. globulus* and *E. nitens* breeding value prediction by STBA TREEPLAN® genetic assessment software.	*Achievement date:* 2008
Milestone 2.1.2 *RM 2.1.1/2.1.2*	Solid-wood breeding objective and assessment techniques used to develop dedicated seed orchards to produce a solid-wood breed in one member's breeding programme.	*Achievement date:* 2008
Milestone 2.1.3 *RM 2.1.1*	Accredited service available for solid-wood assessment techniques.	*Achievement date:* 2009
Milestone 2.1.4 *RM 2.1.3/2.1.4*	Molecular genetic information incorporated into breeding value prediction for pulp and solid-wood traits of *E. globulus* and *E. nitens*, using STBA TREEPLAN® genetic assessment software.	*Achievement date:* 2010

SP Outcome 2.2 From RP 2	**Adoption of improved silvicultural prescriptions by eucalyptus growers targeting solid and engineered wood markets.**	
Output 2.2	Uptake of prescriptions for silvicultural treatments, which will maximise recovery of fit-for-purpose, grades maximising value of product mix from eucalypt plantations. *Delivery Targets: 2010, 2011*	
Milestone 2.2.1 *RM 2.2.1*	Silvicultural prescriptions to maximise solid-wood value of two target species available and demonstrated to industry members in pilot trial.	*Achievement date:* 2010
Milestone 2.2.2 *RM 2.2.2*	Silvicultural regime to minimise solid-wood timber degrade in *E. nitens* adopted by one industry member.	*Achievement date:* 2011

SP Outcome 2.3 From RP 2	**Forest managers incorporate expectations of value-characterised wood quality into stand and estate level management practice.**	
Output 2.3	Systems for the assessment and prediction of fibre and solid wood quality at stand and estate levels and incorporation of wood quality layer into company GIS systems, with uptake by 25% of Australia's major growers of eucalypt plantations. *Delivery Targets: 2009, 2012*	
Milestone 2.3.1 *RM 2.3.1*	Sampling protocols for prediction of log and stand value for solid wood products applied by two CRC members at estate level.	*Achievement date:* 2009
Milestone 2.3.2 *RM 2.3.1*	Accredited service available for solid-wood assessment techniques.	*Achievement date:* 2009
Milestone 2.3.3 *RM 2.3.2/1.3.2*	Licensed software modules for wood quality prediction incorporating spatial, germplasm and silvicultural information available.	*Achievement date:* 2012

SP Outcome 3.1 From RP 3	**Ready availability to management of detailed and timely system performance data through automated digital data capture, transmission and centralised storage.**	
Output 3.1	Systems for automatic performance monitoring including generic data capture technologies, field communication network components and software and data storage systems used by 30% of harvesting contractors. *Delivery Targets: 2006, 2007, 2009*	
Milestone 3.1.1 *RM 3.1.1*	On-board data capture for key equipment types and in-forest data network communications systems developed and tested.	*Achievement date:* 2006

Milestone 3.1.2 *RM 3.1.2*	Deployment at pilot scale of integrated data capture, network communication, data transfer and delivery systems with two harvesting contractors.	*Achievement date:* 2007
Milestone 3.1.3 *RM 3.1.2*	Commercial hardware and software available.	*Achievement date:* 2009

SP Outcome 3.2 From RP 3	**Reduced operational costs and improved supply capability via significant enhancement to planning and control systems for harvesting and transportation, from improvement in ability to predict and monitor system performance.**	
Output 3.2	Company and regional wood-flow systems supported by new operational planning and control procedures and software tools adopted by 30% of industry. *Delivery Targets: 2007, 2008, 2010*	
Milestone 3.2.1 *RM 3.2.1*	Methodologies for industry to analyse their operational systems, to develop local predictive performance models and to monitor performance.	*Achievement date:* 2007
Milestone 3.2.2 *RM 3.2.2*	Software systems for industry to analyse and optimise integrated wood flow systems in the context of improved systems task and capability knowledge.	*Achievement date:* 2008
Milestone 3.2.3 *RM 3.2.3*	Procedures and software systems for improved local and regional forestry operations planning and control with high spatial and temporal resolution.	*Achievement date:* 2010

SP Outcome 3.3 From RP 3	**Reduced cost and improved efficiency through improved utilisation and productivity of harvesting and transportation equipment.**	
Output 3.3	Performance control systems used to monitor and support continuous improvement in day-to-day harvesting and transport equipment and crew operations. *Delivery Targets: 2007, 2008*	
Milestone 3.3.1 *RM 3.3.1*	Job-site and daily to weekly performance level management software for contractors and field managers.	*Achievement date:* 2007
Milestone 3.3.2 *RM 3.3.1*	Performance analysis and benchmarking service to establish a basis for continuous industry improvement.	*Achievement date:* 2008
Milestone 3.3.3 *RM 3.3.1/3.3.2*	Commercial software available and training modules developed with vocational training contractors.	*Achievement date:* 2008

SP Outcome 3.4 From RP 3	**Reduced cost and improved flexibility in wood supply through improved allocation of roles and functions between organisations along supply chain**.

Output 3.4	Design recommendations for improved supply chain organisation and task re-design to effectively capture capabilities of new information based monitoring and control technologies. *Delivery Targets: 2008, 2011*	
Milestone 3.4.1 *RM 3.4.1*	Pilot projects of improved inter-organisational allocation of role and responsibility.	*Achievement date:* 2008
Milestone 3.4.2 *RM 3.4.2*	Adoption by 25% of industry users of wood supply chain analytical methods.	*Achievement date:* 2011

SP Outcome 4.1 From RP 4	**Implementation of strategies for management and establishment of forests and tree crops that maintain productivity with optimal water outcomes.**	
Output 4.1	Tools to predict the effect of forestry activities on water yield and quality and strategies for sustainable water outcomes used by half of the resource and catchment management authorities in southern Australia. *Delivery Targets: 2008, 2009, 2011, 2012*	
Milestone 4.1.1 *RM 4.1.1*	Provisional strategies for locating and managing tree crops to optimise productivity and water outcomes adopted by industry members and agreed with catchment management authorities.	*Achievement date:* 2008
Milestone 4.1.2 *RM 4.1.1*	Pilot projects testing best-bet strategies on catchment scale.	*Achievement date:* 2009
Milestone 4.1.3 *RM 4.1.2*	Validated forest management water use models integrated into user-friendly, licensed software.	*Achievement date:* 2011
Milestone 4.1.4 *RM 4.1.3*	Validated strategies adopted by industry members and agreed with catchment management and certification bodies	*Achievement date:* 2012

SP Outcome 4.2 From RP 4	**Sustained or enhanced biodiversity values of forest production landscapes through improved capacity to predict and monitor biodiversity responses against baseline criteria and enhanced capacity to fulfil biodiversity planning, legislative and certification requirements. 'Smarter' and sustainable management of forest pests, weeds and pathogens with reduced negative economic and/or environmental impacts while maintaining productivity.**
Output 4.2	Tools and prescriptions for monitoring and managing biodiversity used by 50% of industry in temperate Australia. *Delivery Targets: 2008, 2009, 2010, 2011, 2012*

Milestone 4.2.1 *RM 4.2.1*	Revised prescriptions for native forest silviculture and management of coarse woody debris adopted by two major forest managers.	*Achievement date:* 2008
Milestone 4.2.2 *RM 4.2.6*	Prescriptions for non-lethal strategies for controlling marsupial browsing integrated into pest management strategies of Tasmanian forest managers.	*Achievement date:* 2009
Milestone 4.2.3 *RM 4.2.3*	Web-based decision support system for assessing the risk of gene flow from plantations into native forest gene pools and strategies to manage this risk use in planning.	*Achievement date:* 2010
Milestone 4.2.4 *RM 4.2.3/4.2.4*	Prescriptions for the integrated management of threatened and keystone taxa in production landscapes, including revised seed transfer guidelines for key commercial eucalypts, adopted by native forest managers and recognised by certification agencies.	*Achievement date:* 2010
Milestone 4.2.5 *RM 4.2.2*	Service providers able to implement biodiversity monitoring procedures recognised by certification agencies.	*Achievement date:* 2009
Milestone 4.2.6 *RM 4.2.3*	Modules for evaluating risk of gene flow from plantations into native forests linked to web-base system and licensed to forest managers.	*Achievement date:* 2011
Milestone 4.2.7 *RM 4.2.6*	Prescriptions for managing key pests, weeds and pathogens, including targeted and more humane lethal strategies for controlling marsupial browsing, adopted by forest managers and recognised by certification agencies.	*Achievement date:* 2011
Milestone 4.2.8 *RM 4.2.3-4.2.7*	Prescriptions for monitoring the on- and off-site effects of forestry practices on biodiversity and sustainability at a local and landscape level adopted by industry and recognised by certification agencies.	*Achievement date:* 2012

SP Outcome 4.3 From RP 4	**Increased community and landholder support and greater community benefits from plantation forestry, with wood production managed with less conflict and in ways acceptable to the wider public.**	
Output 4.3	**S**trategies adopted by forest industry to improve their engagement with immediate neighbours, other local landholders, planning authorities and the wider community. *Delivery Targets: 2008, 2011*	
Milestone 4.3.1 *RM 4.3.2/4.3.3*	Full 'engagement' strategies implemented as pilot projects with industry members in 3 regions.	*Achievement date:* 2008
Milestone 4.3.2 *RM 4.3.4/4.3.5*	Revised strategies adopted by forest managers and recognised by certification authorities.	*Achievement date:* 2011

SP Outcome 4.4 From RP 4	**Improved capacity to plan wood production systems which integrate industry operations and forest productivity needs with environmental and community requirements.**	
Output 4.4	Software for negotiation support systems to guide landscape planning and evaluation of trade-offs between production, water, biodiversity, visual amenity and other community requirements. *Delivery Targets: 2007, 2008, 2010*	
Milestone 4.4.1 *RM4.4.1/4.4.2*	Completion of an estate design plan for a controversial situation negotiated through participatory modelling involving a wide range of stakeholders.	*Achievement date:* 2007
Milestone 4.4.2 *RM4.4.4*	Adaptable modules and user-guides to support participatory modelling evaluated and agreed with industry partners and other stakeholders.	*Achievement date:* 2008
Milestone 4.4.3 *RM4.4.1-4.4.4*	Generic optimisation modules for evaluation of stand and landscape level trade-offs available through licensed service providers.	*Achievement date:* 2010

Selection criterion 3. The collaboration has the capability to achieve the intended results.

3.1. The Research Programmes (RPs)

The research objectives remain substantially unchanged from the Preliminary Business Plan, although there has been some re-alignment of activities. This package of multi-disciplinary Programmes is designed to service the forestry business chain (from choice of plantation site to delivery at mill gate), which requires the execution of many discrete but inter-related management activities. This presents opportunities for cross-programme research linkages. The CRCSFL will take full advantage of these opportunities and will manage the Research Programmes as nodes of concentrated activity within a wider network of interactions between all of the CRC's members. The potential for wood-flow planning (RP3) to take account of water and community related outputs (RP4), is a good example of an interaction which would not be easily fostered in other research environments.

All Research Outputs contribute to an Outcome at the Sub-Programme, Programme and Industry Levels. In practice, a Sub-Programme may have more than one Output, but only the most important or representative is presented in Table 6.

RP1. Managing and Monitoring for Growth and Health

The research will be managed in three Sub-Programmes under the leadership of Dr M. Battaglia (CSIRO) and will develop new tools for assessment and inventory of forest condition.

1.1. Monitoring and Measuring. Projects include:
1.1.1 Characterisation and mapping of key site and soil attributes for site evaluation. Accurate, cost effective and spatially explicit characterisation and mapping of key site and soil attributes that are GIS compatible, including the use of new remote sensing technologies for soil characterisation.
1.1.2. Monitoring of forest condition with multi-spectral and hyper-spectral remote sensing. Development of tools for multi-temporal remote sensing which can distinguish between change in forest condition due to health factors and to ambient environment at the time of image capture. This will create new opportunities for monitoring forest health and nutrient status with pro-active capability.
1.1.3. Improved forest inventory using high resolution airborne remote sensing. Development of applications of airborne and satellite remote sensing systems, in particular LIDAR, which have the potential to provide spatially extensive data at a cost that allows for frequent data collection.

1.2 Managing and Sustaining. Projects include:
1.2.1 Sustaining site resources through successive rotations. Quantifying the effects of tree growth, silviculture and harvesting regimes on the capacity of sites to maintain growth through successive rotations and capture this into decision support tools for exploring growth implications and the role of management options in mitigating impacts.
*1.2.2 Measuring and managing forest health***.** Temporal and spatial prediction of pest damage in real time, coupled with yield and economic impact modelling to guide intervention strategies. This will involve integration of digitised canopy condition coverage (from 1.1.2) with other physical and environmental GIS layers.

1.3. Modelling and Information Integration. Projects include:
1.3.1 Models for precision forestry. Decision support tools for the prediction of genotype, site and management effects on stand production, end use suitability of plantation grown products, stand-scale fluxes of carbon and water and risks inherent in plantation development. This will permit managers to tailor silviculture for site attributes and allow precise targeting of fertiliser and pesticide application.
1.3.2 Integrated information for industry. Many of CRCSFL research outputs will offer even greater utility if combined. The project will integrate information in the form of spatial surfaces and digital data streams and deliver outputs in an industry-ready format.

Originality and Achievability: This research programme looks to adapt and develop new techniques in plantation condition sensing, conducting inventories and monitoring. In some cases, techniques successfully applied in agriculture will be applied to forests for the first time. In other areas, such as 1.1.2, fundamentally new work is being undertaken. All projects facilitate a new approach to forest

broad acre approach to one responsive to site demands and customised to local conditions, thereby minimising impacts and increasing profitability.

Coherence and Balance Including Cross-programme Linkages: There will be strong linkages within and between programmes, both formally (via SP 1.3) and informally through well-established research links (as indicated by co-publication by many of the project leaders) contributing to the CRC's ability to produce an integrated 'toolbox' for industry. Work on understanding the biology of forest health in Programme 4 will, for example, combine with the development of stress indices in 1.1.2 and the evaluation of these on growth impacts in 1.2.2 and the delivery of these as a decision support tool and cash flow analysis in SP 1.3.

Major International and Other External Linkages: US Department of Agriculture; Complex Systems Research Center, University of New Hampshire, USA; University of Sao Paulo, Brazil; ARACRUZ, Brazil; Department of Forest Resources Management, University of British Columbia, Canada; Institute for Commercial Forest Research, South Africa; Horticulture Research International, UK; and CSIRO Exploration and Mining, CRC for Landscape Environments and Mineral Exploration.

RP2. High-Value Wood Resources

The research will be managed in three Sub-Programmes under the leadership of Dr C. Harwood (CSIRO) and will build on the successful assessment and breeding methodologies and silvicultural systems developed for improving plantation productivity in the earlier forestry CRCs.

2.1 Breeding: Sampling protocols for early low-cost prediction of log value for solid/engineered wood applications will be refined. Molecular genetic information obtained on variation in genes strongly influencing key wood traits (e.g. cellulose and lignin content) will be combined with quantitative genetic information for accurate breeding value prediction in *E. globulus, E. nitens and E. pilularis*. Knowledge of the impact of these traits on wood properties of economic importance to end users will be used to define the Breeding Objectives for developing fit-for-purpose varieties.

2.2 Silviculture: Silviculture (spacing, thinning, pruning, fertilizing) affects not only wood yields but also wood quality, particularly for solid/engineered wood applications. Empirical studies of growth and wood quality responses to silvicultural treatments will enable growers to optimise financial returns by adopting treatments matched to germplasm that maximise production of high-value products to meet processor quality specifications.

2.3 Incorporating Wood Value into Estate Planning and Management: This project will draw on the outputs of the other sub-programmes to develop software routines for wood quality prediction incorporating spatial, germplasm and silvicultural information at the stand and estate level.

Originality and Achievability: The team has expertise in genetics, silviculture and wood quality research that will work closely together. Use of methods including *Silviscan* and near infra-red spectroscopy technologies will establish functional relationships between wood micro-structure traits under genetic control, and log quality/value.

Coherence and Balance Including Cross-Programme Linkages: Genetics and silviculture interact with site factors to determine wood quality so the Sub-Programmes need to be linked to provide integrated outcomes. The research will also link with the process-based modelling of SP 1.5 to produce management applications.

Major International and Other External Linkages: CSIR Environmentek South Africa; International Genome Network with partners in Brazil, Portugal and South Africa; Non-CRC research providers funded by FWPRDC for research into eucalypt wood processing.

RP3 Harvesting and Operations

This new area of research will be managed in four Sub-Programmes under the leadership of Dr L. Bren, University of Melbourne and Dr R. McCormack (CSIRO), complemented by a senior cash-funded researcher recruited by international search. Harvesting and transportation may account for over 60% of delivered wood cost and new information technologies offer solutions with significant potential to improve management and reduce costs. This is particularly critical for the Australian industry as labour costs are high relative to major competitors.

3.1 Automating Data Capture: Systems developed to implement automatic capture of performance data from forest machines and to support networked data transfer from forest to office. Options for expanding the range of machine performance information collected will also be explored.

3.2 Optimising Harvesting Systems: Adapt or develop and apply new and advanced industrial engineering and operations research approaches to forestry operations to produce a set of tools allowing harvesting operations to approach optimal efficiency. The approach involves improved modelling of systems (harvesting and transport including roads management); the development of new algorithms and systems for operations planning and control; and the examination of incoming data against model expectations for adaptive improvement of performance.

3.3 Optimising Operator Performance: A management toolbox will be developed including routines for monitoring key performance indicators for each element of the operation. This will assist front line equipment and crew managers to improve on-the-job efficiency and productivity. Outcomes will be improved performance, tools to support ongoing improvement and a cadre of staff trained in operational use.

3.4 Supply Chain Structure: Work with industry members to diagnose opportunities and constraints and recommend changes in organisational structure needed to capture the full benefit from implementation of the new technologies. It applies particularly to cross-organisational links and will pilot improved systems to demonstrate proof-of-concept.

Originality and Achievability: The most important outcome of this Programme is that technical approaches in general use in other industries will be adapted to Australian business conditions and made available to a wide range of Australian forestry companies. The power of evolving Information and Communication Technology, the receptivity of the industry to mechanisation solutions, and the willingness of the CRC's industry members to collaborate in bringing the necessary resources to bear, give confidence that the programme will be carried to a successful conclusion.

Coherence and Balance Including Cross-programme Linkages: This Programme is founded on a systems theory approach recognising the essential linkage between forestry planners, the day-to-day controllers and implementers (contractors, supervisors and operators) and managers responsible for supply chain structure and coordination, and their interplay with the physical technologies and the changing state of the forest. Inputs from Programme 4 will ensure incorporation of knowledge of environmental and community factors. Data acquired through SP3.1 technology, such as location-specific timber yield or quality data will also be utilised for inventory and modelling in Programme 1, and contribute to a new integrated approach to forest management and operations based on shared information, performance models and decision support tools.

Major International and Other External Linkages: Precision Forestry Cooperative, University of Washington, USA; SkogForsk (Forest Research Institute) in Sweden; Forest Engineering Research Institute Canada. Planning and Transport Research Centre, WA; CSIRO Maths & Information Sciences; National Institute of Engineering and Information Sciences, ANU. For commercialisation strategy, links with machinery manufacturers John Deere, Komatsu and Waratah.

RP4. Trees in the Landscape

The research will be managed in three Sub-Programmes under the leadership of Assoc. Prof. B Potts (UTAS). Sustainable forest practices are of critical for the Australian forest industry with increasing commercial and regulative incentives for forest certification. Research outputs will contribute to security of the forest industry's long-term 'license-to-operate' in the Australian landscape.

4.1 Water. Projects include:
4.1.1 Impact of forest harvesting: Models will be developed to predict the impact of forest harvesting on water yields, water quality and aquatic biota (e.g. macro-invertebrates) using data to be collected from two catchments in Victoria and Tasmania.
4.1.2: Development of integrated tree cropping systems with water benefits: Hydrological and productivity data will be measured to model the environmental and water benefits of integrated tree cropping systems in the 400-750 mm rainfall areas in southern Australia.

4.2 Biodiversity. Projects include:
4.2.1: Monitoring and management of biodiversity in forestry landscapes: Techniques (e.g. molecular characterisation and surrogates) for monitoring indicator species and communities will be developed and used to monitor the effectiveness of forest practices (e.g. silvicultural regimes; retained reserves, buffers and coarse woody debris) and to develop sustainable strategies for biodiversity management.
4.2.2: Gene pool management: Genetically defined seed transfer zones will be developed for the key commercial eucalypts as well as strategies to assess and manage the impacts of gene flow between plantations and of native forests.
4.2.3: Sustainable pest management: Practices reducing the impact of pest and pathogen management regimes on non-target organisms will be developed. Primary target organisms will be *Mycosphaerella* leaf disease, autumn gum moth, *Chrysophtharta* and *Gonipterus* leaf defoliating beetles and marsupials. Marsupial browsing management will focus on alternatives to 1080 poisoning. Approaches will include modified estate design, modifying feeding behaviour (repellents and resistance), and more targeted and humane lethal approaches.

4.3 Communities. Projects include:
4.3.1: Costs and benefits of plantation forest industry: Industry segments will be profiled to ascertain the full socio-economic costs and benefits of plantation forestry for local and regional communities and identify key elements for exploring community attitudes in 4.3.2.
4.3.2: Better understanding of community attitudes to plantation forestry: A combination of longitudinal studies and visualisation technology will be used to explore the attitudes of different community segments (e.g. immediate neighbours, urban people) to plantation forestry and to develop strategies for better community engagement.
4.4 Landscape Design. Projects include:
4.4.1: Re-design of existing plantation estates during inter-rotations: This project will interact with SP1.1 and SP3.2 to develop spatio-temporal models to optimise plantation estate design.
4.4.2: Participatory modelling of forested landscapes: Systems that facilitate participatory modelling will be developed to guide landscape planning and evaluation of trade-offs between production, water, biodiversity, visual amenity and other community requirements.

Originality and Achievability: This Programme provides a unique opportunity to coordinate and integrate sustainability research. The programme is backed by a strong and diverse group of scientists. The direct involvement of researchers from industry and regulatory organisations, such as the Forest Practices Board, will ensure rapid adoption of research results. The programme has access to a unique set of research sites and long-term data sets, member commitment to operational scale experimental treatments (e.g. harvesting/replanting) and support for monitoring. Research will adapt, as well as develop new techniques, and specific indicators and strategies for monitoring sustainability criteria and indicators. Novel approaches will include the integration of stand productivity and water use with hydrological models, the application of new molecular tools such as DNA bar coding for monitoring biodiversity, the integration of improved non-lethal and lethal strategies for control of marsupial browsing and the use of computer visualisation in exploring community attitudes.

Coherence and Balance Including Cross-programme Linkages: There will be active interaction between programmes and sub-programmes on a regional basis. For example, SP4.1 and SP4.2 will interact in the area of biological indicators of water quality. Interactions across Programmes 1 and 4 will occur by shared post-doctoral appointments in WA and Tasmania in plantation health monitoring and management (SP4.2 and SP1.2.2), SP4.1 will also interact with SP1.1 and SP1.2 in the development of integrated water models and SP4.2 will interact with the SP1.1 to explore possibilities of remotely monitoring biodiversity. SP4.4 will provide a base for integrating research outputs from across the Programme for estate planning at landscape level.

Major International and Other External Linkages: North Arizona University, USA; Swedish University of Agricultural Science; University of Pretoria, South Africa; Centre for International Forest Research, Indonesia; CRC for Catchment Hydrology; CRC for Plant Based Management of Dryland Salinity; CRC for Freshwater Ecology; The Ecology Centre, University of Queensland.

Table 6: Key Researchers and Time Commitments

Programme/ Sub-Programme	***Name***	***Role***	***Member Org***	***% * Time***
Administration	Prof. A.R. Griffin	CEO		100
1. Managing & Monitoring for Growth & Health	Dr M. Battaglia	Programme Leader	CSIRO	50
1.1 Monitoring & Measuring	Dr P. Ryan	Project Leader	CSIRO	25
	Dr D. Culvenor	Project Leader	CSIRO	50
	Dr J. Osborn	Key Researcher	UTAS	20
	Dr C. Stone**	Key Researcher	SFNSW	50
1.2 Managing & Sustaining	Dr D. White	Project Leader	CSIRO	15
	Dr C. Mohammed	Key Researcher	CSIRO	45
	Dr T. Burgess	Key Researcher	Murdoch	50
1.3 Modelling & Information Integration	Dr M. Battaglia	Project Leader	CSIRO	
	Mr I. Wild	Key Researcher	UMelb	50
2 High-Value Wood Resources	Dr C. Harwood	Programme Leader	CSIRO	30
2.1 Breeding	Dr C. Harwood	Project Leader	CSIRO	
	Dr R. Vaillancourt	Key Researcher	UTAS	50
	Prof. R. Henry	Key Researcher	SCU	20
2.2 Silviculture	Dr T. Baker**	Key Researcher	DSE	40
	Dr P.W. Volker**	Project Leader	FT	30
	Dr R. Washusen	Key Researcher	CSIRO	40
	Dr C. Beadle	Key Researcher	CSIRO	20
2.3 Wood Value in Planning & Management	Dr G. Downes	Project Leader	CSIRO	50
3 Harvesting and Operations	Ass. Prof. L. Bren	Programme Leader	UMelb	50
3.1. Data Capture	Dr R. McCormack	Project Leader	ANU	100
3.2 Harvesting Systems	Ass. Prof. L. Bren	Project Leader	UMelb	
	Dr Min Qiu	Key Researcher	Murdoch	15
3.3 Operator Performance	Dr B. Greaves	Project Leader	UTAS	100
4. Trees in the Landscape	Ass. Prof. B. Potts	Programme Leader	UTAS	100
4.1 Water	Dr J. Morris*	Project Leader	DSE	40
	Dr. G. Sheridan*	Key Researcher	DSE	30
	Dr J. McGrath**	Key Researcher	FPC WA	30
	Dr. P. Smethurst	Key Researcher	CSIRO	20
	Dr S. Roberts**	Key Researcher	FT	40
	Dr S. Munks**	Key Researcher	FPB	40
4.2 Biodiversity	Ass. Prof. B. Potts	Project Leader	UTAS	
	Dr G. Hardy	Project Leader	Murdoch	30
	Dr S. Grove**	Key Researcher	FT	60
	Dr G. Allen	Key Researcher	UTAS	40
	Dr P. Ades	Key Researcher	UMelb	30
	Prof D. Cooper	Key Researcher	M'quarie	20
4.3 Communities	Dr K. Williams	Key Researcher	UMelb	30
	Dr D. Race	Project Leader	ANU	65
4.4 Plantation Estate Design	Prof. J. Vanclay	Project Leader	SCU	50

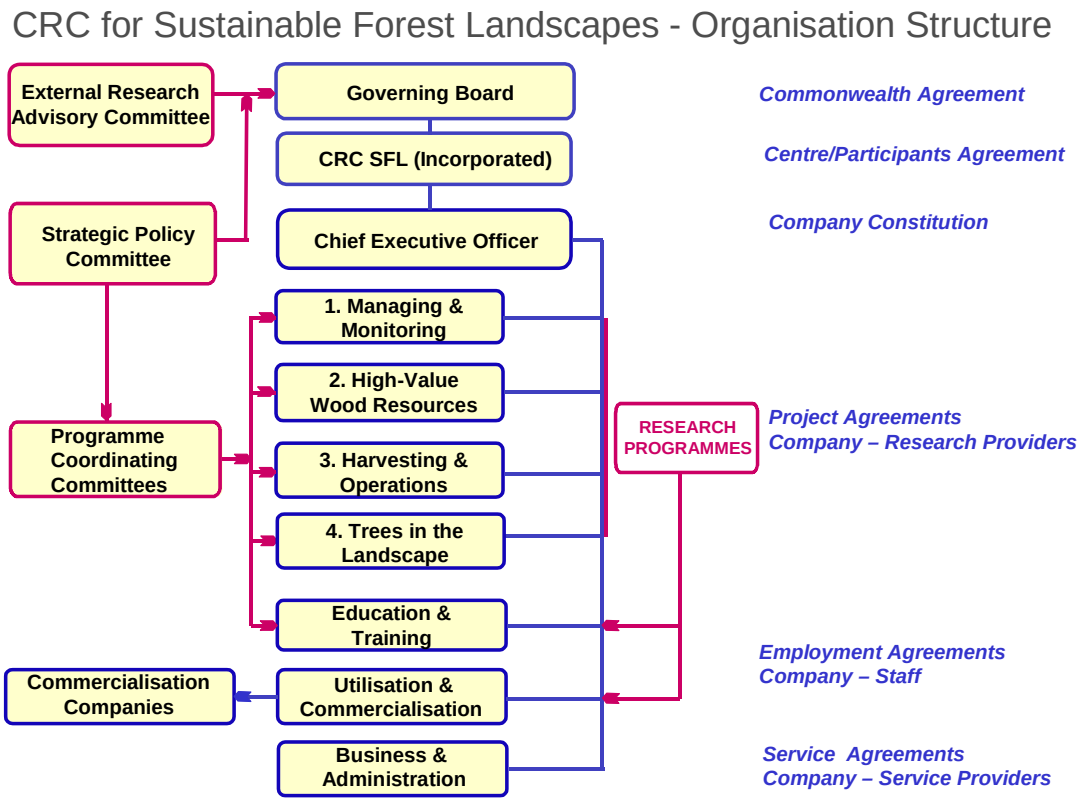
* Total – includes both cash funded and in kind time. **From Industry member.

3.2 Nature of the Collaborative Arrangements

Core industry participants and research providers continuing from CRCSPF have proven their ability to work together. New core research providers (University of Melbourne and Murdoch University) will bring additional strong links to industry participants in their respective States. Each core research provider will have a significant role in at least one sub-programme within each of the programmes, thus securing a comprehensive network of regional focal points. Links will be established via MOU with other CRCs interfacing with CRCSFL. At Supporting Member level, involvement of the Forest Practices Board in Tasmania provides a good model for extension of CRC knowledge into the emerging market of certification and demonstration of sustainable forest practice. A senior researcher/manager from each industry organisation will be a primary contact for commercialisation/utilisation matters, e.g. Dr P. Volker for Forestry Tasmania and Dr J. McGrath for the Forest Products Commission WA.

3.3 Governance and Management Arrangements

CRCSFL will be incorporated as a Company limited by guarantee. The primary activity of the Company will be to carry out scientific research. The Company may undertake ancillary activities such as commercialisation, external contracts, consultancies and for-profit training. As these ancillary activities will be minor compared to the research and education aims, it is expected that the Company will qualify as a not-for-profit entity with tax-exempt status (subject to ATO ruling). A specialist commercialisation company will not be established at the outset, but the Company may establish other companies later for particular commercialisation purposes.



All Core participants in the CRCSFL will be members of the Company. Supporting participants may also be members of the Company, provided they are committed to the objectives and operations of the whole CRC. The CRC Company will be paid, and will receive in its own right, the Commonwealth funds and other cash contributions from the core and supporting participants. As a separate legal entity, the Company will be able to enter into agreements in its own right, own assets, including intellectual property, and employ staff. Agreements will be made between the Company and the research provider participants to carry out the research programmes. The research staff will be employed by the participating research organisations.

Requirements for membership of the CRC, and entitlements of core, supporting and associate members, have been developed by the bid steering committee and will form the basis for the Company's constitution. These are substantially in line with the Australian Institute of Commercialisation/CRC Association Project model recommendations.

The CRC Company will have a seven-member skills-based governing Board, at least half nominated by industry, including an independent chairperson and the CEO as an ex officio member. The Board will be responsible for decisions relating to spending the Commonwealth funds and participant contributions, the selection of and oversight of projects being undertaken, and the management and commercialisation of IP. A sub-committee structure will be set up to oversee the research and education activities. The Board will be advised by a Strategic Policy Committee, chaired by a Board Member and composed of representatives of all Core partners. Advice on research quality will be via a Committee of external experts who will meet annually and be available as required on an ad hoc basis. The Director of CRCSPF, Prof. R. Griffin, is available as CEO to provide continuity.

3.4 Education and Training

The Education Programme will create a national focus of excellence for post-graduate training in forestry to produce well-trained, industry-oriented staff, develop the skills of students and staff in research and adoption, and support industry training activities. Structural changes in the public and forest industry sectors have diminished the pool of experienced researchers within traditional research providers, and created a market for a new generation of knowledge generators and brokers who can work effectively with a range of clients. These demands and opportunities in Australia are mirrored globally.

The programme will be integrated with other projects in the Utilisation and Commercialisation Programme through a range of joint activities, and with the research Programmes through the ongoing supervision of students. Education and Training will achieve its objectives by:

1. Training a cohort of student researchers at Honours, Masters and PhD levels through identification of appropriate projects relevant to Research Programme goals, and implementation under joint university-industry supervision. University partners will encourage promising later-year undergraduates to pursue CRC-relevant research by offering small research projects with CRC researchers as part of their Honours year experience. Cross-partner experience will be fostered and research students will be exposed to industry issues and offered generic skills training to ensure readiness for employment.
2. Helping to develop researcher and industry capacity to communicate about research needs, approaches, and outcomes, by providing opportunities for formal and informal co-learning and extension, using mechanisms identified in the Utilisation sub-programme.
3. Support training for sub-professional staff through interaction with external service providers in the TAFE system and elsewhere. The adoption of some innovations, particularly from RP 3 will depend on increasing the knowledge and skills base of the forest industry work force.
4. Fostering community learning and dialogue about forests in sustainable landscapes. This activity will be closely linked to outputs from RP4.3. It will draw on social sciences methodologies to enhance researchers' and industry staff's skills for effective dialogue about CRC research and its applications with community groups and members. In conjunction with organisations such as the Forest Education Foundation, the CRC will support the development of new teaching resources to increase community learning and dialogue about forests.

At any time the average enrolment of postgraduate students will be 35, and over the life of the CRC, 70 PhD and MSc students will be trained. The CRC will also actively foster the development of at least 3 promising Honours students per year or 30 over the life of the CRC. Students will be co-supervised by industry partners who will provide experimental sites and other support. Half the PhD studentships will be fully funded by the CRC, with the rest being in employment or given top-up funding for other scholarships.

3.5 Strategies to Manage the Transition Between CRCSPF and CRCSFL

The Business Plan for Year 8 of the CRCSPF provides for the completion of research deliverables and expenditure of all funds by 30 June 2005, at which date the un-incorporated JV will terminate and the Board dissolve. Provision has been made to fund the University of Tasmania, as Centre Agent, to complete the task of winding up financial activities and final audit. The Board has confirmed IP arrangements, whereby ownership reverts to the innovators, with partners having continuing right of use, but not to any subsequent improvements. The Members Website and all incorporated information will transfer to CRCSFL ownership unless otherwise agreed on a case-by-case basis.

All CRCSPF staff contracts will conclude on or before termination date, with provision made, via member universities, for supervision and funding of a few students whose scholarships extend beyond this time. Responsibility for any ongoing externally funded contracts/projects will be transferred to the relevant partners.

An interim Board for CRCSFL will be appointed prior to interview and continue through the Agreement negotiation stage, to ensure positioning for a rapid start up on 1 July 2005. During the first semester of 2005, research providers will negotiate new contracts with those CRCSPF staff required for CRCSFL.

3.6 Evidence from Independent Review of CRCSPF

The bid builds on experience with a forestry CRC since 1991. In 2002, CRCSPF completed a successful 5th Year Review. The Stage 1 Panel concluded that quality of the CRC 'research was high across all programs, and outstanding in some projects' and commented that 'The industry partners in the CRC-SPF are highly satisfied with research performance and outcomes. … There are many examples of research outputs being successfully delivered to industry.' Subsequently, the Minister for Science approved, and part funded, a one-year extension to June 2005, permitting further value to be taken from the research. $650,000 of new money from industry participants underpins this activity – an expression of confidence that the CRCSPF is delivering value for money.

Three of the people involved in the 5th Year Review of the CRCSPF were invited, in June 2004, to Hobart to re-assess performance. The reviewers (Prof. R. Sands, University of Canterbury NZ; Dr S. Verryn, CSIR, South Africa; and Dr M. Whitten, CRC SPF Visitor) have professional expertise that maps onto the three CRC Research Programmes. Over a three-day period they updated their 5th Year Review, using background documentation; the CRC work plans for 2003-2005; presentations from the Programme Managers; interviews with industry partners; and a meeting with students.

The Review Panel's Final Report strongly endorses the view that the CRCSPF continues to operate effectively in the interests of all partners.

'Over the review period, 2002-2004, the CRC maintained its excellent record of research productivity and relevance established by the year-5 review.

The CRC continues to be underpinned by postgraduate research. The morale and enthusiasm of postgraduate students were high. Postgraduate students felt that they enjoyed an ideal operating environment and benefited by the collegiality of the CRC, and industry partners strongly favoured employment of CRC postgraduates over postgraduates outside of the CRC.

The panel was impressed by the uptake of research by industry. There was an improvement in this since the 5th year review.' Examples cited include 'TREEPLAN®, which has been adopted by the industry, through STBA, as their primary 'selection tool for breeding', 'the model STEPS V3.0 has been used throughout the last year to perform economic analyses of exotic and native pine plantations across Queensland', and 'registration in Tasmania of Success, an effective pesticide for controlling leaf beetles; and its immediate use in Tasmania as part of a successful IPM program.'

'Industry was convinced that they had received value for money from their investment. Industry considered that the CRC structure in which there was a focused and coordinated research programme over a 7-year funding period would provide them with better outcomes than any alternative model in which they acted independently.'

Table 7: Summary of Outcomes, Key Research Outputs and Milestones

Sub-Programme Outcome 1.1 from RP 1	**Improved productivity and investment security arising from better site and stand measurement and assessment.**	
Output 1.1	A 3D GIS visualisation system that incorporates soil assessment, pedo-transfer functions and digital terrain models to visualise below ground forest conditions and remotely-sensed multi-spectral, hyper-spectral, and LIDAR imagery to inventory and sense the above-ground forest condition. *Delivery Targets: 2006, 2009, 2011*	
Milestone 1.1.1	A methodology for integrating large format aerial photography with airborne LIDAR scanner data to allow high-precision (tree level) data fusion and production of canopy level orthography	*Achievement date:* 2006
Milestone 1.1.2	Tested and calibrated down-bore-hole EM-dielectric sensor and EM-resistivity instruments for rapid assessment of forest soil conditions for soil water and fertility constraints on forest production.	*Achievement date:* 2009
Milestone 1.1.3	Development of 3D GIS capacity suitable for forest soil volume visualisation, and incorporation of multi-source data including procedures for combining pedo-transfer functions, terrain analysis and field measurements.	*Achievement date:* 2011
SP Outcome 1.2 From RP 1	**Location and management of plantations with reduced risk of disease, insect attack and drought death risk and management strategies that sustain production through multiple rotation cycles while minimising costs of management intervention.**	
Output 1. 2	Management systems for predicting impacts, consequences and best-bet intervention strategies to minimize the risks of growing plantations, maximizing production through the management cycle and predicting the spatial distribution of hazards. *Delivery Targets: 2009, 2011*	
Milestone 1.2.1	Incorporation of coppice, and multi-rotation nutrient and water balance models into existing process-based plantation productivity models.	*Achievement date:* 2009
Milestone 1.2.2	Description of the epidemiology, physiological impact and factors associated with the occurrence of key plantation pests (fungal and insect) and incorporation into risk hazard maps and models predictive of rotation length impact.	*Achievement date:* 2011
SP Outcome 1.3 From RP 1	**Production of more uniform wood products from plantations, with reduced risk and increased profitability, from application of a decision support system that integrates the effects of genetic stock, site variability and plantation management history, to predict the size class distribution (stem sizes, clear log length) and survival of trees.**	

Output 1.3	Software for integrating effects of genetic stock and site variability, plantation history and plantation management to predict the size class distribution (stem sizes, clear log length) and survival of trees. *Delivery Targets: 2007, 2009*	
Milestone 1.3.1	Application of cellular-automata model to predict development of social hierarchies in forest stands.	*Achievement date:* 2007
Milestone 1.3.2	Incorporation of improved sub-models of understorey and weed water use into catchment hydrological models and application to predict impacts of management practices.	*Achievement date:* 2009
Milestone 1.3.3	Assessment of the roles of genetic variation, site variability due to edaphic conditions and the role of plantation history and management in generating size class distributions and patterns of mortality in forest stands.	*Achievement date:* 2009

SP Outcome 2.1 From RP 2	**Methodology for efficient selection and breeding for high value wood traits adopted and applied by managers of Australia's Eucalypt breeding programmes, positioning for supply of improved stock for plantation establishment.**	
Output 2.1	Solid-wood breeding objective and assessment techniques available to industry through co-operatives and service providers. *Delivery Targets: 2007, 2008, 2010, 2011*	
Milestone 2.1.1	Protocols for prediction of solid-wood log value from non-destructive sampling methods on standing trees developed for *E. globulus*, *E. nitens* and *E. pilularis*.	*Achievement date:* 2007
Milestone 2.1.2	Breeding objective developed for solid-wood production from *E. nitens* (2008) and *E. globulus* (2009), incorporating genetic information on relevant selection and objective trait, and economic weights derived from industry study.	*Achievement date:* 2008-09
Milestone 2.1.3	Quantification of effects of functional allelic variants of major genes influencing pulpwood and solid wood quality in *E. globulus* and *E nitens* (2008), and *E. pilularis* (2010).	*Achievement date:* 2008-10
Milestone 2.1.4	Methodology developed for integrating molecular genetic information on key wood traits into breeding value prediction for *E. globulus* and *E. pilularis*.	*Achievement date:* 2011
SP Outcome 2.2 From RP 2	**Adoption of improved silvicultural prescriptions by eucalypt growers targeting solid and engineered wood markets**.	

Output 2.2	Prescriptions for silvicultural treatments that will optimise value of product mix from eucalypt plantations. *Delivery Targets: 2009, 2011*	
Milestone 2.2.1	Degree of silvicultural control of economically important wood quality characteristics evaluated for *E. globulus* (2009), *E. nitens* (2010) and *E. pilularis* (2011).	*Achievement date:* 2009-11
Milestone 2.2.2	Silvicultural regime determined to minimise fungal decay in *E. nitens*.	*Achievement date:* 2011
SP Outcome 2.3 From RP 2	**Forest managers incorporate expectations of value-characterised wood quality into stand and estate level management practice.**	
Output 2.3	Systems for the assessment and prediction of solid wood quality and incorporation into company GIS. *Delivery Targets: 2009, 2011, 2012*	
Milestone 2.3.1	Cost-effective sampling protocols developed for estimating stand value based on returns from solid-wood, engineered-wood and pulpwood products for *E. nitens* (2009), *E. globulus* (2010) and *E. pilularis* (2011).	*Achievement date:* 2009-11
Milestone 2.3.2	Algorithms for wood quality prediction incorporating site, germplasm and silvicultural information developed and tested for *E. nitens* (2010), E. globulus (2011) and *E. pilularis* (2012).	*Achievement date:* 2010-2012

SP Outcome 3.1 From RP 3	**Ready availability to management of detailed and timely system performance data through automated digital data capture, transmission and centralised storage.**	
Output 3.1	Systems for automatic performance monitoring including generic data capture technologies, field communication network components and software and data storage systems for use by harvesting contractors. *Delivery Targets: 2005, 2007*	
Milestone 3.1.1	Review and choice of technology for in-forest data capture and communication networks.	*Achievement date:* 2005
Milestone 3.1.2	Proof of concept implementation and performance analysis at pilot scale	*Achievement date:* 2007
SP Outcome 3.2 From RP 3	**Reduced operational costs and improved supply capability via significant enhancement to planning and control systems for harvesting and transportation, from improvement in ability to predict and monitor system performance.**	

Output 3.2	Company and regional wood-flow systems supported by new operational planning and control procedures and software tools. *Delivery Targets: 2007, 2008, 2010*	
Milestone 3.2.1	Analytical procedures for locally adapted performance monitoring and prediction.	*Achievement date:* 2007
Milestone 3.2.2	Wood-flow system simulation techniques suited to user application, experiment and optimisation.	*Achievement date:* 2008
Milestone 3.2.3	New systems optimisation techniques to jointly optimise forestry operation planning and control functions maximising use of new data capture and reporting networks.	*Achievement date:* 2010
SP Outcome 3.3 From RP 3	**Reduced cost and improved efficiency through improved utilisation and productivity of harvesting and transportation equipment.**	
Output 3.3	Performance control systems used to monitor and support continuous improvement in day-to-day harvesting and transport equipment and crew operations. *Delivery Targets: 2007, 2008*	
Milestone 3.3.1	A management accounting based approach to automated performance monitoring and tracking for individual work crews.	*Achievement date:* 2007
Milestone 3.3.2	Benchmarking procedures applicable to comparison of forestry operations crews across and within regions.	*Achievement date:* 2008
SP Outcome 3.4 from RP 3	**Reduced cost and improved flexibility in wood supply through improved allocation of roles and functions between organisations along supply chain**.	
Output 3.4	Case studies and design recommendations to support evolution of supply chain organisation and task redesign to effectively capture capabilities of new information based monitoring and control technologies. *Delivery Targets: 2008, 2009*	
Milestone 3.4.1	Case study and reports on wood supply chain organisation.	*Achievement date:* 2008
Milestone 3.4.2	Methods for supply chain analysis and knowledge to guide evolution in design.	*Achievement date:* 2009

SP Outcome 4.1 From RP 4	**Implementation of strategies for management and establishment of forests and tree crops that maintain productivity with optimal water outcomes.**	
Output 4.1	Knowledge of the net benefits/costs of planting and managing trees on the quantity and quality of water in production forestry landscapes. *Delivery Targets: 2007, 2009, 2011*	
Milestone 4.1.1	Review long-term hydrological data for selected experimental forest catchments.	*Achievement date:* 2007
Milestone 4.1.2	Integration of catchment hydrological models with tree- and stand-level productivity and water use models.	*Achievement date:* 2009
Milestone 4.1.3	Report on the impacts of forestry practices (harvesting, replanting/regeneration) in high and medium to low rainfall areas on water quality and quantity.	*Achievement date:* 2011
SP Outcome 4.2 From RP 4	**Sustained or enhanced biodiversity values of forest production landscapes through improved capacity to predict and monitor biodiversity responses against baseline criteria and enhanced capacity to fulfil biodiversity planning, legislative and certification requirements. 'Smarter' and sustainable management of forest pests, weeds and pathogens with reduced negative economic and/or environmental impacts while maintaining productivity.**	
Output 4.2	Strategies and indicators for monitoring and managing biodiversity in production landscapes including: genetic and biological indicators for monitoring sustainability criteria; strategies to maintain the long-term biodiversity values of production landscapes and manage the biotic interchange between plantations and adjacent native communities; and sustainable strategies for managing populations of pests, weeds and pathogens of tree crops which reduce reliance on chemicals. *Delivery Targets: 2007, 2008, 2009, 2010, 2011*	
Milestone 4.2.1	Review of biodiversity values of silvicultural regimes in native forest and forest components such as course woody debris.	*Achievement date:* 2007
Milestone 4.2.2	Molecular and species (including soil microbes and fungi) based diagnostics and strategies for biodiversity monitoring and management.	*Achievement date:* 2008
Milestone 4.2.3	Strategies for assessing and managing the risk of gene flow between plantations and native eucalypt populations in temperate Australia.	*Achievement date:* 2009
Milestone 4.2.4	Strategies for the management of keystone and listed threatened taxa in production landscapes. Including improved seed zone classifications of key commercial eucalypt species.	*Achievement date:* 2010
Milestone 4.2.5	Synthesise knowledge of impacts of operations in native forests and plantations on biodiversity values.	*Achievement date:* 2010

Milestone 4.2.6	Development of sustainable strategies for managing key pests, weeds and pathogens, including more socially acceptable means of controlling of vertebrate browsing.	*Achievement date:* 2010
Milestone 4.2.7	Review of the biodiversity values of plantations and the effectiveness of retained biodiversity habitat, reserves and corridors.	*Achievement date:* 2011
SP Outcome 4.3 From RP 4	**Increased community and landholder support and greater community benefits from plantation forestry, with wood production managed with less conflict and in ways acceptable to the wider public.**	
Output 4.3	Understanding of the costs and benefits for regional communities from the plantation forest industry and elucidation of community attitudes related to plantation forestry and the regional context in which it operates. *Delivery Targets: 2006, 2007, 2008, 2010, 2011*	
Milestone 4.3.1	Preliminary socio-economic profile of the costs and benefits of plantation forestry in 3 regions.	*Achievement date:* 2006
Milestone 4.3.2	Full socio-economic profile of the costs and benefits of plantation forestry in 3 regions.	*Achievement date:* 2007
Milestone 4.3.3	Analysis and explanation of community attitudes and values in 3 regions.	*Achievement date:* 2008
Milestone 4.3.4	Strategies evaluated and refined with industry members.	*Achievement date:* 2010
Milestone 4.3.5	Analysis of change in community attitudes and values in 3 regions.	*Achievement date:* 2011

SP Outcome 4.4 From RP 4	**Improved capacity to plan wood production systems which integrate industry operations and forest productivity needs with environmental and community requirements.**	
Output 4.4	Negotiation support systems to guide landscape planning and evaluation of trade-offs between production, water, biodiversity, visual amenity and other community requirements. *Delivery Targets: 2006, 2007, 2008, 2009*	
Milestone 4.4.1	Framework to enable GIS-data and participatory spatio-temporal models for evaluation of estate design scenarios and assist participatory planning**.**	*Achievement date:* 2006
Milestone 4.4.2	Custom modules to simulate temporal changes in the landscape surrounding target estate areas.	*Achievement date:* 2007

Milestone 4.4.3	Spatio-temporal modules to simulate dynamics of forested landscapes.	*Achievement date:* 2008
Milestone 4.4.4	Proven algorithms for spatio-temporal optimisation of land use.	*Achievement date:* 2009

Selection criterion 4. The funding sought will generate a return and represents good value for the taxpayer.

4.1 CRC Resources

There have been minor changes to the bid group since the Preliminary Business Case was submitted. Supporting members, the Australian Forest Contractors Association and Treecorp Pty Ltd, have withdrawn from the group. One participant, Great Southern Plantations has signed the application on behalf of a consortium, or 'multi-core' participant, which includes Hansol Plantations International and Albany Forest Research Centre, with an increased contribution. Additional participants are the Department of Economic Development Tasmania, Hancock Victorian Plantations Pty Limited, and South East Fibre Exports Pty Ltd. Overall the total cash and in kind contributions have increased to $56.8m.

The CRC involves 14 members whose core business is the management of half of Australia's industrial forest estate. Four members are headquartered in Tasmania, three in Victoria, five in WA and two in NSW. The collaboration is structured to involve industry members directly in the CRC research programme and in pilot adoption projects. They will be positioned to make direct use of innovation, giving strong prospects for significant market penetration. Australian growers not in the CRC represent a commercial market that will be used to assess possible international business opportunities.

Participants will contribute an average of $1.5m pa cash and $6.6m pa in-kind over the 7-year term of the CRC. Some of the cash is tied on the basis that the research programmes set out in this document will be carried out via the agencies described. The Board will still have broad discretion over the use of CRC resources to achieve the outputs and outcomes intended.

As well as the cash, the in-kind contribution from both research providers and industry will be critical to the success of the CRC. The in-kind includes not only researchers' and managers' time, but also access to unique long-term experimental sites with up to 20 years of accumulated data. It also includes access to high-cost services such as harvesting machine and sawmill time, which will be essential to the conduct of significant parts of the R&D programme.

Including an average of $3.8m pa from the CRC Programme, the cash budget will average $5.7m pa out of a total budget of $12.3m pa. This is a total of more than $80m over seven years or $64m in present value terms. This will fund the research programmes as well as the CRC's education, utilisation and commercialisation, and administration activities.

The work programme will be carried out by 72 FTE staff, 29 cash-funded (15 FTE researcher, and 14 FTE technical and administrative staff). Participants will provide the remaining 43 FTE in-kind staff. The relatively high level of in-kind staff support is a reflection of forest industry structure. Several members with forest management functions (FPC, FT, SFNSW, DSE) also have substantial in-house research capability and their in-kind staff will make a very significant contribution to the R&D effort. Unlike the Universities and CSIRO, these organisations will take significant value as users of CRC IP, and therefore require lower levels of cash support – to the overall benefit of the CRC.

It is anticipated that the CRC will generate revenue, other than that shown in the application, from the contributions of new members, the provision of consultancy and contract services to members, especially Associate members, and from the commercialisation of Centre IP. The Board will be able to use these funds to further the objectives of the CRC.

4.2 Return on Investment

The Centre for International Economics (CIE), in its report *Economic Evaluation of R&D Portfolio* commissioned by CRCSPF in May 2002, estimated benefit cost ratios of between 5 and 137 for six selected projects of the CRCSPF, through take-up of research outputs by members and the wider industry. CIE concluded: 'The returns from the projects selected for detailed cost benefit analysis far exceed the CRC's expenditure over its seven year term. Using these projects as a guide …it is clear the Australian economy is achieving a very high rate of return on funds spent by the CRC.' A more commercially oriented CRCSFL will aim to realise even stronger returns, within a shorter time.

The proposed work programme of the CRCSFL was subjected to an economic evaluation in June 2004

by the Economic and Environmental Analysts, BDA Group.

Their report concluded that:

'The proposed CRC targets four key industry outcomes that have an economic dimension.

1. Increase of area suitable for investment in forest plantations, and on-going access to native production forests.
2. Lower cost of forest production operations.
3. Increased forest output value from genetic improvement of plantation grown eucalypts.
4. Lower cost of harvesting and logistics.'

'Total benefits were estimated at $827m in present value terms and were measured in terms of increased profitability of commercial forestry operations. The net present value was calculated at $763m with a benefit cost ratio of 13 and internal rate of return of 55%. This is a solid return on investment for CRC members, commercial forestry operations and the Australian economy more broadly.'

Based on the benefit cost ratio of 13, the requested taxpayer investment of $26.6 over the seven years would yield $346m, or $247m in present value terms.

1.3 Allocation of CRC Resources

The research programme is the outcome of an extensive consultation process begun in July 2003, and driven by an Interim Steering Committee of industry representatives. The Steering Committee identified issues where innovative science was likely to contribute to improved business performance, and an advisory group of scientists was involved from an early stage in articulating research options. Industry participants and research providers were not formally engaged in discussion of the programme until the framework had been determined by the Steering Committee. All the major Universities providing forestry-related education, plus the CSIRO, were then able to identify value in aspects of the framework, and confirmed an interest in participating as core research providers, thus securing the research capability necessary to implement the programme. The need for capacity building in order to meet an important industry for harvesting and operations R&D was identified at this time.

Potential Programme Leaders were identified and invited to consult with scientists and users in preparing more detailed research objectives and specification of outputs and milestones.

The research proposal was circulated to all industry core members and funding agencies (FWPRDC and FFIC) with a questionnaire inviting comment on relative interest to the sub-programme level. Members are geographically dispersed, and differ in degree of business maturity and in production objectives. Therefore, it was inevitable that priorities would vary. However, the success of the planning process was indicated by the fact that all sub-programmes were rated of High interest by at least two of the core industry respondents.

Initially, estimates were made of the participant cash and in-kind contributions plus a cash contribution from the CRC Programme that might realistically be available for the proposed work. This provided a budget framework for the development of the work programme. The costs of running the CRCSFL company, including commercialisation and administration, were determined. The balance of resources were then allocated across the research programmes taking into account the results of the industry survey; the geographic location of research providers and ability to efficiently conduct field-based research using the land and resources offered in-kind by industry members; and the needs of research providers in meeting funding expectations from participation in the CRC.

The principles for the allocation of resources were established by the bid steering committee as follows:

- 70-75% of total resources will be allocated directly to the four research programmes based the requirements of each project.
- 25-30% of resources will go to the support activities – split between Education, Utilisation and Commercialisation; and Administration on the basis of budgeted costs.
- Allowance will be made for the three stages of development: start-up, full-flow and ramp-down.
- Funds will be transferred to research providers under project agreements to enable the research to be carried out in those organisations. The disbursement of these funds will be closely monitored and audited to ensure compliance with the project agreements.

References

2020 Plantations 1997, Plantations for Australia - The 2020 Vision.

Centre for International Economics (CIE) 2002, CRC for Sustainable Production Forestry: Economic evaluation of R&D portfolio.

Juniper, P. 2003, Plantation Timber Association of Australia, Future Forests and Timber Conference 2003.

Meynink, R. 2003, International hardwood fibre markets, ABARE Outlook 2003 Conference.

ABARE 2004a, Australian Forest and Wood Products Statistics, September and December Quarters 2003.

ABARE 2004b, Australian Forests at a Glance 2004.

BDA Group 2004, Economic Evaluation of the Proposed CRC for Sustainable Forest Landscapes.

List (in the table below) the items that comprise the non-staff in-kind contributions to be made by each participant, the total value of which is shown in the online Participant Contribution Details screen. Include only major items such as imputed rent of buildings occupied by the CRC, major items of equipment specifically for the CRC's use, etc. Do not include general overheads for staff provided as in-kind contributions. Indicate the programme(s) in which each item will be used by placing an **X** in the column under the appropriate programme(s) (in the table below). Research Programme numbers must correspond with those in the online tables. Add additional numbered columns (eg, R5) as necessary.

Participant	Item	R1	R2	R3	R4	Edu	Com	Admin
CSIRO FFP	Specialised scientific equipment and laboratories.	X	X		X			
Department of Economic Development Tasmania	Commercialisation Ready, Tasmanian Innovations Program etc. Online commercialisation tools for individual commercialisation projects.						X	
Forest Enterprises Australia	Access to sawmill and plant at Bell Bay.	X						
Forest Products Commission WA	Provision of equipment and access to subcatchment sites.				X			
Forestry Tasmania	Operational support, office and laboratory use.	X	X	X	X			
Gunns Limited	Imputed rental value of land for trials.	X	X	X	X			
Hancock Victorian Plantations	Equipment maintenance, crop assessment and harvesting; and site access.				X			

Participant	Item	R1	R2	R3	R4	Edu	Com	Admin
Macquarie University	Access to Fauna park and use of Biological Sciences laboratories.	X						
Norske Skog	Imputed rental value of trial sites.	X	X	X	X			
Southern Cross University	DNA Bank Robotics and Genetics and PhytoChemistry laboratories.	X	X	X	X			
Southern Tree Breeding Association	Germplasm, field operations, support facilities.		X					
State Forests of New South Wales	Access to Estate, GIS facilities and Biological laboratory.	X						
The University of Tasmania	Central Science laboratory facilities and laboratory and office space in genetics and molecular biology.	X	X	X	X			
Timbercorp	Value of land for field trials.	X	X	X	X			
Treecorp	Sawlogs.		X					
WAPRES	Access to land for trials, operational trial maintenance and office support.	X	X	X	X			