# Comparing the value of alternative uses of native forests in Southern NSW

Frontier Economics and Prof. Andrew Macintosh, ANU | 30 November 2021

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# Contents

## Tables



## Figures

## Boxes

# Executive Summary

## Study context and purpose

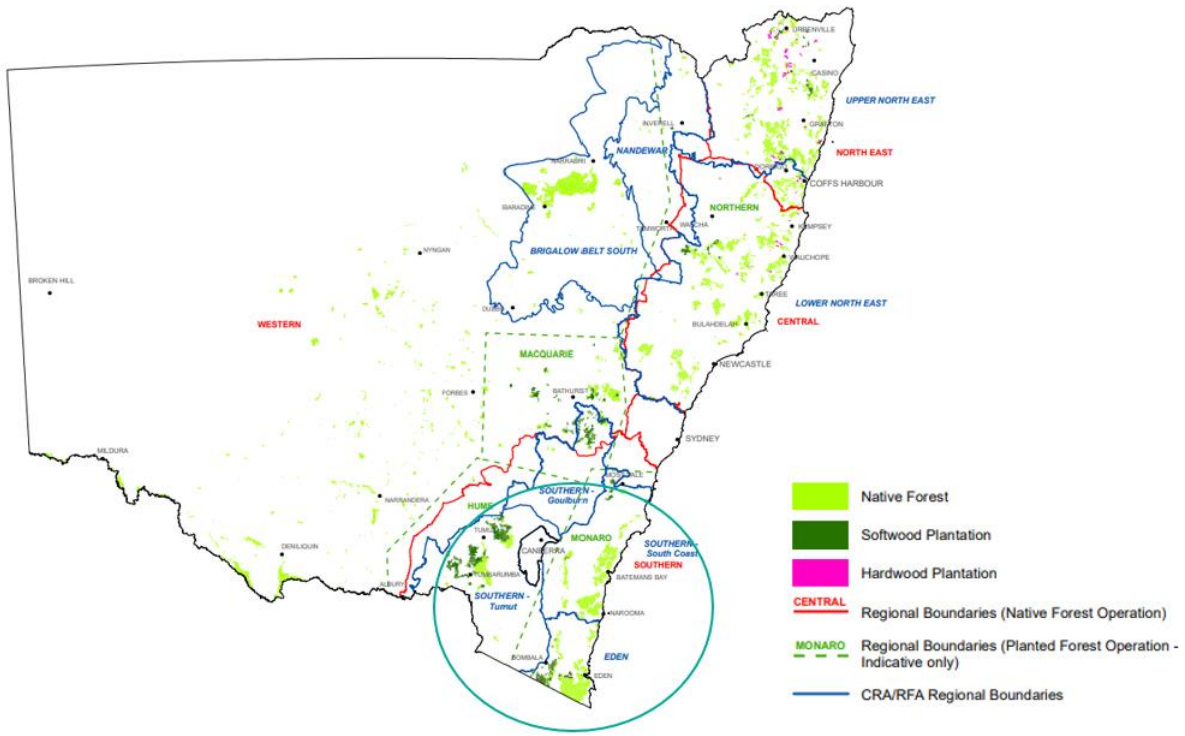
The state-owned native hardwood forests in the southern part of New South Wales (NSW) are harvested and used to produce wood chips and appearance and structural timbers. These forests were significantly impacted by the 2019-20 bushfires including impacts to over 80% of the native hardwood forest in the South Coast and Eden areas.

In this context, Frontier Economics and Professor Andrew Macintosh of the Australian National University have undertaken economic analysis to test whether the economic value of the native hardwood forest is higher when it is harvested and used to make processed timber products or when it is left in its natural state to provide environmental and recreational services, including carbon abatement.

## Study area is the southern NSW native forests

This economic analysis of alternative uses of native hardwood forests focuses on the Southern and Eden Regional Forest Agreement (RFA) areas shown within the circled area in the figure below. These areas contain a significant proportion of the native hardwood forests managed by the Forestry Corporation of NSW (FCNSW), accounting for just over 40% of the net harvestable area across NSW.

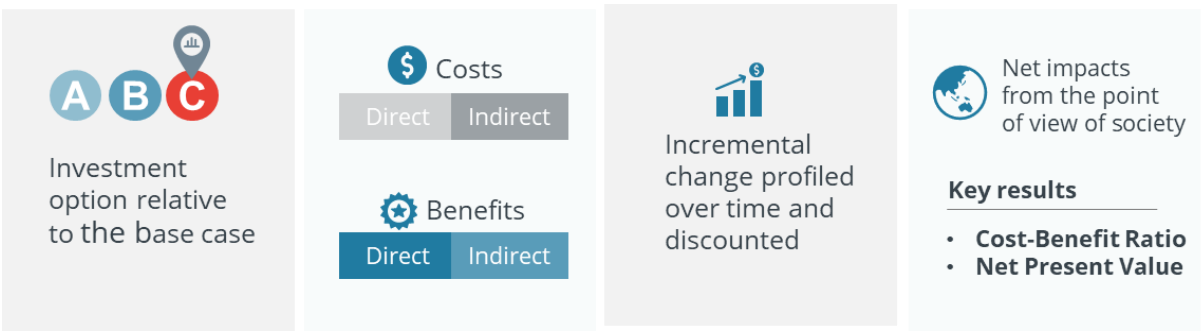
### State Forest and Regional Forest Agreement boundaries



## Cost-benefit analysis is used to compare the value of different native forest uses

A cost-benefit analysis provides a rigorous approach to assess the economic merit of different courses of action and associated investment by comparing the costs and benefits of alternative options over time. The figure below shows the cost-benefit analysis process and outcomes.

### Cost-benefit analysis overview




The cost-benefit analysis compares:

- The status quo, which in this case is for FCNSW to continue harvesting the native forest estate in the Southern and Eden RFA regions
- No logging, which involves ceasing harvesting and capturing the values associated with the standing forest.

The analysis identifies and values the additional costs and benefits of the no logging scenario over and above the status quo. This analysis is undertaken from the point of view of the welfare of society and includes economic, environmental and social impacts. Detailed carbon modelling was undertaken to provide inputs to the cost-benefit analysis.

The key output measures produced by the cost-benefit analysis are:

- The net benefit: the net present value of total benefits *minus* the net present value of total costs. If this is a positive value then the benefits outweigh the costs.
- The cost-benefit ratio: the present value of total benefits *divided by* the present value of total costs. If this value is greater than one then the proposed alternative is beneficial.

#### Total economic impacts are not measured

Every sector of the economy has broader linkages to other sectors of the domestic economy and potentially to international economies. For example, the state-owned native forestry sector has broader economic linkages to downstream sectors that consume wood products that it produces, such as the paper making and construction sectors.

It would involve extensive economic impact analysis to identify and measure these broader economic impacts under the two scenarios. This is outside of the scope of this study. However, the employment impacts in the Southern and Eden RFA regions under the two scenarios is explicitly examined given the importance of this impact for local communities.

## There is economic benefit from ceasing native forest harvesting

The cost-benefit analysis found there is economic benefit from ceasing native forest harvesting in the Southern and Eden forest regions of NSW. The economic analysis measures the stream of costs and benefits over a 30 year period to 2051. The figure below shows incremental costs that are incurred and the incremental benefits that are gained when the state-owned native forests in the Southern and Eden RFA are no longer harvested.

### What changes when harvesting ceases?

**Costs**

- Foregone wood product revenue
- Cost of constructing and maintaining mountain bike recreation area

**Benefits**

- Avoided costs of harvesting logs, and processing wood products
- Value of carbon credit
- Benefits from mountain bike recreation area

### There is a net economic benefit

| | |
|---|---|
| **Benefit ($m NPV)** | **$61.96** |
| **Benefit Cost Ratio** | **1.05** |

The cost-benefit analysis compares the incremental changes that are incurred when the state-owned native forest is no longer harvested. This includes:

- The incremental cost of the foregone revenue that would have been earned from the processed wood product and the cost of establishing new uses for the forest areas, which in our study is the cost of establishing a mountain bike recreation area. It is assumed that the cost of managing the forest is the same under the status quo and when native forest harvesting ceases, although the management purpose differs.
- The incremental benefits are the costs of harvesting and hauling the logs and producing processed wood products that are no longer incurred, the value of carbon credits earned and the economic benefit of the mountain bike recreation area.

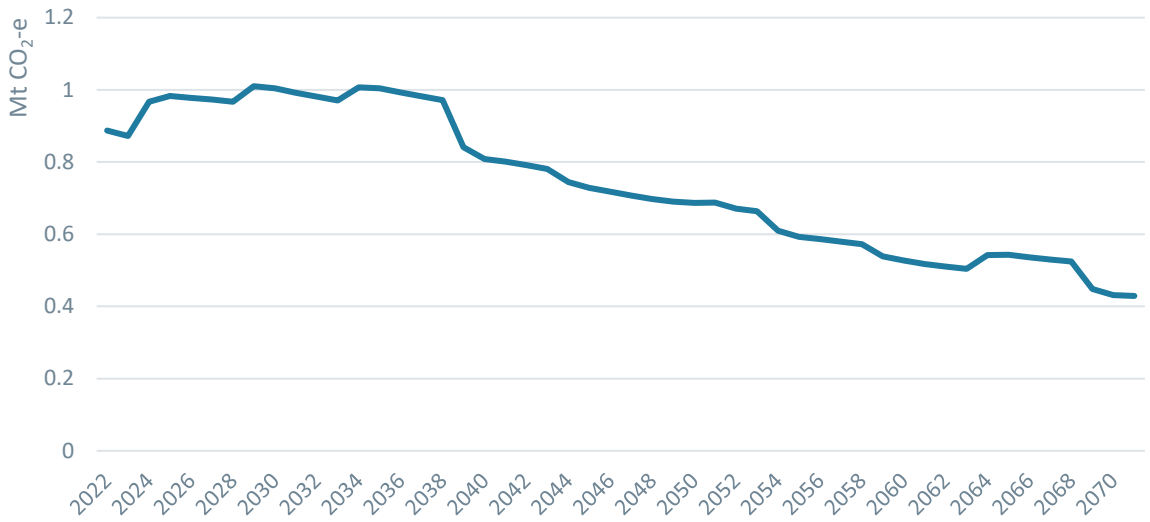
As shown above, when compared in today's dollars, the incremental benefits of ceasing native forest harvesting are higher than the incremental costs by $61.96 million. This means that there is an economic benefit from stopping harvesting the state-owned native forest in the Southern and Eden RFA areas and obtaining the higher value environmental and recreational benefits from the forest.

Sensitivity testing was undertaken to test whether this finding holds if changes are made to key assumptions. The sensitivity analysis assessed: 10% higher and lower assumed values of processed wood products, a higher carbon price (as a conservative price has been used) and changes to the assumed discount rate. The finding of net benefits when native forest logging ceases held under all scenarios except where there is a 10% increase in the value of wood products. Given that the supply of native logs has been shifting to smaller logs that produce lower value wood products, this scenario is considered unlikely.

### Main benefit is carbon abatement, which will contribute to addressing climate change

The carbon modelling found that stopping native forest harvesting in the Eden and Southern RFA regions is likely to generate significant abatement. Under the no logging scenario, net emissions (carbon dioxide equivalents ($CO_2$-e)) are projected to be 0.95 million tonnes $CO_2$-e less per year than they would be under the base case over the period 2022-2041, falling to 0.72 $MtCO_2$-e $yr^{-1}$ in the final 10 years of the appraisal period (to 2051). This is shown in the figure below.

**Greenhouse gas abatement from stopping native forest harvesting, Mt $CO_2$-e per year**

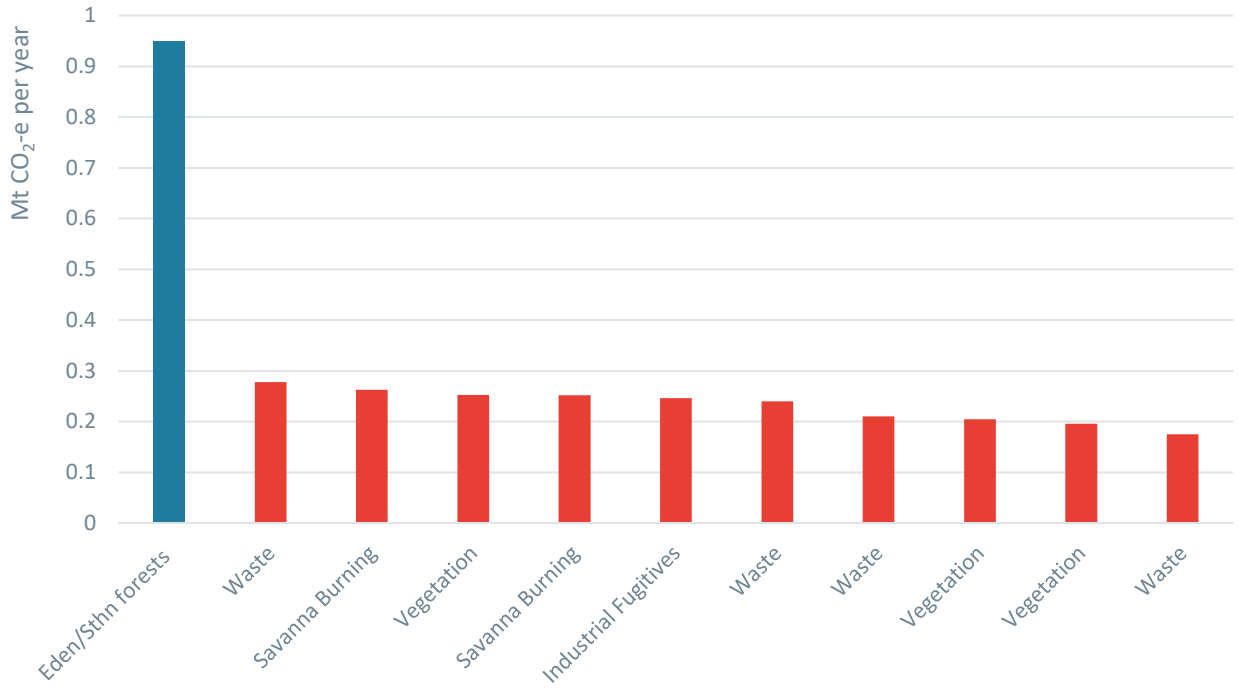



*Source: Analysis by Professor Andrew Macintosh, ANU.*

Compared to NSW's total greenhouse gas emissions (137 $MtCO_2$-e in 2019), the abatement associated with stopping native forest harvesting is relatively modest. However, there are unlikely to be many larger single, low-cost abatement opportunities in NSW or across Australia, particularly in the land sector.

To demonstrate this, the figure below compares the average annual projected abatement generated by the cessation of native forest harvesting in the Eden and Southern RFA regions over the period 2022-2041 to the average annual abatement generated by the ten largest offset projects in the Australian Government's Emissions Reduction Fund (ERF). The no logging scenario would generate 3.4 times more abatement per year over this period than the largest existing ERF project, demonstrating its potentially significant role in emissions abatement.

**Average annual projected abatement from no logging scenario (2022-2041) vs average annual abatement from 10 largest Emissions Reduction Fund (ERF) projects**



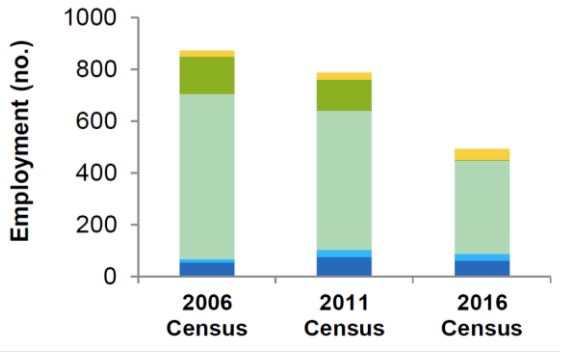

*Source: Author analysis and Clean Energy Regulator (2021) 'Emissions Reduction Fund project register'. Available at: http://www.cleanenergyregulator.gov.au/ERF/project-and-contracts-registers/project-register (30 September 2021).*

## Employment impacts

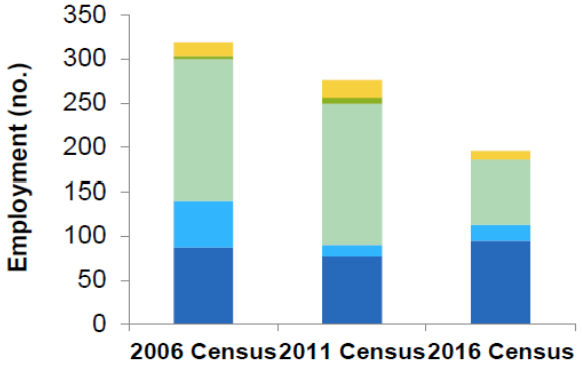
### The native forest sector is a small employer in the Southern and Eden RFA regions

Employment that is directly associated with the native forest harvesting includes the FCNSW employees that manage the native forest and harvesting operations, the harvest and haulage contractors and the wood processors. As shown below, direct employment in the Southern and Eden RFA area associated with these activities has declined significantly over the period from 2006 to 2016, with declines of 27% and 39%, respectively. This reflects the contraction of the industry that has occurred with changes to wood supply and to the economics of and competition in downstream markets.

**Southern RFA region: 27% reduction from 2006 to 2016**




**Eden RFA region: 39% reduction from 2006 to 2016**





*Source: NSW Department of Primary Industries 2018, NSW Regional Forest Agreements – Assessment of matters pertaining to renewal of NSW Regional Forest Agreements, August p. 300.*

### Employment has fallen further

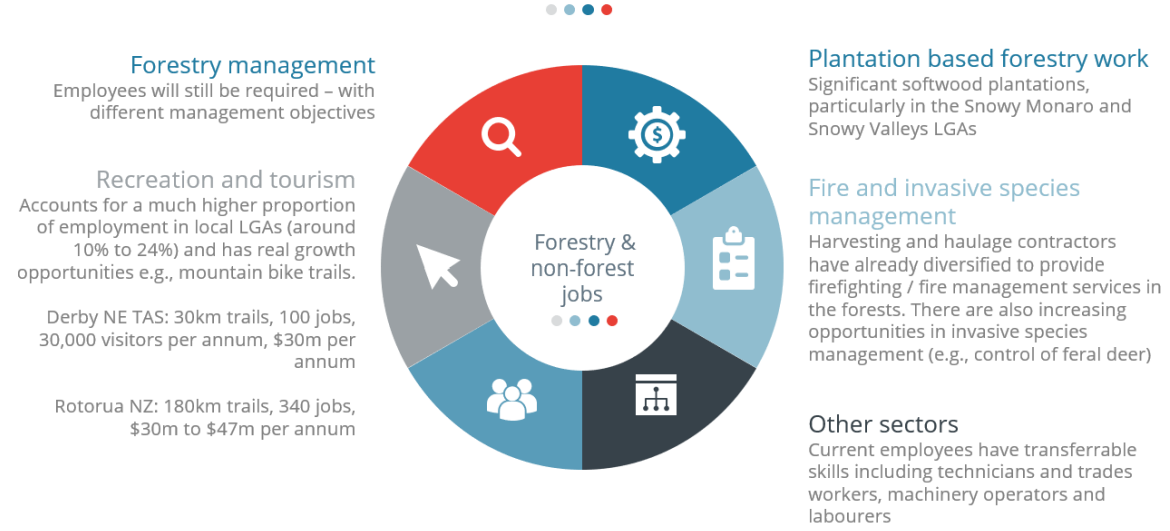
Employment data for the Local Government Areas (LGAs) which best map to the study area shows by 2019-20, the proportion of forestry employees ranges between only 0.1% and 1.6% of the total workforce. The estimates of direct employment we have seen which best aligns with publicly available information is that the study area has around 110-120 harvest and haulage jobs and 180-200 processing jobs. However, it is understood that the level of employment varies over time e.g. in line with harvesting activity.

In addition, a significant wood processing mill in Eden that had 51 employees (Blue Ridge Hardwoods) is currently closing due to the loss of wood supply contracts. This loss of jobs will be partially offset by a new mill development by ANWE in Eden to produce pallets and briquettes.

However, it is clear that the employment impact from ceasing to harvest native forests in the Southern and Eden RFA areas is likely to be very small, particularly as there are credible, alternative employment opportunities in the area for displace workers. Regardless, it would be crucial for the NSW Government to provide financial transition support to the industry and impacted workers should a decision be made to cease native forest logging. As explained within the report, this is occurring in other states including Western Australia and Victoria.

### There are credible alternative regional employment opportunities

As shown below there are alternative employment opportunities associated with forest plantations in the area, the alternative management and use of the native forests and in other sectors in the Southern and Eden RFA areas.




## Low financial returns to NSW taxpayers is also a concern

It appears that FCNSW (which is a government owned business) makes very limited financial returns on the harvesting and sale of native hardwood forests in the Southern and Eden RFA regions. Unfortunately, financial data relating to the native forest business alone, and in individual RFA regions is not published.

However, financial information is published on FCNSW's hardwood business as a whole, which includes operations across the whole of NSW and includes both native forest harvesting and hardwood plantations sales. The hardwood plantation sales account for only a small proportion of the hardwood business.

FCNSW's hardwood business made a normalised profit of $0.4 million in the financial year 2020, and an average normalised profit of $2.3 million over the five years to 2020. This is a very small profit and significantly smaller than the $64 million five year average over the same period earned by their softwood plantation business.[1] This suggests the current native forest logging is making very poor returns on the investment of taxpayers' dollars.

This poor return should be taken in context with the economic benefit from ceasing native forest harvesting and obtaining environmental and recreational services from the forest. This, along with the environmental concerns, has led other Australian states to decide to cease logging their native forests and to provide significant financial support to the industry to transition to a greater focus on planation operations and other sectors of the economy.

Greater transparency is needed in NSW about the true financial position of the native forest business to support similar informed policy-making.

[1] FCNSW, *Annual Report 2019-20*, p. 9, 11.

# 1 Purpose of this study

New South Wales' native hardwood forests are an important natural resource, providing a range of economic and environmental services. At present, approximately 1.75 million hectares[2] of these forests are managed by the Forestry Corporation of New South Wales (FCNSW) for multiple purposes, including harvesting for wood products.

The native hardwood forests in southern NSW are harvested to provide pulp logs for wood chipping and to provide sawlogs for appearance and structural timbers. These forests were significantly impacted by the 2019-20 bushfires including impacts to over 80% of the native hardwood forest in the South Coast and Eden areas. Much of the forest will regenerate over time. However, these are slow growing forests and hence this will involve long recovery time frames.

In this context, Professor Andrew Macintosh of the Australian National University and Frontier Economics have prepared this study to re-examine the economics of the native hardwood forests and the way in which the services they provide are used. This study explores the question whether the economic value of the native hardwood forest is higher when:

- It is harvested and used to make processed timber products or
- It is left in its natural state to provide environmental and recreational services including carbon sequestration.

This is a contentious question that has been the subject of significant political debate over a long period in Australia and elsewhere. This study explores this question by comparing the costs and benefits to NSW associated with each option.

## The study compares direct costs and benefits

This study estimates the costs and benefits that can be gained from the native forest under two alternative scenarios:

- The status quo in terms of expected harvesting of native forest logs from the public native forest estate in the Southern and Eden Regional Forest Agreement (RFA) areas which are then processed to produce woodchips, milled timber and other wood products
- An alternative scenario where harvesting of the native forest from the public native forest estate in the Southern and Eden RFA areas has ceased, and the alternative services that become available from the forest are utilised, including carbon sequestration services (earning carbon credits) and tourism and recreation services. In the report this is referred to as the "no logging" scenario.

The study updates and builds on earlier analysis by Francis Perkins and Professor Andrew Macintosh.[3]

Every business sector has broader economic linkages across the domestic economy and potentially to international markets. For example, in the case of the state-owned native forestry sector there are economic linkages to local communities and downstream sectors that consume

[2] FCNSW, *Sustainability Report 2019-20*, p. 17.

[3] Perkins, F. and Macintosh, A. 2013, *Logging or carbon credits Comparing the financial returns from forest-based activities in NSW's Southern Forestry Region*, Australia Institute Technical Brief No. 23, June.

wood products such as the paper making and construction sectors. It would involve extensive economic impact analysis to identify and measure these broader economic impacts under the two scenarios. This is outside of the scope of this study.

### Employment impacts are explored

However, one of the most important economic impacts is the impact on employment in the regional communities that are currently involved in the state-owned native forestry industry. This includes employees of the state forestry business (FCNSW), harvest and haulage contractors and wood processing employees (e.g. at chipping plants and saw mills).

As we discuss within the report, the native forestry sector associated with the state-owned forests has become quite small in employment terms in the Southern and Eden RFA areas, and there are regional employment opportunities associated with the alternative uses of the forests.

### Report structure

The following report is structured as follows:

- Section 2 explains the geographical scope of the state-owned native forest areas that are considered in this study
- Section 3 describes the current arrangements for the harvesting and processing of the state-owned native forest
- Section 4 describes the base case and alternative (no logging) scenario modelled in the cost-benefit analysis
- Section 5 describes the results of the cost-benefit analysis, which shows that the economic value of the native forest is higher under the scenario where harvesting ceases and the alternative services from the forest can be obtained, including carbon sequestration services
- Section 6 assesses the employment impacts of the alternative native forest usage scenarios explored.

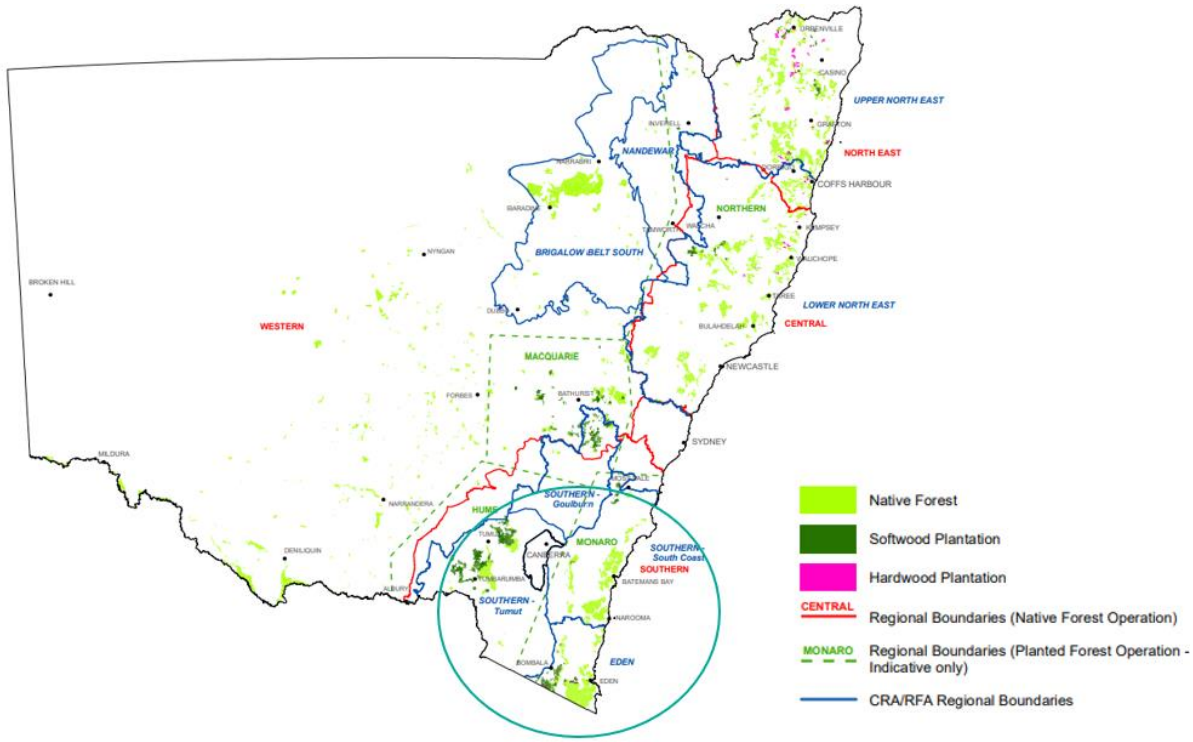
Additional information is provided in supporting appendices including:

- The historical volume of native forest logs supplied from the Southern and Eden RFA areas, by log product type (Appendix A)
- Current FCNSW estimates of long term sustainable log supply from the Southern and Eden RFA areas, estimated in December 2020 following the 2019-20 summer bushfires (Appendix B)
- The methodology used to quantify carbon emissions and removals for the two economic modelling scenarios (Appendix C)
- Additional information on the cost-benefit analysis methodology including key assumptions and data sources (Appendix D).

# 2 Native forest area that is the subject of this study

The economic analysis of alternative uses of native hardwood forests focuses on the Southern and Eden Regional Forest Agreement (RFA) areas.[4] The Southern RFA region includes two sub-regions: South Coast and Tumut. The boundaries of the Southern and Eden RFA areas are shown within the circled area in **Figure 1**. These areas contain a significant proportion of the native hardwood forests managed by FCNSW across NSW, accounting for just over 40% of the net harvestable area.

**Figure 1**: State Forest and Regional Forest Agreement boundaries




*Source: Forestry Corporation NSW, Boundary Map, https://www.forestrycorporation.com.au/operations/esfm (accessed 16 September 2021). Note: The study area for this analysis includes Southern - South Coast, Southern – Tumut and Eden. It excludes Southern – Goulburn.*

[4] There are three Regional Forest Agreements (RFAs) for NSW – North East, Southern and Eden. The agreements between the Australian Government and the NSW government control and manage the native forests in these areas and seek to balance economic uses with environmental protections.

## 2.1 Species in the native forest

The Southern RFA area covers over 265,000 hectares of native forest and around 173,000 hectares are able to be harvested.[5] The predominant native species in the Southern RFA region are spotted gum (*C. maculata*), alpine ash (*E. delegatensis*) and brown barrel (*E. fastigata*). Other hardwood species in the area include blackbutt (*E. pilularis*), bluegum (*E. saligna*), and ironbark and stringybark species groups.[6]

The Eden RFA area covers around 167,000 hectares of native forest and around 109,000 hectares are able to be harvested.[7] The predominant native species in the Eden RFA region are silvertop ash (*E. sieberi*) and brown barrel (*E. fastigata*). Other hardwood species in the area include stringybark/gum forest types.[8]

## 2.2 Impact of the 2019-20 bushfires

The native forests in the Southern and Eden RFA areas were significantly impacted by the 2019-20 bushfires. Over 80% of the forest area that is able to be harvested in the South Coast and Eden RFA areas were impacted by fire. The recovery of the forests will take longer than the northern NSW forests as the southern region forests are slower growing. As discussed further below, this is estimated to have reduced the possible long-term sustainable timber supply from the south coast forests by approximately 30%.

The Alpine Ash around Tumbarumba in the Tumut region of the Southern RFA area (shown in **Figure 1**) is reportedly still being assessed. However, FCNSW report that the fire impact was severe in this region, partly because the forests are dominated by alpine ash (*E. delegatensis*) and mountain ash (*E. regnans*), both of which are fire sensitive. In the Eden RFA area it is expected that many of the fire-affected trees will die or decline in quality over the coming 10 years. [9]

The large areas of native forest impacted by fire in the Southern and Eden RFA regions is shown in **Table 1**.

5 https://www.forestrycorporation.com.au/operations/fire-management/fire-impact-of-2019-20, accessed 16 September 2021.

6 NSW Natural Resources Commission 2020, *Coastal IFOA: Monitoring plan, Baselines and trends in wood supply*, October, p. 7.

7 https://www.forestrycorporation.com.au/operations/fire-management/fire-impact-of-2019-20, accessed 16 September 2021.

8 NSW Natural Resources Commission 2020, *Coastal IFOA: Monitoring plan, Baselines and trends in wood supply*, October, p. 7, 8.

9 https://www.forestrycorporation.com.au/sustainability/timber-volumes-and-modelling, accessed 16 September 2021.

**Table 1:** Hectares of native forest impacted by 2019-20 fire

| RFA region/sub-region | Harvestable area (hectares) | Fire affected (hectares) | Proportion impacted by fire (%) |
|---|---|---|---|
| Eden | 109,400 | 87,300 | 80% |
| South Coast sub-region | 128,800 | 109,800 | 85% |
| Tumut sub-region | 44,800 | 31,100 | 69% |

*Source: FCNSW 2020, 2019–20 Wildfires NSW Coastal Hardwood Forests Sustainable Yield Review, December , p. 6.*

### Forecasts of sustainable yield

Long term, sustainable levels of wood supply or yield from the forest areas that are able to be harvested are estimated by FCNSW. The sustainable yield is intended to show the amount and types of log products that can be harvested from the native forest each year without diminishing the volume the forests can produce into the future. The estimated sustainable yields for the Southern and Eden RFA areas to 2034, and how this has been impacted by the 2019-20 bushfires, is shown in **Table 2**.

This shows that in the period to 2034, there will be between a 13% and 30% reduction in sustainable yield of high quality logs in the study areas.

**Table 2:** Fire impact on short-term wood supply for NSW RFA regions (2020-34)

| RFA region | High quality logs ($m^3$) | Reduction due to fire impact (%) |
|---|---|---|
| Eden | 22,700 | 13% |
| South Coast | 35,000 | 30% |
| Tumut | 25,800 | 27% |

*Source: FCNSW 2020, 2019–20 Wildfires NSW Coastal Hardwood Forests Sustainable Yield Review, December, p. 3.*

Further detail on the longer term sustainable yield outlook is provided in **Appendix B.**

# 3 Harvesting and processing of the native forest

## Supply of native forest log products and use

The native hardwood trees harvested in the Southern and Eden RFA produce high quality (HQ) and low quality (LQ) log products. The classification of these log products and the processed wood products produced from them are shown in **Table 3**.

**Table 3:** Native forest log products and use

| Log product type | Processed wood product |
|---|---|
| **High quality** | |
| Poles and piles | Power poles |
| Girders | Construction beams |
| High quality sawlogs | Flooring and decking |
| **Low quality** | |
| Low quality sawlogs | Fencing pales |
| Pulpwood | Woodchips (for paper) |
| Firewood/other | Firewood |

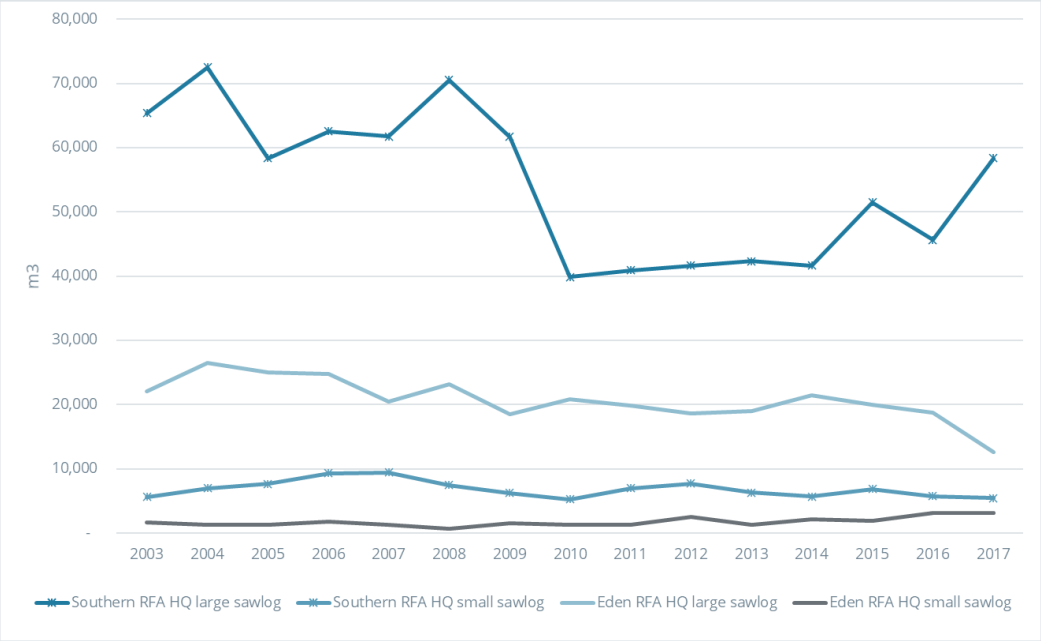
*Source: IPART 2017, Review of Forestry Corporation of NSW's native timber harvesting and haulage costs, Final Report, December, p. 14*

## Historical log volumes

Historical volumes of HQ and LQ sawlogs harvested from the Southern and Eden RFA areas over the period from FY2003 to FY2017 are shown in **Figure 2** (and additional historical data on all products is provided in **Appendix A)**.

**Figure 2** shows that sawlog volumes have fallen in the two RFA regions since 2003, particularly HQ large sawlog volumes. As is evident in recent contracts issued for log supply from the Southern and Eden RFA areas (discussed further below), the large HQ log resource has substantially reduced (although higher volumes have been provided from the Southern RFA regional from 2014).

**Figure 2**: HQ large and small sawlog volumes ($m^3$), Southern and Eden RFA regions, FY2003-2017




*Source: NSW Department of Primary Industries 2018, NSW Regional Forest Agreements – Assessment of matters pertaining to renewal of NSW Regional Forest Agreements, August p. 226-227.*

As well as supplying sawlogs, the native forest, particularly in the Eden region is largely harvested for pulpwood for woodchip and paper producers. The historical volumes of pulpwood supplied are shown in **Figure 3**. The volume has declined over this period, particularly from the Eden RFA.

**Figure 3**: Pulp log volumes (tonnes), Southern and Eden RFA regions, FY2003-2017


*Source: NSW Department of Primary Industries 2018, NSW Regional Forest Agreements – Assessment of matters pertaining to renewal of NSW Regional Forest Agreements, August p. 226-227.*

### Current long term wood supply agreements

Historically FCNSW has sold native forest logs to wood processors under long term (e.g. 20 year) Wood Supply Agreements (WSAs). There are two current WSAs with wood processors located in the Southern and Eden RFA regions. These are both with Allied Natural Wood Enterprises Pty Ltd (ANWE) including:

- A contract to 2033 supplying 290,000 $m^3$ per annum of pulplogs to its Eden woodchip mill
- A contract to 2029 providing 25,000 $m^3$ of sawlogs per annum to a new sawmill producing green sawn timber products. Under this WSA, the sawmill was to be commissioned by 31 December 2020.[10] ANWE intend to produce pallets and briquettes at this plant. The development of the mill has been delayed as the Development Application for the plant was rejected in the Land and Environment Court of NSW on 24 August 2021.[11] A new Development Application is before the Bega Valley Shire Council.

A third WSA with Braidwood Sawmill for 5,886 $m^3$ of high quality and low quality sawlogs per annum has recently expired (end of 2020). We understand that this WSA has not been renegotiated at this stage, pending the finalisation of the sustainable yield assessments after the 2019−20 bushfires.

There are also smaller local mills and processors that purchase native forest logs from the Southern and Eden regions at volumes of less than 1,000 $m^3$ per annum outside of the WSAs.[12]

A fourth WSA provides native timber from the Southern Region to Ryan & McNulty in Benalla, Victoria. This WSA provides 18,500 $m^3$ of high quality sawlogs per annum to 2030. This is the only remaining substantial contract for supply of high quality logs from the Southern region.

### Agreements are being adjusted to reflect reduction in available high quality log supply

Blue Ridge Hardwoods in Eden had a WSA for 24,000 $m^3$ of high quality sawlogs per annum which expired in 2018.[13] The native forest resource was no longer available to supply this quantity of high quality sawlogs and hence the WSA was not renewed.

FCNSW has been able to offer 25,000 $m^3$ per annum of smaller regrowth sawlogs rather than high quality sawlogs. Presumably to ensure that it obtains a fair market price for this wood, it was also offered the smaller sawlogs to the market via a competitive tender process.

Blue Ridge Hardwoods would have required new or altered equipment to process the smaller logs. They were unsuccessful in the tender process, which was won by ANWE (see above) who proposed to build a new mill suited to processing the smaller logs.[14] The Blue Ridge Hardwoods

10 IPART 2021, *Review of Forestry Corporation's native timber harvesting and haulage costs*, p.34 and the FCNSW WSAs provided at https://www.forestrycorporation.com.au/about/sales-and-supply accessed 16 September 2021. Note that the volumes supplied annually may vary within limits based on sustainable yield, but the agreed volume of wood is supplied over the life of the agreement.

11 https://begavalley.infocouncil.biz/Open/2021/09/OC_14092021_AGN_736_AT_EXTRA_WEB.htm, accessed 21 September 2021.

12 IPART 2021, *Review of Forestry Corporation's native timber harvesting and haulage costs*, p.34.

13 IPART 2017, *Review of Forestry Corporation of NSW's native timber harvesting and haulage costs, Final Report*, December, p. 17.

14 https://www.forestrycorporation.com.au/about/releases/2019/eden-wsa-statement, accessed 16 September 2021.

mill is currently closing and the government is providing financial transition support to the impacted workforce of around 50 employees.[15]

### Native forest log supply is a marginal business in financial terms for FCNSW

It appears that FCNSW (which is a government owned business) makes very limited financial returns on the harvesting and sale of native hardwood forest in the Southern and Eden RFA regions.

The limited financial information made available publicly by FCNSW makes it difficult to know this with certainty. However, the hardwood business as a whole (which includes both native forest harvesting and hardwood plantations sales) made a normalised profit of $0.4 million in the financial year 2020, and an average normalised profit of $2.3 million over the five years to 2020. This is a very small profit and significantly smaller than the $64 million five year average over the same period earned by their softwood plantation business.[16]

### Wood processing sector associated with the Southern and Eden RFA native forests

The wood processing sector that relies on the harvesting of the Southern and Eden RFA native forests, and the number of people it employs, has been shrinking over time. Over the period from 2006 to 2016, employment in the native industry in the Eden RFA region declined by 39%. Over the same period, the decline was 27% in the Southern RFA region.[17]

Current employment levels and the employment impacts associated with different usage of the native forest in the Southern and Eden RFA regions is explored in Section 6.

15 https://www.parliament.nsw.gov.au/lcdocs/other/15367/Answers%20to%20supplementary%20questions%20-%20Barilaro.pdf, accessed 16 September 2021.

16 FCNSW, *Annual Report 2019-20*, p. 9, 11.

17 NSW Department of Primary Industries 2018, *NSW Regional Forest Agreements – Assessment of matters pertaining to renewal of NSW Regional Forest Agreements*, August p. 300.

# 4 How the economic value of native forest harvesting and alternative uses is measured

## 4.1 Cost-benefit analysis

A cost-benefit analysis provides a rigorous approach to assess the economic merit of different courses of action and associated investment by comparing the costs and benefits of alternative options over time. **Figure 4** provides an overview of cost-benefit analysis process and outcomes.

**Figure 4:** Cost-benefit analysis overview


The analysis is incremental: additional costs and benefits of an alternative scenario over and above a base case scenario are identified and valued (i.e., the net benefits with the investment are compared with what would occur without the investment).

This analysis is undertaken from the point of view of the welfare of society and includes economic, environmental and social impacts.

Key outputs of the cost-benefit analysis include the cost-benefit ratio (the present value of total benefits *divided by* the present value of total costs) and net present value (the net present value of total benefits *minus* the net present value of total costs).

The cost-benefit analysis undertaken in this study is consistent with the NSW Treasury cost-benefit analysis guidelines.[18]

## 4.2 Scenarios

A cost-benefit analysis has been undertaken which compares the costs and benefits associated with the following two scenarios:

[18] NSW Treasury 2017, *Guide to Cost-Benefit Analysis*.

- **Status quo:** Under the base case or status quo, FCNSW continue harvesting the native forests in the Southern and Eden RFA regions. It is assumed this logging occurs at the sustainable yield, with roundwood removals averaging 465,000 $m^3$ per year over the 30 year appraisal period (see **Appendix D** for further details).
- **No logging:** Under the alternative or no logging scenario native forest logging in the Southern and Eden RFA regions is discontinued from the start of 2022 and the alternative services that become available from the forest are utilised, including carbon sequestration services (earning carbon credits) and tourism and recreation services.

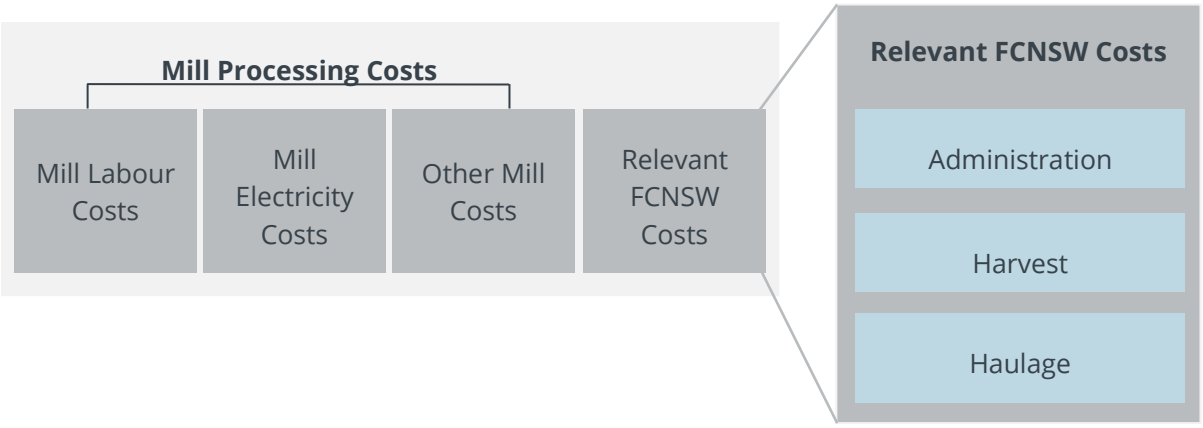
The cost-benefit analysis focuses on the impacts within NSW and does not model downstream impacts (for example the impacts of wood products beyond impacts on revenues for mills in NSW). There is also a separate employment impacts assessment which is in Section 6.

## 4.3 Incremental costs and benefits

### 4.3.1 Avoided cost of harvesting and processing of wood

The avoided cost of harvesting and processing wood will be a key saving associated with no logging scenario. These costs are shown in **Figure 5**.

**Figure 5:** Wood harvest and processing costs




The costs incurred in harvesting and hauling the logs to the mills, and associated administrative costs, are avoided when logging ceases. As such, the cost-benefit analysis considers the avoided costs relating to wood harvesting and processing include the administrative cost of contracts, the cost of harvesting the logs, and hauling it to the mill door. Once at the mill door, all labour, transportation, electricity, and other expenses are directly attributable to processing the logs. If logging ceases these processing costs are not incurred, therefore they are included as avoided costs in the cost-benefit analysis.

One of the key costs that is also avoided, but is not included in **Figure 5** is the cost of the logs sold by FCNSW to the wood processors (i.e. the stumpage cost). This is offset by the saving made by wood processors no longer required to make this payment. Hence, this transfer does not need to be reflected in the cost-benefit analysis.

### 4.3.2 Forgone revenue from wood product sales

While ceasing the logging of native forests in the Southern and Eden RFA regions will avoid the costs discussed above, all revenues from this activity will also be foregone. Mill revenues from the sale of wood products (e.g., panels, poles, round wood) are entirely foregone by ceasing logging in the region. Box 1 discusses our approach to valuing this revenue forgone under the no logging scenario.

**Box 1:** Value of processed wood products

The cost-benefit analysis has taken a conservative approach to the valuation of processed wood products. Updated historical data that reflects a mix of products produced from log resources that included a higher mix of high quality logs was used.

In reality the log quality mix has been changing in the Southern and Eden RFA areas. For example in the Eden RFA the native forest resource is transitioning out of older forest and into a regrowth dominated resource, which has significantly changed the average size and quantity of all logs produced. There are also challenges maintaining the mix of high quality logs from the Southern RFA region:

> *To meet the long term yield as modelled, high quality logs would need to be increasingly supplied from foothill and tablelands forests. Historically yields from these forests have been difficult to obtain due to issues with the terrain, accessibility of harvest areas and high proportions of low quality and residue logs. While these areas remain a potential source of high quality logs in the region, the increased costs to harvest and the reduced quality within the yield may make these areas economically unviable to harvest.*

*Source: NSW Department of Primary Industries 2018, Sustainable Yield in New South Wales Regional Forest Agreement regions, November.*

Under the no logging scenario FCNSW also loses the revenue from the cost of the logs (stumpage). This is offset by the saving made by wood processors no longer required to make this payment. Hence, this transfer does not need to be reflected in the cost-benefit analysis.

### 4.3.3 Value of carbon abatement

Logging native forests reduces the stocks of carbon stored in biomass and soils, contributing to global climate change. The extent of the climate impacts depend on the nature of the forests and the extent to which the biomass that is harvested is used for long-lived wood products like furniture and framing. Previous studies have demonstrated that stopping harvesting in the Southern and Eden RFA regions can generate significant carbon abatement, partly because of the low proportion of harvested on-site biomass that ultimately finds its way into long-lived wood products (most of it is left as slash or used for pulp and paper).[19]

[19] Macintosh, A., Keith, H., Lindenmayer, D 2015, "Rethinking forest carbon assessments to account for policy institutions" *Nature Climate Change* 5(10), 946-949; Keith, H., Lindenmayer, D., Macintosh, A., Mackey, B. 2015,

For this study, we modelled emissions and removals from four sources and sinks (onsite forest carbon, harvested wood products, landfills, and fossil emissions associated with forest management, transport, and wood processing) under the base case and no logging scenario across the Eden and Southern RFA regions. Details of the methods used in the modelling are provided in **Appendix C**. The results were consistent with previous studies, demonstrating that the no logging scenario is likely to generate significant net reductions in greenhouse gas emissions over the appraisal period.

The fact that stopping harvesting generates abatement means the NSW Government could potentially earn carbon credits under the no logging scenario. The sale of these carbon credits could result in a revenue stream for FCNSW. However for our analysis it is not necessary to assume this financial impact. Regardless of whether credits are traded, by preventing the logging of native trees there is a benefit to Australian society associated with carbon sequestration due to the role of carbon emissions in global climate change. Our analysis prices the value to society from avoided carbon emissions at $\$20/tCO_2$, based on the prevailing spot price of carbon credits issued under the Australian Government's Emissions Reduction Fund (Australian carbon credit units, or ACCUs).

There is significant academic debate regarding the marginal economic cost of an additional unit of carbon, with values ranging significantly. Transport for NSW provides guidelines on the economic parameter values used to estimate the avoided carbon benefits of initiatives across the NSW Transport cluster. This guidance provides the unit value for emission of carbon dioxide equivalent to $\$62.79/tCO_2$ (2019$).[20] The UK government sets the price of carbon within a range of \$70 - $211/tCO_2$ (2020 AUD),[21] while the US federal government set the price of carbon at $\$70/tCO_2$ (2020 AUD) in policy assessment.[22]

Therefore, while we have confidence in this market price for carbon, we recognise that this might be understating the benefits to society from carbon sequestration. We perform sensitivity analysis on this input, using the Transport for NSW carbon price.

### 4.3.4 Cost and benefit from recreational area

To estimate the potential value of recreation from preserved native forestry, we assume a single usage scenario: the development of a mountain biking trail network. We consider this to be an appropriate 'next best' opportunity foregone by logging, given the interest in mountain biking in this region, and the appropriate topography of the area. This scenario is illustrative of the potential value of opening the forest as an attractive tourist destination, with minimal costs. We assume 60km of commercially developed mountain bike trails. Based on consultation with mountain bike experts, at least 50km of trail is required to make the area attractive to visitors.

"Under What Circumstances Do Wood Products from Native Forests Benefit Climate Change Mitigation?" *PLoS ONE* 10(10): e0139640.

20 NSW Treasury 2017, *NSW Government Guide to Cost-Benefit Analysis*, TPP17-03, p.61. www.treasury.nsw.gov.au/sites/default/files/2017-03/TPP17-03%20NSW%20Government%20Guide%20to%20Cost-Benefit%20Analysis%20-%20pdf_0.pdf

21 Department of Energy and Climate Change 2009, *Carbon Valuation in UK Policy Appraisal: A Revised Approach*, https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/245334/1_20090715105804_e___carbonvaluationinukpolicyappraisal.pdf

22 https://www.scientificamerican.com/article/cost-of-carbon-pollution-pegged-at-51-a-ton/

We conjecture that planning, approval, and construction take 5 years, with ongoing maintenance costs. Visits to the region are modelled to commence 1-year after construction finishes, with visitor numbers increasing over 5-year ramp-up period.

For all visitors to the trail, we recognise the social benefit from increased health and activity. Additionally, we assume that tourists will provide additional revenue to the region.

### 4.3.5 Management of forest estate

Under the status quo significant resources are required to manage the forest estate. Resources will be required to manage the forest estate under the no logging scenario, although the management purpose differs. For the purposes of this analysis it is assumed that the cost of managing the forest is the same under the status quo and when native forest harvesting ceases.

## 4.4 Overarching modelling assumptions

The overarching model assumptions are listed in **Table 4**.

**Table 4:** Model assumption inputs

| Input | Value |
|---|---|
| Discount rate | 7% |
| Logging ceases | 1 Jan 2022 |
| Appraisal timeline | 30 years (from 1 Jan 2021) |
| End appraisal date | 1 Jan 2051 |

# 5 There is economic value in ceasing native forest harvesting

## 5.1 Results

Cost-benefit analysis compares the net present value (NPV) of incremental costs and benefits between the status quo and no logging scenarios. To calculate the NPV, the profile of costs and benefits is discounted to present value, using a 7% discount rate consistent with NSW Treasury guidance.

The key output measures produced by the cost-benefit analysis are:

- The net benefit: the net present value of total benefits *minus* the net present value of total costs. If this is a positive value then the benefits outweigh the costs
- The cost-benefit ratio: the present value of total benefits *divided by* the present value of total costs. If this value is greater than one then the proposed alternative is beneficial.

The present value of total costs and benefits are presented in **Table 5**. The profile of undiscounted benefits and costs are presented in **Figure 6** and **Figure 7**, respectively. Based on our analysis no logging makes sense from the point of view of society, as the present value of total benefits outweigh the present value of total costs.

**Table 5:** Cost-benefit analysis results

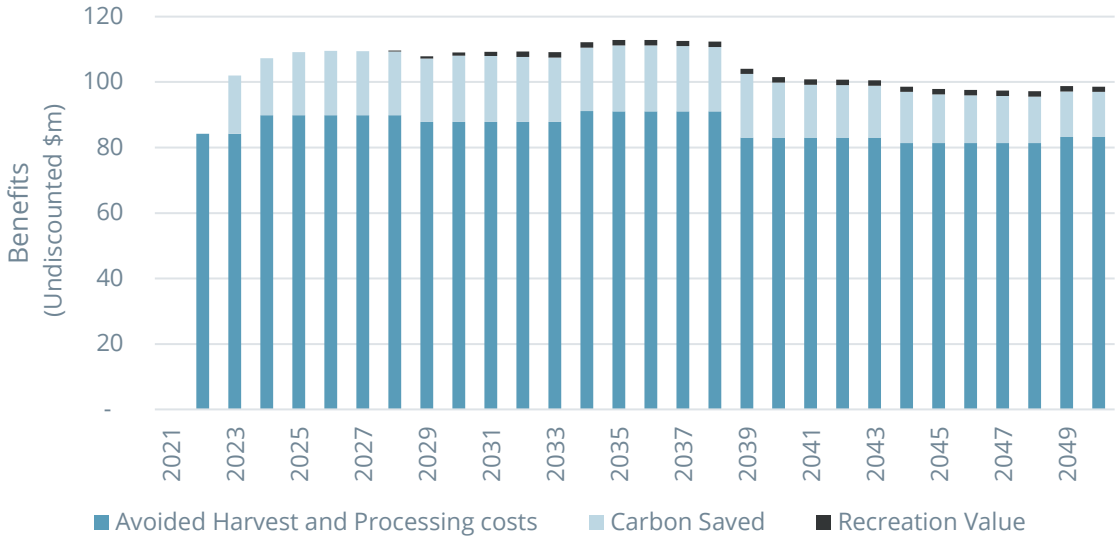
| | Results |
|---|---|
| Benefits ($m) | $1,291.95 |
| Costs ($m) | $1,229.99 |
| Net Present Value ($m) | $61.96 |
| Benefit Cost Ratio | 1.05 |

The cost-benefit analysis considers three primary benefits associated with shifting from logging, to no logging in native forest in the Southern and Eden RFA regions of NSW:

- The largest of these benefits is the avoided costs associated with harvesting, hauling, and processing the logged wood to make wood products.
- Additionally, the avoided carbon emissions associated with logging provide a significant benefit to society.
- Finally, there is value from added recreation, which cannot occur in active logging sites.

The undiscounted values of these benefits over time are presented in **Figure 6**.

**Figure 6:** Undiscounted benefits




Ceasing the harvest of wood results in foregone revenue from the sale of wood products. This presents the largest cost associated with the no logging scenario. There are also additional costs from the construction and maintenance of the recreation areas. The undiscounted cost of the program over time is presented in **Figure 7**.

**Figure 7:** Undiscounted costs

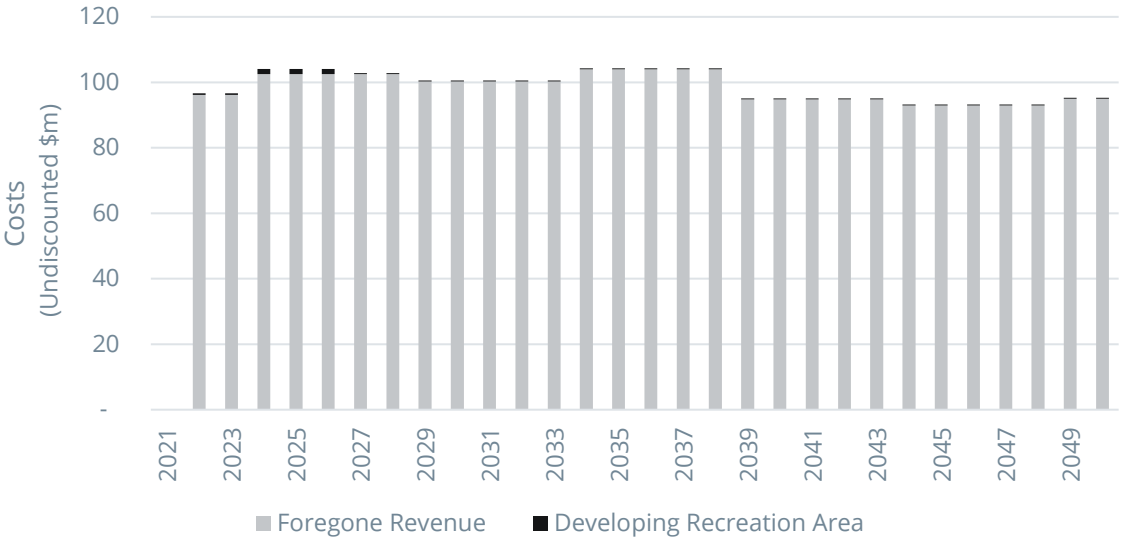



**Table 6** presents a breakdown of the costs and benefits by source in present value terms.

**Table 6:** Costs and benefits by source

| | Sources | Present Value ($m) |
|---|---|---|
| **BENEFITS** | Avoided harvest, haulage and processing costs | $1,071.58 |
| | Carbon abatement value | $210.04 |
| | Recreation value | $10.33 |
| **COSTS** | Foregone revenue | $1,223.19 |
| | Cost of developing recreation | $6.80 |

## 5.2 Sensitivity analysis

The analysis presented in Section 5.1 is based on inputs defined in **Appendix D**. Although these inputs are based on reputable sources and informed assumptions, the results might be sensitive to specific key inputs. **Table 7** presents six alternative scenarios, based on deviations in three key parameters:

- the price of carbon credits
- the value of wood products
- the discount rate.

**Table 7:** Sensitivity analysis assumptions

| Parameter | Central | NSW Transport Carbon Price | High Wood Product Value | Low Wood Product Value | Low Discount Rate | High Discount Rate |
|---|---|---|---|---|---|---|
| **Discount rate** | 7% | 7% | 7% | 7% | 4% | 10% |
| **Price of carbon ($/tCO2e)** | $20 | $63.49 | $20 | $20 | $20 | $20 |
| **Value of wood products** | - | - | +10% | -10% | - | - |

The results from each scenario are presented in **Table 8**. The sensitivity analysis demonstrates that our assessment that the changes will be net beneficial to society is robust, as this outcome is reflected in all but one case.

### 5.2.1 Carbon price

As discussed in Section 4.1, our analysis assumes the value to society from carbon abatement to be equal to the market price of carbon, as described by ACCUs. However, this market value might not accurately reflect the social cost of carbon emissions. We consider a sensitivity analysis using an alternative valuation based on the NSW Transport guideline's estimate. The higher valuation of carbon abatement increases the benefits associated with no logging.

### 5.2.2 Value of wood products

Our analysis is performed using the best estimates available. However, there are limitations to our estimates due to limited reporting. Given the significant role of mill processing cost and revenue in the results of our analysis, we have considered a 10% deviation in mill revenues. If mill revenues are 10% higher than current estimates, then our analysis concludes that the benefits measured are insufficient to account for the lost revenue from wood products.

### 5.2.3 Discount rate

As a cost-benefit analysis discounts all future values to the present day, a lower discount rate will mean that future benefits and costs will have a more significant affect. In the no logging case, there is not a significant upfront cost with long term benefits, but instead a stream of ongoing costs and benefits, which do not change significantly over time. As such, changing the discount rate does affect the net present value of no logging (as future benefits and costs are worth more today), but does not affect the benefit cost ratio.

**Table 8:** Sensitivity analysis results

| | Central | NSW Transport Carbon Price | High Wood Product Value | Low Wood Product Value | Low Discount Rate | High Discount Rate |
|---|---|---|---|---|---|---|
| **Total Benefits ($m)** | 1,291.95 | 1,748.68 | 1,291.95 | 1,291.95 | 1,785.47 | 984.61 |
| **Total Costs ($m)** | 1,229.99 | 1,229.99 | 1,352.31 | 1,107.67 | 1,693.74 | 941.44 |
| **Net Present Value ($m)** | 61.96 | 518.69 | -60.36 | 184.28 | 91.72 | 43.17 |
| **Benefit-Cost Ratio** | 1.05 | 1.42 | 0.96 | 1.17 | 1.05 | 1.05 |

## 5.3 Greenhouse gas abatement

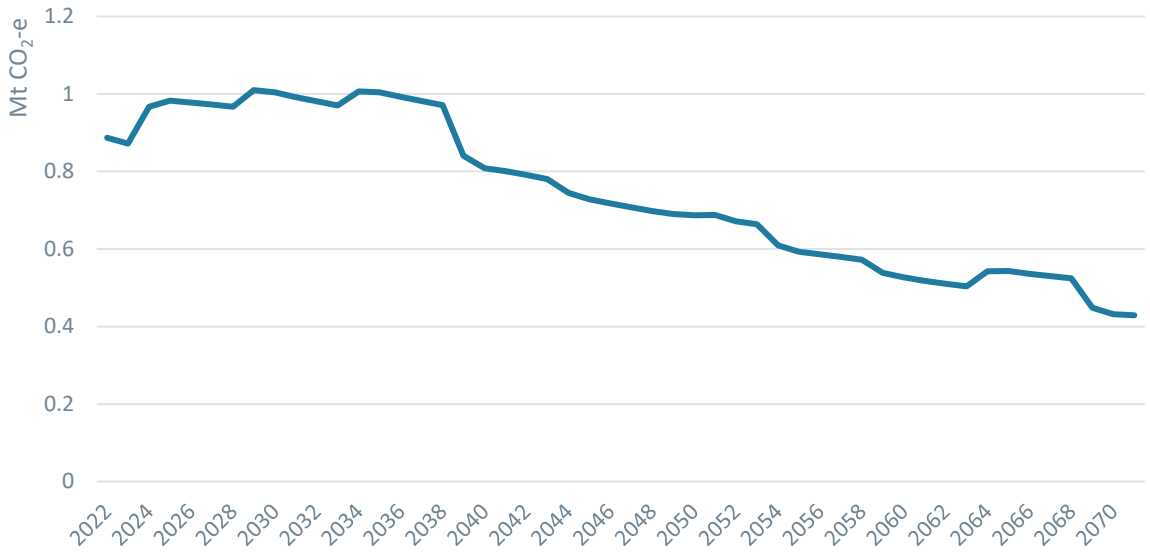
As discussed in section 4.3, the carbon modelling found that stopping native forest harvesting in the Eden and Southern RFA regions is likely to generate significant abatement. Under the no logging scenario, net emissions (carbon dioxide equivalents ($CO_2$-e)) are projected to be 0.95 million tonnes (Mt) $CO_2$-e less per year than they would be under the base case over the period 2022-2041, falling to 0.72 Mt$CO_2$-e $yr^{-1}$ in the final 10 years of the appraisal period.

As **Figure 8** and **Figure 9** demonstrate, stopping native forest harvesting is projected to continue to generate abatement well-beyond the appraisal period. The amount gradually declines over time as forests regenerate in the base case and the forest carbon stocks reach a new (higher) quasi-equilibrium in the no logging scenario.

In the base case, net carbon stocks are relatively stable, with slight increases accumulating in the harvested wood product (HWP) and landfill carbon pools over the next century. However, if harvesting is stopped, there is a substantial increase in the forest carbon stocks as more of the forest is allowed to mature and reach its maximum carbon carrying capacity.

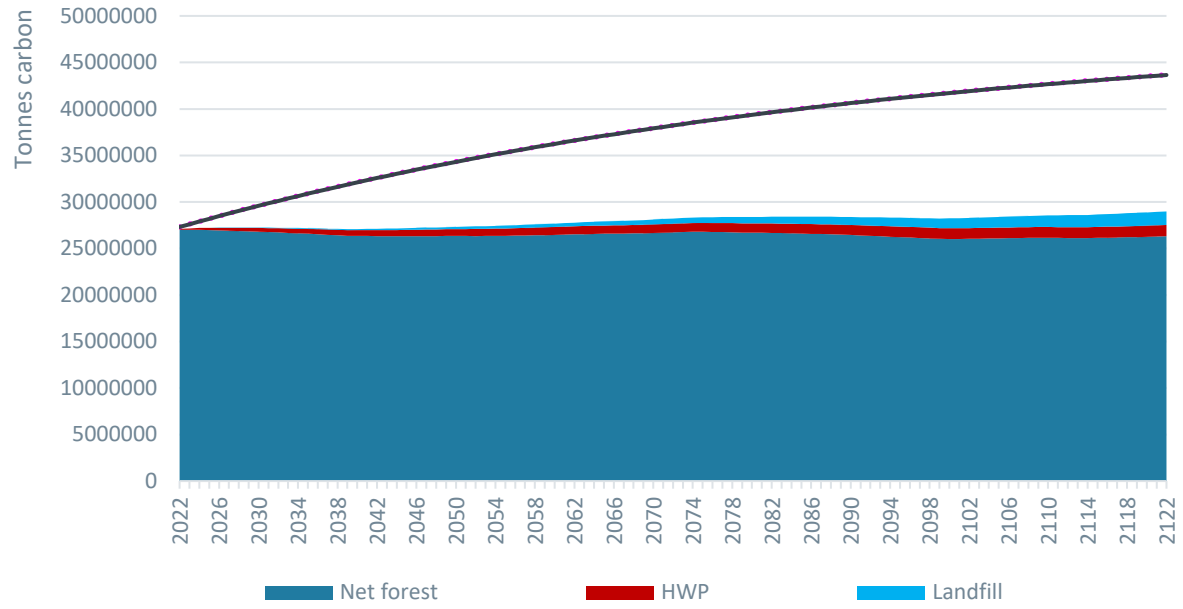
In reality, natural disturbances such as bushfires will cause variability in forest carbon stocks through time. However, the available research demonstrates that, generally, harvesting native forests causes far greater sustained losses in forest carbon than wildfires and that, typically, the carbon losses associated with bushfires are relatively short-lived.[23]

**Figure 8:** Greenhouse gas abatement from stopping native forest harvesting, Mt $CO_2$-e per year




[23] Keith, H., Lindenmayer, D.B., Mackey, B.G., Blair, D., Carter, L., McBurney, L., Okada, S., Konishi-Nagano, T. 2014, "Accounting for biomass carbon stock change due to wildfire in temperate forest landscapes in Australia" *PLoS ONE* 9 e107126; Wilson, N., Bradstock, R., Bedward, M. 2021, "Comparing forest carbon stock losses between logging and wildfire in forests with contrasting responses to fire" *Forest Ecology and Management* 481, 118701.

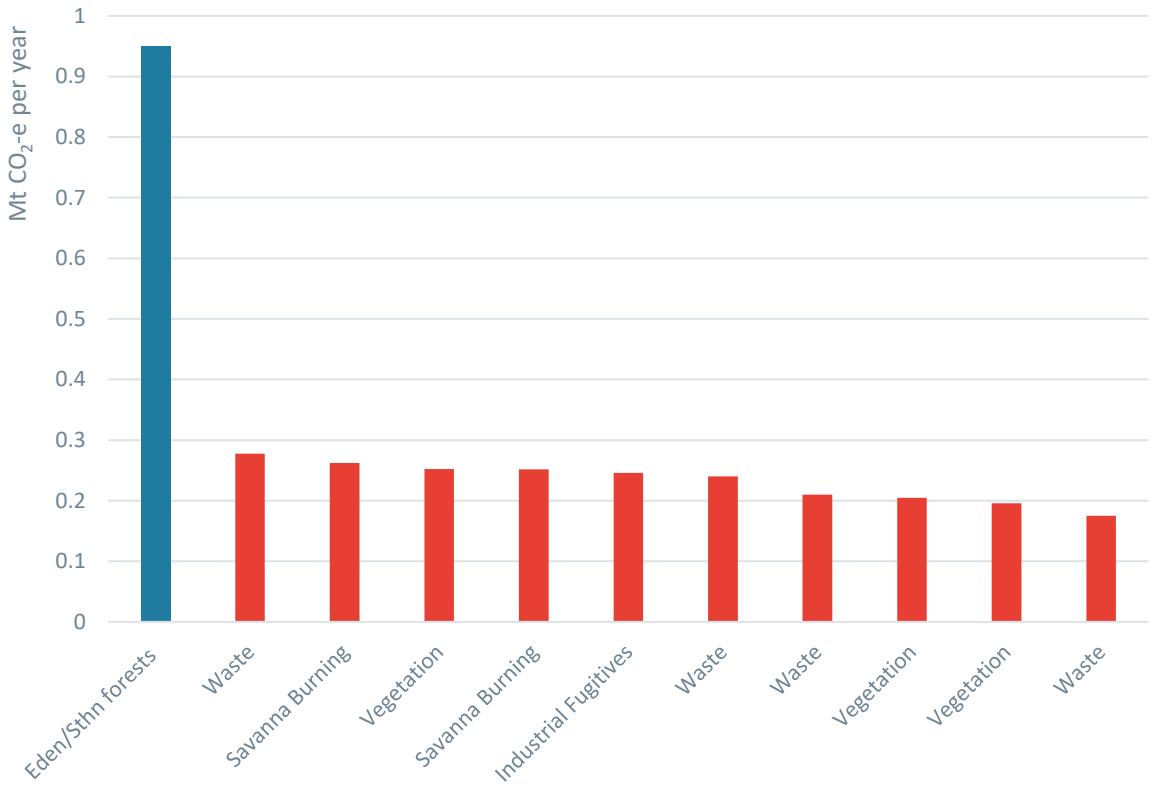
**Figure 9:** Net carbon stocks (forest, harvested wood products (HWP), landfill and fossil sinks and sources), base case vs no logging scenario




Compared to NSW's total greenhouse gas emissions (137 $MtCO_2$-e in 2019), the abatement associated with stopping native forest harvesting is relatively modest. However, there are unlikely to be many larger single, low-cost abatement opportunities in NSW or across Australia, particularly in the land sector.

To demonstrate this, **Figure 10** compares the average annual projected abatement generated by the cessation of native forest harvesting in the Eden and Southern RFA regions over the period 2022-2041 to the average annual abatement generated by the ten largest offset projects in the Australian Government's Emissions Reduction Fund (ERF). The no logging scenario would generate 3.4 times more abatement per year over this period than the largest existing ERF project: 0.95 $MtCO_2$-e compared to 0.28 $MtCO_2$-e. This demonstrates the potential role for ceasing logging in reducing NSW emissions.

**Figure 10:** Average annual projected abatement from no logging scenario (2022-2041) vs average annual abatement from 10 largest Emissions Reduction Fund (ERF) projects




*Source: Author analysis and Clean Energy Regulator (2021) 'Emissions Reduction Fund project register'. Available at: http://www.cleanenergyregulator.gov.au/ERF/project-and-contracts-registers/project-register (30 September 2021).*

# 6 Employment impacts

This section examines the employment impacts associated with the two scenarios examined in this report, which is a crucial issue of concern for local communities.

The employment associated with FCNSW's native hardwood harvesting in the Southern and Eden RFA regions is a small proportion of direct employment in these regions, and this direct employment has fallen significantly over time. This has been seen most recently with the closure of Blue Ridge Hardwoods which has around 50 employees, although this will be offset to some degree if the ANWE pallet and briquette facility is built.

We note that the transition of the Blue Ridge Hardwoods workers from the industry is being financially supported by the NSW Government. Transition support packages are a necessary support for employees in industries undergoing structural change. For example, this is a crucial element of the transition away from native forest harvesting in Victoria and Western Australia (see **Box 1**).

**Box 1:** Supported transition out of native forest logging in Victoria and WA

Victoria and Western Australia are transitioning away from native forest harvesting. In Western Australia logging of native forests will cease by the end of 2023, while Victoria is phasing out native logging of state forests by 2030. According to Australian Bureau of Agricultural and Resource Economics and Sciences data for 2019-20, roundwood removals from Victoria's native forests were 938,000 $m^3$, while roundwood removals from WA's native forests were 452,000 $m^3$.

In WA, it is estimated that up to 400 forestry jobs will be lost by the decision to stop native forest harvesting. To address the employment impacts, the WA government has announced a $50 million "Just Transition Plan" that is intended to help affected works find new employment. The WA Government also announced $350 million over ten years for the creation of new softwood plantations.

The Victorian Government has announced a 30-year forestry plan, which includes $120 million to support industry transition. The plan includes establishing a Consultative Committee with representatives from industry, VicForests, unions, local councils and government to help manage the transition. Specific initiatives included within the plan include plant and equipment redundancy payments, mill site rehabilitation funding, top up of redundancy payments and a $36m Regional Growth Fund.

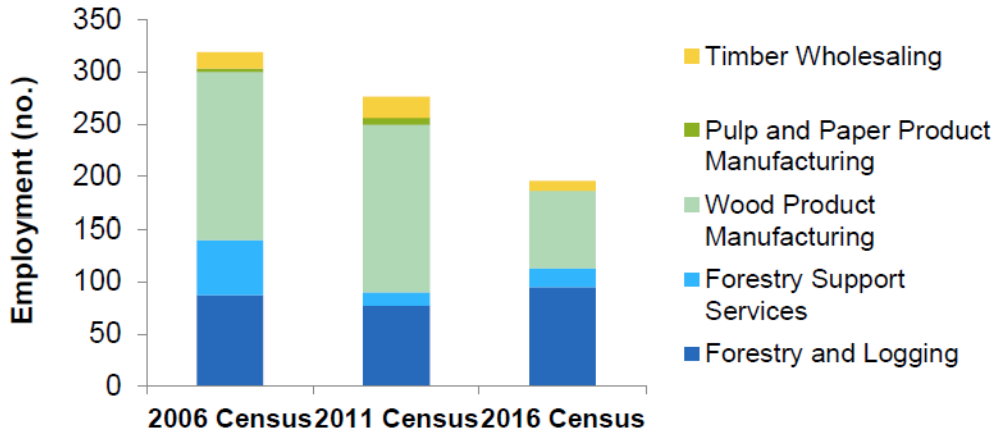
*Source: ABARES, Australian forest and wood products statistics; The Western Australian, Logging of native forests to be banned in WA from the end of 2023 and Victorian Government, Victorian Forest Plan.*

## Native hardwood forestry workforce has been reducing

Employment that is directly associated with the native forest harvesting includes the FCNSW employees that manage the forest and operations, the harvest and haulage contractors and the wood processors.

Analysis undertaken by the NSW and Australian Government into employment in these services in the Southern and Eden RFA area has been undertaken in the context of the renewal of the RFAs. This showed that employment in the Eden RFA region native forest industry (represented by Bega Valley LGA) declined by 39% over the period from 2006 to 2016, as shown in **Figure 8**.

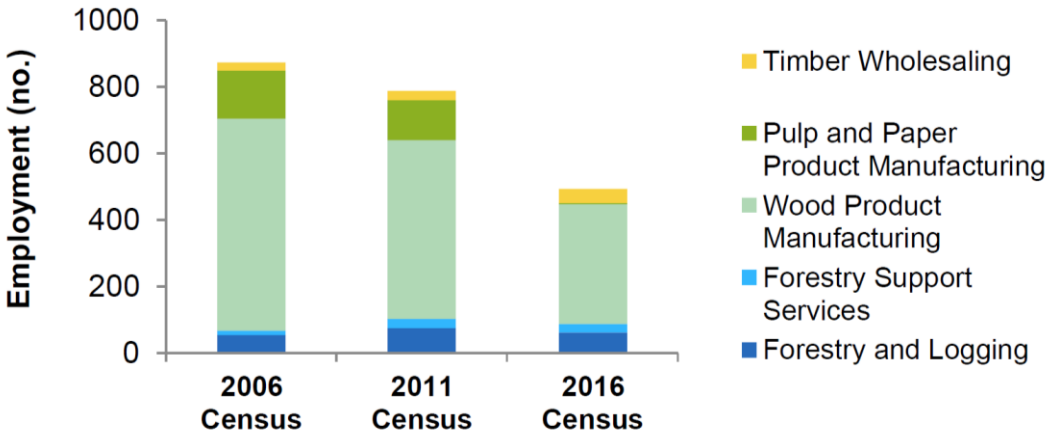
**Figure 8**: Direct native forest and wood products employment in Eden RFA region




*Source: NSW Department of Primary Industries 2018, NSW Regional Forest Agreements – Assessment of matters pertaining to renewal of NSW Regional Forest Agreements, August p. 300.*

Over the same period employment in the Southern RFA region native forest industry (represented by Eurobodalla, Shoalhaven and Queanbeyan-Palerang Regional LGAs) declined by 27%, as shown in **Figure 9**.

**Figure 9**: Direct native forest and wood products employment in the Southern RFA region




*Source: NSW Department of Primary Industries 2018, NSW Regional Forest Agreements – Assessment of matters pertaining to renewal of NSW Regional Forest Agreements, August p. 301.*

Direct employment in the two RFA regions has fallen further in the five years since 2016. The estimates we have seen which best aligns with publicly available information is that the study area has around 110-120 harvest and haulage jobs and 180-200 processing jobs. It is understood that the level of employment varies over time e.g. in line with harvesting activity.

As discussed in Section 3, the closure of the Blue Ridge Hardwoods mill in Eden is very significant in terms of reducing employment in the sector in the Eden RFA region. The mill shut after it failed to obtain a new wood supply agreement (the supply went to Allied Natural Wood Exports). Around the time of the closure there were press reports that 56 employees were impacted.[24] More recently, as part of the NSW Budget Estimates 2020-21 process it was stated that 51 employees accessed a special government pay out scheme.[25] Given that Blue Ridge Hardwoods mill previously held the key wood supply agreement for the study area, this suggests that the figure of 180-200 processing jobs at risk may be more of an upper bound for native forestry-dependent employment in the area.

To put these employment impacts in the context of the broader local economy, **Table 9** shows employment data for the Local Government Areas (LGAs) which best map to the study area. This shows that forestry employs only a small proportion of the total workforce. The decline in the forestry workforce means that by 2019-20, the proportion of forestry employees ranges between only 0.1% and 1.6% of the total workforce in the LGAs. This means that the employment impact from ceasing to harvest native forests is likely to be very small, particularly as there would be alternative employment opportunities under this scenario as discussed below.

**Table 9**: Forestry and logging employment as a percentage of total employment

| | 2014-15 employment | | | 2019-20 employment | | |
|---|---|---|---|---|---|---|
| | Total | Forestry and logging | % of total | Total | Forestry and logging | % of total |
| Bega Valley Shire | 10,735 | 137 | 1.3% | 10,951 | 126 | 1.2% |
| Eurobodalla Shire | 10,369 | 72 | 0.7% | 11,045 | 52 | 0.5% |
| Queanbeyan-Palerang Regional Council | 14,034 | 26 | 0.2% | 14,034 | 16 | 0.1% |
| Snowy Monaro Council | 9,268 | 132 | 1.4% | 8,540 | 100 | 1.2% |
| Snowy Valleys Council | 6,286 | 280 | 4.5% | 10,951 | 170 | 1.6% |

*Source: National Institute of Economic and Industry Research data from the economy.id website - https://economy.id.com.au/*

*Note: Forestry employment in the Snowy Monaro and Snowy Valleys LGAs includes softwood and native forestry employment.*

### Employment opportunities if native hardwood harvesting ceases

There are likely to be alternative employment opportunities for displaced workers from the native forestry sectors in the Southern and Eden RFA regions. There will be alternative forms of employment that are associated with the native hardwood forests and softwood plantation

[24] About Regional 2019, *Eden timber jobs in limbo as change takes hold*. Available at: https://aboutregional.com.au/eden-timber-jobs-in-limbo-as-change-takes-hold/ [Accessed 8 September 2021].

[25] NSW Government, *Budget Estimates 2020-2021 Supplementary Questions Portfolio Committee No. 4 – Industry*.

forests in the areas. In addition, it is likely that some workers would transition employment in other sectors of the local economies.

The key areas of significant employment associated with the native hardwood forest include:

- **Forest management:** Forest management employees will still be required, albeit with different management objectives.
- **Recreation and tourism:** It would be expected that there would be jobs created in recreation and tourism. By means of an illustrative example, Derby in the North East of Tasmania has created around 100 part-time and full-time jobs as result of becoming a mountain biking destination,[26] while the Wild Mersey mountain bike development in the north west of Tasmania is estimated to create 51 full-time jobs.[27] This analysis included development of a network of mountain bike trails to become a tourism destination and therefore 50-100 recreation and tourism jobs supported may be a reasonable benchmark. Additional information is provided in **Box 2**.

**Box 2:** Mountain bike trail industry in Tasmania and New Zealand

Derby in north-east Tasmania is an example of a rural town which has been transformed by developing a network of high quality mountain bike trails. Around 30km of purpose built mountain trails were opened in 2015 with the network now extending to more than 80km. Prior to covid the trails were getting 30,000 visitors per year, bringing an estimated $30m per annum of tourism spend while it has been reported that the network cost $3.1m to develop. It has been estimated that the area supports around 100 jobs (a combination of full-time and part-time roles).

In Rotorua, New Zealand they have 180km mountain bike trail network. This has been estimated to bring between NZ$29.2 million and NZ$47.4 million per annum and support up to 340 jobs.

*Source: Australian Geographic, Going with the flow down Derby way; Mountain Bike Australia, The Rise of Blue Derby Case Study; Stuff NZ, How mountain biking became part of Rotorua's DNA.*

The tourism and recreation sector is also one that is a significant employer in the study area as shown in **Table 10**.

[26] Australian Geographic, *Going with the flow down Derby way*.

[27] Mountain Bike Australia, *The Rise of Blue Derby Case Study*. Available at: https://www.mtba.org.au/wp-content/uploads/CCJ17427-Blue-Derby-Case-Study.pdf, Accessed 8 September 2021.

**Table 10**: Recreation, accommodation and food services employment

| | 2014-15 employment | | | 2019-20 employment | | |
|---|---|---|---|---|---|---|
| | Accomm & Food | Arts & Recreation | % of total | Accomm & Food | Arts & Recreation | % of total |
| Bega Valley Shire | 1,042 | 138 | 11.0% | 1,023 | 135 | 10.6% |
| Eurobodalla Shire | 1,121 | 163 | 12.4% | 1,102 | 122 | 11.1% |
| Queanbeyan-Palerang Regional Council | 751 | 161 | 6.5% | 959 | 138 | 7.8% |
| Snowy Monaro Council | 1,771 | 734 | 27.0% | 1,452 | 556 | 23.5% |
| Snowy Valleys Council | 318 | 54 | 5.9% | 219 | 52 | 2.5% |

*Source: National Institute of Economic and Industry Research data from the economy.id website - https://economy.id.com.au/*

- **Plantation-based forestry work**: both in softwood and hardwood plantations and in the establishment and management of new plantations, for which there is known demand associated with the Visy paper mill in Tumut.[28] Softwood plantation work in the area – in the Eden RFA region, the softwood sector centres around the Snowy Monaro LGA. In the Southern RFA region, the softwood industry is concentrated around Tumut which is within the Snowy Valleys LGA.[29]
- **Fire and invasive species management**: Harvesting and haulage contractors have already diversified in providing firefighting and fire management services in the forests. There are also increasing opportunities in invasive species management (e.g. control of feral deer). It should be noted that the harvesting and haulage contractors may also work over significant areas, well beyond the Southern and Eden RFA boundaries, including into Victoria and other parts of NSW.

[28] Hawkins, D. 2020, Submission by Visy Pulp and Paper Pty Ltd (Visy) to the House of Representative Standing Committee on Agriculture and Water Resources Timber Supply Chain Constraints in the Australian Plantation Sector. Commonwealth of Australia, Canberra.

[29] NSW Department of Primary Industries 2018, *NSW Regional Forest Agreements – Assessment of matters pertaining to renewal of NSW Regional Forest Agreements*, August p. 299.

# A Log volumes 1999-00 to 2016-17

Source: NSW Department of Primary Industries 2018, *NSW Regional Forest Agreements – Assessment of matters pertaining to renewal of NSW Regional Forest Agreements*, August, p. 244 -

## Southern RFA

**Table 3.19 Southern RFA region – volume of logs**

| Log type | 99/00 | 00/01 | 01/02 | 02/03 | 03/04 | 04/05 | 05/06 | 06/07 | 07/08 |
|---|---|---|---|---|---|---|---|---|---|
| High quality large sawlog ($m^3$) | N/A | N/A | N/A | 65 384 | 72 496 | 58 376 | 62 539 | 61 761 | 70 538 |
| High quality small sawlog ($m^3$) | N/A | N/A | N/A | 5635 | 6980 | 7669 | 9307 | 9437 | 7472 |
| Low quality sawlog ($m^3$) | N/A | N/A | N/A | 59 299 | 53 210 | 62 214 | 52 675 | 40 009 | 42 283 |
| Poles, piles and girders ($m^3$) | N/A | N/A | N/A | - | 155 | 180 | 522 | 1337 | 819 |
| Veneer ($m^3$) | N/A | N/A | N/A | - | 173 | 27421 | 181 | 244 | 569 |
| Pulp-grade logs (tonnes) | N/A | N/A | N/A | 63 236 | 78 291 | 85 582 | 109 691 | 126 109 | 115 319 |
| Miscellaneous grades ($m^3$) | N/A | N/A | N/A | - | 620 | 2223 | 3150 | 3805 | 8794 |

Note: 1 –Miscellaneous grades includes products which have been classified as 'residue' in five-yearly implementation report and 'fencing, landscape and sleepers (sawn)' in EPA annual reports.

**Table 3.20 Southern RFA region – volume of logs (*continued*)**

| Log type | 08/09 | 09/10 | 10/11 | 11/12 | 12/13 | 13/14 | 14/15 | 15/16 | 16/17 |
|---|---|---|---|---|---|---|---|---|---|
| High quality large sawlog ($m^3$) | 61 644 | 39 827 | 40 876 | 41 661 | 42 298 | 41 643 | 51 483 | 45 629 | 58 350 |
| High quality small sawlog ($m^3$) | 6261 | 5238 | 6987 | 7705 | 6283 | 5671 | 6877 | 5729 | 5451 |
| Low quality sawlog ($m^3$) | 34 693 | 24 831 | 26 826 | 23 395 | 25 540 | 32 136 | 28598 | 28 984 | 29 556 |
| Poles, piles and girders ($m^3$) | 796 | 798 | 1082 | 540 | 1057 | 601 | 819 | 257 | 143 |
| Veneer ($m^3$) | 358 | - | 181 | 376 | 290 | 183 | 288 | 212 | - |
| Pulp-grade logs (tonnes) | 98 787 | 82 219 | 99 418 | 74 658 | 68 289 | 28 103 | 30 381 | 30 089 | 36 074 |
| Miscellaneous grades ($m^3$) | 8853 | 11 518 | 13 351 | 28 966 | 20 996 | 14 442 | 16 292 | 31 693 | 30 200 |

Notes: N/A Not applicable

Reference: AFWPS (2016). Australian forest and wood products statistics: September and December quarters 2016, ABARES, 2017

## Eden RFA

**Table 3.15 Eden RFA region – volume of logs**

| Log type | 99/00 | 00/01 | 01/02 | 02/03 | 03/04 | 04/05 | 05/06 | 06/07 | 07/08 |
|---|---|---|---|---|---|---|---|---|---|
| High quality large sawlog ($m^3$) | 23 735 | 27 056 | 25 329 | 22 018 | 26 441 | 25 023 | 24 806 | 20 455 | 23 191 |
| High quality small sawlog ($m^3$) | 1950 | 2067 | 1125 | 1692 | 1262 | 1273 | 1765 | 1277 | 688 |
| Low quality sawlog ($m^3$) | 4089 | 9303 | 9294 | 10 909 | 18420 | 14 365 | 12 464 | 9413 | 7762 |
| Poles, piles and girders ($m^3$) | - | - | - | - | - | - | - | - | - |
| Pulp-grade logs (tonnes) | 352 282 | 337 434 | 279 854 | 279 017 | 320 681 | 296 976 | 310 603 | 352 916 | 316 067 |
| Miscellaneous grades[1] ($m^3$) | - | 221 | 279 | 9 | 43 | 280 | - | 160 | - |

Note: 1 –Miscellaneous grades includes products which have been classified as 'residue' in five-yearly implementation report and 'fencing, landscape and sleepers (sawn)' in EPA annual reports.

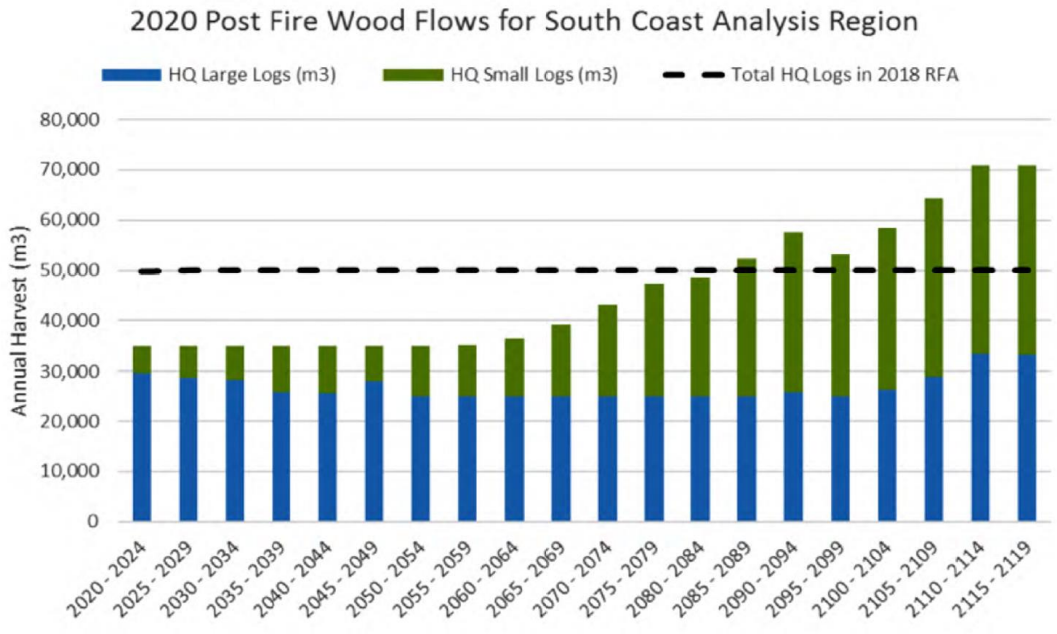
**Table 3.16 Eden RFA region – volume of logs (*continued*)**

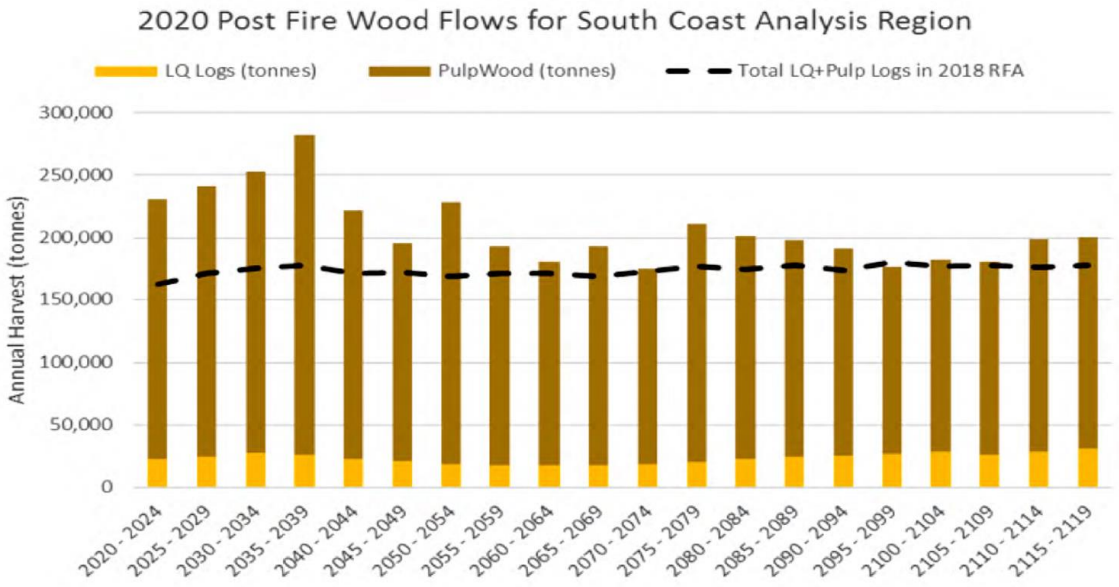
| Log type | 08/09 | 09/10 | 10/11 | 11/12 | 12/13 | 13/14 | 14/15 | 15/16 | 16/17 |
|---|---|---|---|---|---|---|---|---|---|
| High quality large sawlog ($m^3$) | 18 478 | 20 788 | 19 910 | 18 598 | 19 030 | 21 387 | 19 967 | 18 743 | 12 650 |
| High quality small sawlog ($m^3$) | 1573 | 1237 | 1326 | 2510 | 1262 | 2118 | 1856 | 3169 | 3138 |
| Low quality sawlog ($m^3$) | 5309 | 3856 | 2246 | 3348 | 3203 | 2888 | 1668 | 1130 | 1234 |
| Poles, piles and girders ($m^3$) | 237 | 79 | - | - | - | - | | - | - |
| Veneer ($m^3$) | 62 | 50 | - | - | - | - | | - | - |
| Pulp-grade logs (tonnes) | 221 215 | 246 705 | 220 465 | 194 338 | 169 839 | 217 636 | 225 443 | 198 243 | 207 160 |
| Miscellaneous grades[1] ($m^3$) | 23 | 49 | 132 | 920 | 233 | 1481 | 1067 | 1326 | 4430 |

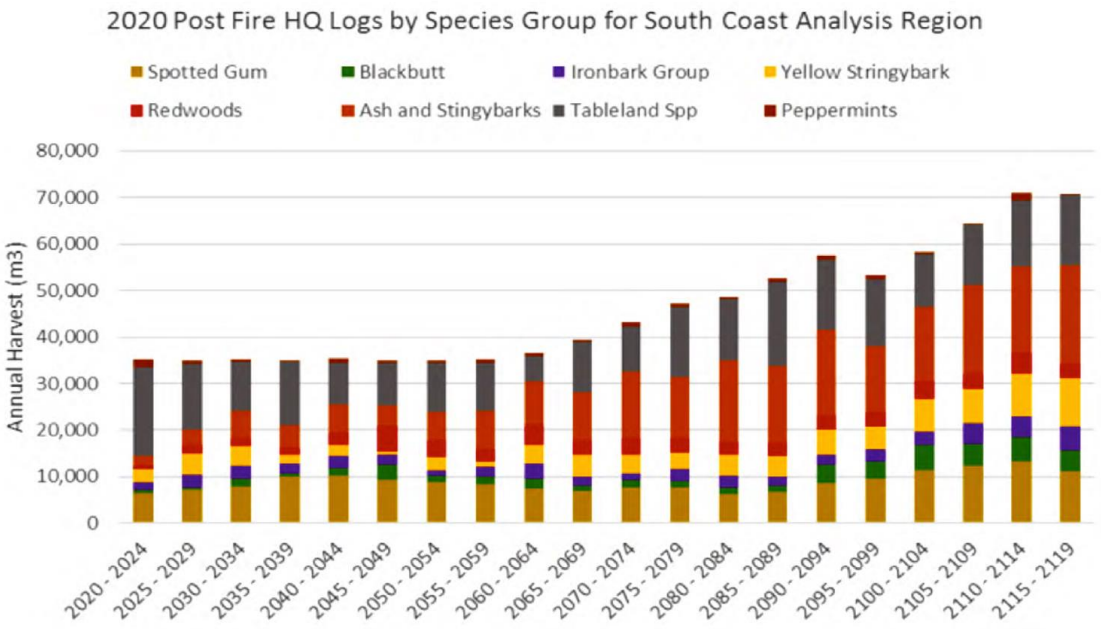
# B Estimated long term sustainable yield

The sustainable yield are from the FCNSW 2020, *2019–20 Wildfires NSW Coastal Hardwood Forests Sustainable Yield Review*, December.

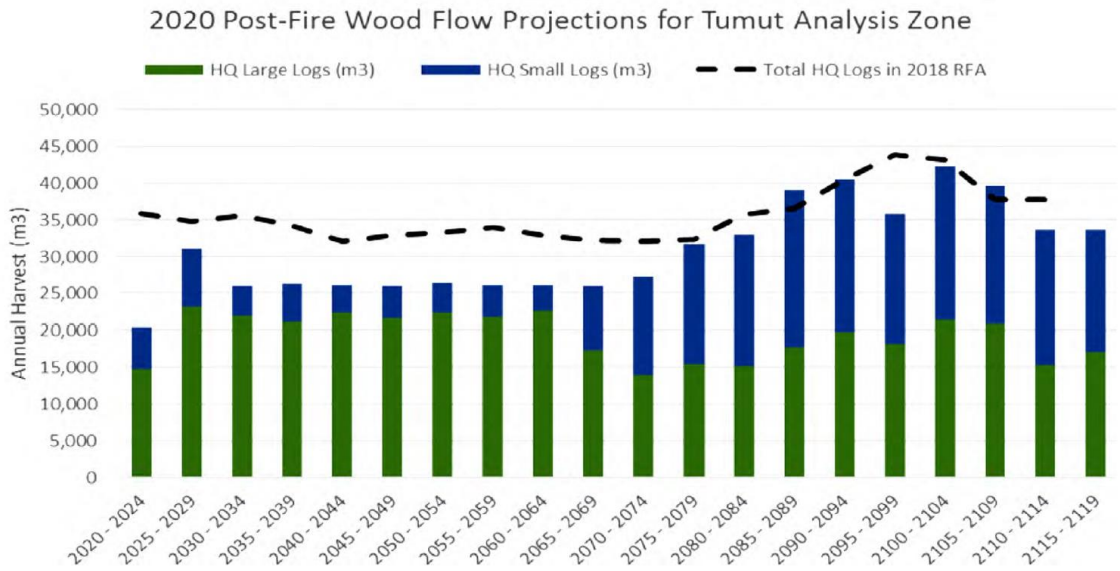
## Southern RFA Region – South Coast Sub-Region

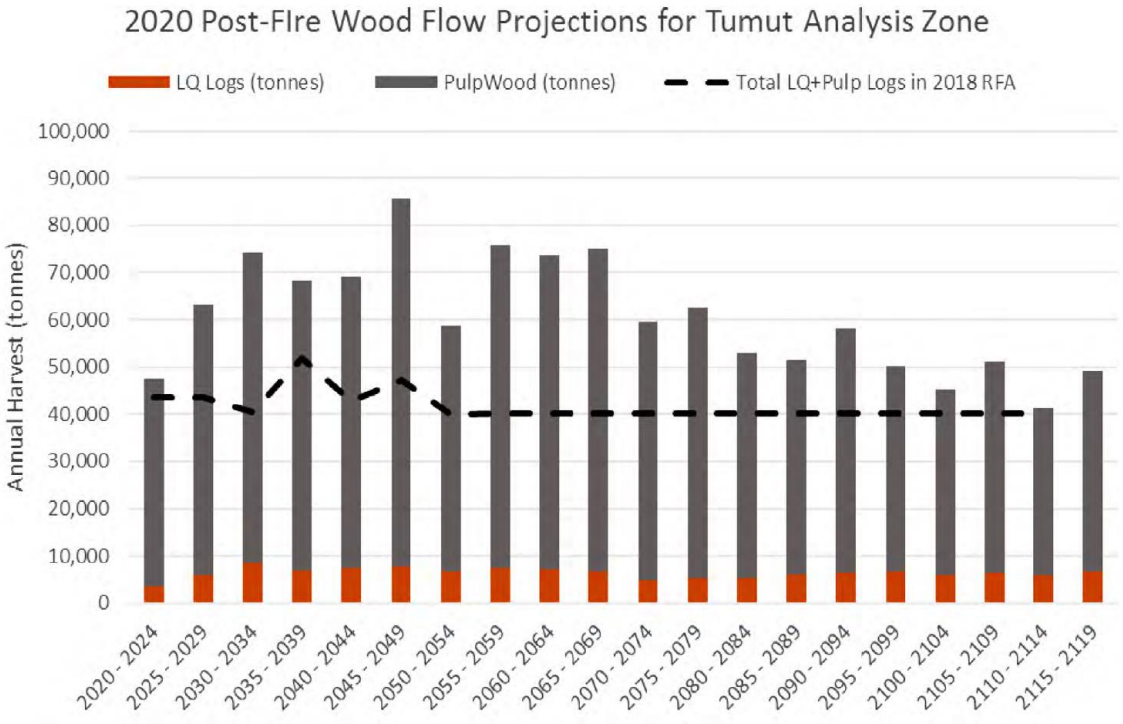


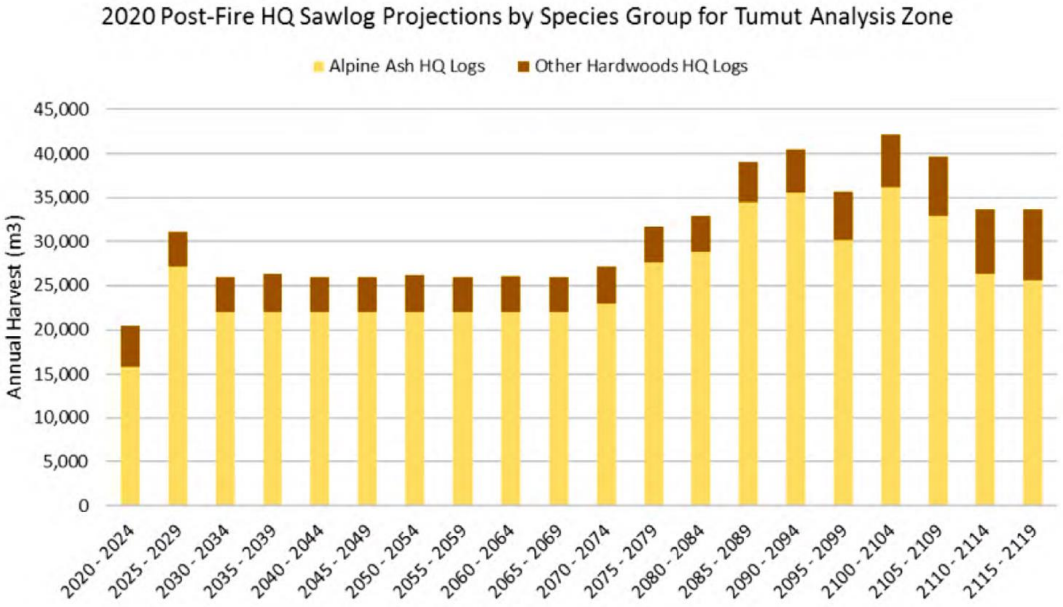





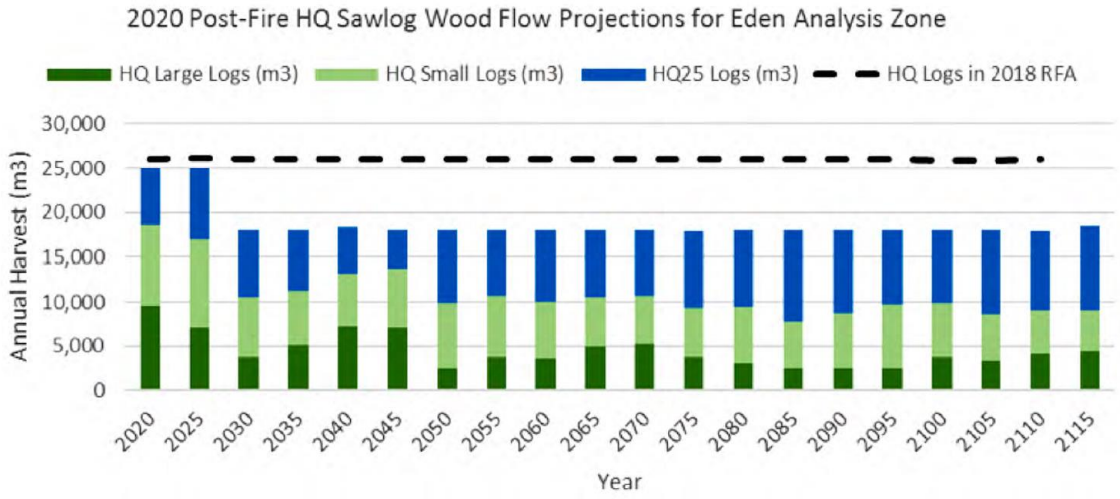

## Southern Region – Tumut Sub-Region

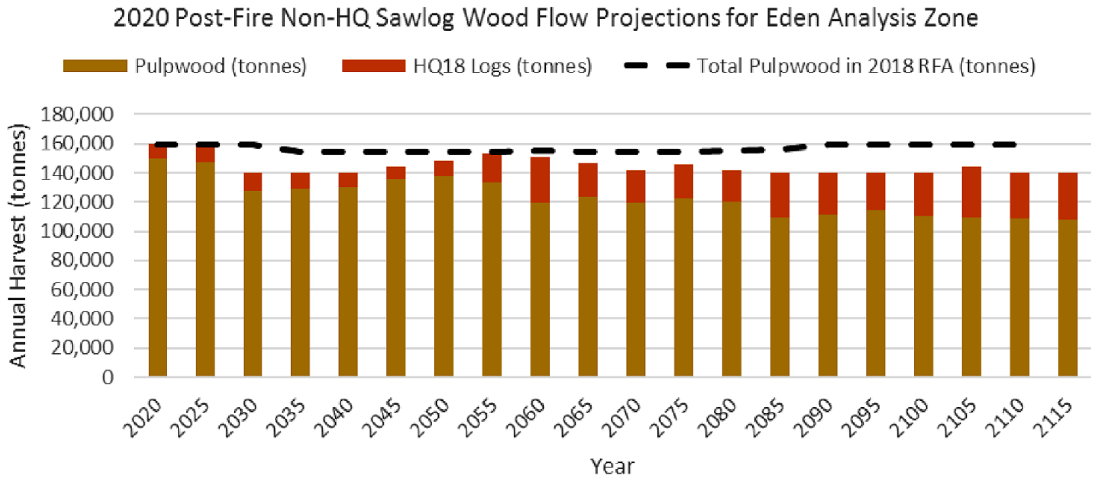





## Eden RFA Region


2020 Post-Fire HQ Sawlog Wood Flow Projections for Eden Analysis Zone
HQ Large Logs (m3)
HQ Small Logs (m3)
HQ25 Logs (m3)
HQ Logs in 2018 RFA
Annual Harvest (m3)
30,000
25,000
20,000
15,000
10,000
5,000
0
2020 2025 2030 2035 2040 2045 2050 2055 2060 2065 2070 2075 2080 2085 2090 2095 2100 2105 2110 2115
Year


2020 Post-Fire Non-HQ Sawlog Wood Flow Projections for Eden Analysis Zone
Pulpwood (tonnes)
HQ18 Logs (tonnes)
Total Pulpwood in 2018 RFA (tonnes)
Annual Harvest (tonnes)
180,000
160,000
140,000
120,000
100,000
80,000
60,000
40,000
20,000
0
2020 2025 2030 2035 2040 2045 2050 2055 2060 2065 2070 2075 2080 2085 2090 2095 2100 2105 2110 2115
Year

# C Carbon modelling

For the purposes of estimating carbon emissions and removals under the two scenarios, we modelled four sinks and sources:

- onsite forest carbon;
- harvested wood products;
- landfills; and
- fossil emissions from forest management, transport, and wood processing.

The methods applied in calculating emissions and removals associated with these sinks and sources are summarised in Table C1. Further details on methods used to account for emissions and removals from these sinks and sources are provided below.

**Table C1. Coverage of sinks and sources***

| Scenario | Onsite forest carbon | Harvested wood products (HWP) | Landfill | Fossil emissions (management, transport, and wood processing) |
|---|---|---|---|---|
| Base case | Stock change in above- and below-ground live biomass, litter, dead wood C pools | Stock change in HWP C pool | Stock change in landfill C pool | Emissions ($CO_2$-e) from management, transport and processing |
| Alternative (no harvest) | As above | NA | NA | Emissions ($CO_2$-e), confined to management of forest estate |

* SFR = Southern Forestry Region; C = carbon.

### Onsite forest carbon

The Southern and Eden RFA regions contain a mix of forest types dominated by *Eucalyptus* and *Corymbia spp.*, including *C. maculata* (spotted gum), *E. muelleriana* (yellow stringybark), *E. pilularis* (blackbutt), *E. sieberi* (silvertop ash), *E. obliqua* (messmate), *E. fastigata* (brown barrel), *E. cypellocarpa* (mountain grey gum) and *E. delegatensis* (alpine ash). Most of the estate in these regions is regrowth and mature forest. Any old growth forests within the estate are supposed to be excluded from forestry operations through prescriptions in Integrated Forestry Operations Approvals (IFOAs).[30]

Onsite forest carbon in the Southern and Eden RFA regions was modelled using the Tier 2 capabilities of the Australian Government's Full Carbon Accounting Model (FullCAM).[31] The

30 As at 30 June 2016, there was 180,297 ha and 26,817 ha of old growth forest outside of protected areas in the Southern RFA and Eden RFA regions respectively. NSW Government and Australian Government 2018, *NSW Regional Forest Agreements: Assessment of matters pertaining to renewal of Regional Forest Agreements*. NSW Department of Primary Industries, Sydney.

31 Richards, G., Evans, D. 2004, "Development of a carbon accounting model (FullCAM vers. 1.0) for the Australian continent" *Australian Forestry* 67, 277–283.

modelling covered the above- and below-ground live biomass, litter, and dead wood carbon pools. Soil carbon was excluded due to the uncertainty associated with soil carbon stocks in the native forest estate and the impacts of harvesting on soil carbon.

For modelling purposes, the Southern RFA region was divided into its two management sub-regions (South Coast and Tumut), while the Eden RFA region was modelled as a whole. Details of the net harvestable area of these regions are provided in Table C2.

**Table C2. Net harvestable areas, Eden, South Coast and Tumut**

| Region | Net harvestable area (ha) |
|---|---|
| Eden | 109,400 |
| South Coast sub-region | 128,800 |
| Tumut sub-region | 44,800 |
| **Total** | **283,000** |

Source: Forestry Corporation of NSW (2020) *2019–20 Wildfires: NSW Coastal Hardwood Forests*. *Sustainable Yield Review*. NSW Government, Sydney.

Representative FullCAM forest plots were devised for each of the three regions. The plots were based on the 'medium dense eucalypt forest' and 'tall dense eucalypt forest' plots used in the Australian Government's public native forest model.[32] The medium dense eucalypt forest plot provided the basis for the Eden and South Coast plots, the tall dense eucalypt forest plot provided the basis for the Tumut plots. Adjustments were made to these base plots to account for the assumed silviculture practices, basic density and above-ground biomass yields in the regions.

***Silviculture practice assumptions***

Twenty representative plots were developed that broadly reflect silvicultural practices and forest types in the Eden and Southern RFA regions: six for the Eden RFA region; six for the South Coast sub-region; and eight for the Tumut sub-region. The silvicultural assumptions for these plots are summarised in Table C3.

For Eden, the estate was broken into regrowth and older multi-aged forest, with the latter comprising 9% of the sub-region. Almost half of all regrowth forest was assumed to be thinned at age 30, with a subsequent regeneration harvest at 70 years. The remainder was assumed to be subject to a single regeneration harvest at 60 years (25%) or it was assumed to be harvested once every two rotations (120 years) to reflect the impact of environmental restrictions (25%). Regeneration harvests in all plots were assumed to be by way of Australian Group Selection (AGS) or Alternate Coupe Logging (ACL).[33]

For the South Coast sub-region, we assumed 90% of the estate was harvested by way of modified single tree selection (STS), with the remainder harvested using AGS or ACL. Based on state

32 Australian Government 2021, *National Inventory Report 2019: The Australian Government Submission to the United Nations Framework Convention on Climate Change (Volume 2)*. Commonwealth of Australia, Canberra.

33 Forestry Corporation of NSW 2018, *Native Forest Silviculture Manual, Version 2*. NSW Government, Sydney; Forestry Corporation of NSW (2014-2020) *Biomaterial Reports*. Available at: https://www.forestrycorporation.com.au/about/pubs/timber-volumes-and-modelling/biomaterial-reports (30 September 2021).

forestry agency data, 4% of the estate was assumed to be thinned at 30 years.[34] For Tumut, we divided the net harvestable area into two broad forest types—alpine ash and mountain hardwood—and assumed harvesting in both was by way of STS or ACL. No thinning was assumed to occur in the Tumut sub-region. To reflect the impact of environmental restrictions, in each rotation, we assumed 20% of the net harvestable area in the South Coast and Tumut sub-regions was not harvested and modelled this by assuming 20% of the net harvestable area was harvested once every two rotations.

**Table C3. Representative plots and silvicultural practice assumptions**

| Plot name | Plot subject to thin | % forest affected by thin | Regeneration harvest type* | Regeneration harvest age (yrs.) |
|---|---|---|---|---|
| Eden regrowth 1 | No thin | NA | AGS/ACL | 60 |
| Eden regrowth 2 | Thin at 30 years | 50% | AGS/ACL | 70 |
| Eden regrowth - enviro restrictions | No thin | NA | AGS/ACL | 120 |
| Eden multi-age 1 | No thin | NA | AGS/ACL | 90, thereafter 60 |
| Eden multi-age 2 | Thin at 30 years | 50% | AGS/ACL | 90, thereafter 70 |
| Eden multi-age - enviro restrictions | No thin | NA | AGS/ACL | 120 |
| South Coast 1 | No thin | NA | STS | 60 |
| South Coast 2 | Thin at 30 years | 50% | STS | 60 |
| South Coast - enviro restrictions STS | No thin | NA | STS | 120 |
| South Coast 4 | No thin | NA | AGS/ACL | 70 |
| South Coast 5 | Thin at 30 years | 50% | AGS/ACL | 70 |
| South Coast - enviro restrictions AGS | No thin | NA | AGS/ACL | 140 |
| Tumut Alpine Ash 1 | No thin | NA | STS | 80 |
| Tumut Alpine - enviro restrictions STS | No thin | NA | STS | 160 |
| Tumut Alpine Ash 3 | No thin | NA | ACL | 85 |
| Tumut Alpine - enviro restrictions AGS | No thin | NA | ACL | 170 |
| Tumut Mountain Hardwood 1 | No thin | NA | STS | 70 |
| Tumut Mountain Hardwood - enviro restrictions STS | No thin | NA | STS | 140 |
| Tumut Mountain Hardwood 3 | No thin | NA | ACL | 80 |
| Tumut Mountain Hardwood - enviro restrictions AGS | No thin | NA | ACL | 160 |

* Assumed only to occur after first regeneration harvest. ** STS = modified single tree selection; AGS = Australian Group Selection; ACL = Alternate Coupe Logging.

34 Forestry Corporation of NSW (2014-2020) *Biomaterial Reports*. Available at: https://www.forestrycorporation.com.au/about/pubs/timber-volumes-and-modelling/biomaterial-reports (30 September 2021).

Table C4 provides a summary of the assumptions regarding the proportion of above-ground biomass assigned to roundwood and slash in the plots devised for each region.

**Table C4. Proportions of above-ground biomass assigned to slash and roundwood removals, by region**

| | Eden | South Coast sub-region | Tumut sub-region |
|---|---|---|---|
| Product % | 31-36% | 34-35% | 28% |
| Slash % | 64-69% | 65-67% | 72% |

Sources: Australian Government (2021) *National Inventory Report 2019: The Australian Government Submission to the United Nations Framework Convention on Climate Change (Volume 2)*. Commonwealth of Australia, Canberra; Ximenes, F., George, B., Cowie, A., Williams, J., Kelly, G. (2012) Greenhouse Gas Balance of Native Forests in New South Wales, Australia. *Forests* 3, 653–683; Ximenes, F., Gardner, W.D, Marchant, J. (2005) *Total Biomass Measurement and Recovery of Biomass in Log Products in Spotted Gum (Corymbia maculata) Forests of SE NSW*. Commonwealth of Australia, Canberra; Illic, J., Boland, D., McDonald, M., Downes, G., Blackmore, P. (2000) *Wood Density Phase 1 – State of Knowledge*. Commonwealth of Australia, Canberra.

***Basic density***

The basic densities for the plots in each of the regions are shown in Table C5. All other parameters, including yield allocations to tree components, carbon and turnover percentages, and debris breakdown percentages, were assumed to be the same as those in the relevant medium dense eucalypt forest and tall dense eucalypt forest base plots.

**Table C5. Basic density of representative sub-region forest plots**

| Sub-region | Basic density (kg bone dry matter per $m^3$) |
|---|---|
| Eden | 650 |
| South Coast | 715 |
| Tumut | 550 |

Sources: Australian Government (2021) *National Inventory Report 2019: The Australian Government Submission to the United Nations Framework Convention on Climate Change (Volume 2)*. Commonwealth of Australia, Canberra; Ximenes, F., George, B., Cowie, A., Williams, J., Kelly, G. (2012) Greenhouse Gas Balance of Native Forests in New South Wales, Australia. *Forests* 3, 653–683; Ximenes, F., Gardner, W.D, Marchant, J. (2005) *Total Biomass Measurement and Recovery of Biomass in Log Products in Spotted Gum (Corymbia maculata) Forests of SE NSW*. Commonwealth of Australia, Canberra; Illic, J., Boland, D., McDonald, M., Downes, G., Blackmore, P. (2000) *Wood Density Phase 1 – State of Knowledge*. Commonwealth of Australia, Canberra.

***Above-ground biomass yields***

The above-ground biomass yields in each plot were modelled using the equation:

$$ABY = \alpha * [1 - e^{(-\beta * Age)}]^{\gamma} \quad \text{(equation 1)}$$

ABY is the above-ground biomass yield (bone dry metric tonnes), Age is the stand age in years, α is the maximum attainable above-ground biomass (upper asymptote of the curve) and β and γ determine the shape of the curve (growth rate to the asymptote). Table C6 provides a summary of the parameters for α, β and γ that were used in the plots. Adjustments were made to these parameters to account for the impact of thinning (increased growth rates of residual trees and impeded new growth).

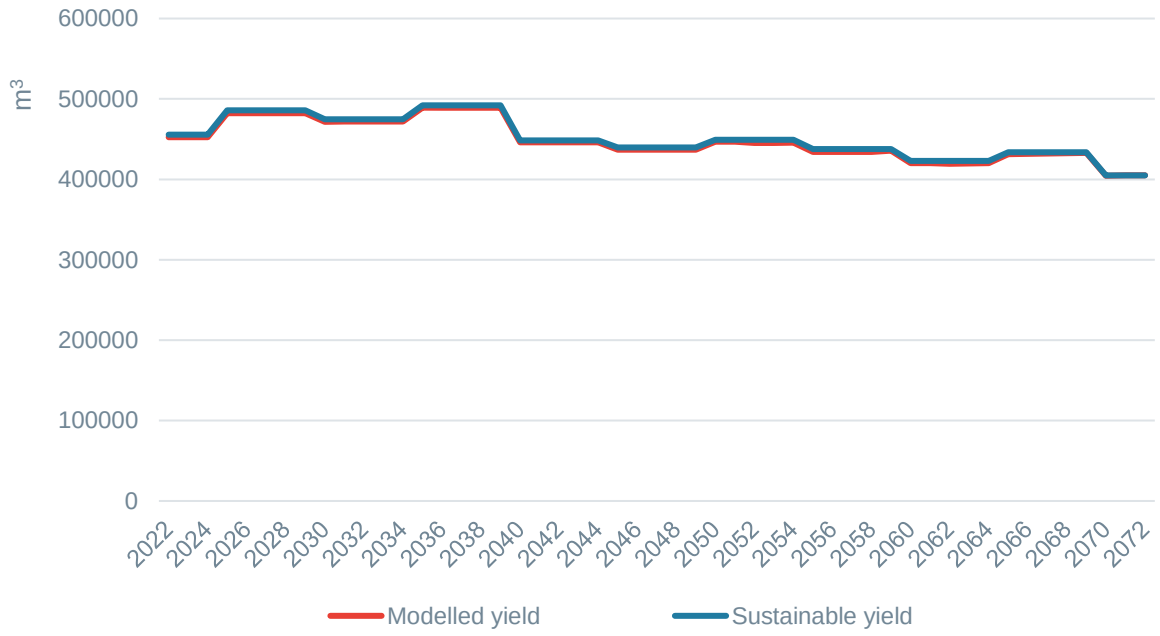
**Table C6. ABG yields for representative plots, parameters for equation (1)**

| Plot type | α (BDMT)* | β | γ |
|---|---|---|---|
| Eden multi-age | 358-364 | 0.01 | 0.55-0.70 |
| Eden regrowth | 341-367 | 0.005-0.01 | 0.55-0.70 |
| South Coast | 332-365 | 0.01-0.02 | 0.60-1.15 |
| Tumut Alpine Ash | 451-462 | 0.01 | 0.55 |
| Tumut Mountain Hardwood | 358-374 | 0.01 | 0.61-0.63 |

* BDMT = bone dry metric tonne.

The parameters for the plots outlined in Table C6 were developed iteratively so as to ensure the modelled sub-region roundwood removals matched, as closely as possible, sustainable yield forecasts published by the Forestry Corporation of NSW.[35] The resulting correlation between the modelled roundwood removals and sustainable yield forecasts is shown in Figure C1.

**Figure C1 Total roundwood removals from Eden and Southern RFA regions – modelled versus adjusted state forestry agency forecast, 2022 to 2072**




Source: Forestry Corporation of NSW (2020) *2019–20 Wildfires: NSW Coastal Hardwood Forests. Sustainable Yield Review*. NSW Government, Sydney.

35 Forestry Corporation of NSW 2020, *2019–20 Wildfires: NSW Coastal Hardwood Forests. Sustainable Yield Review*. NSW Government, Sydney.

### Harvested wood products and landfill

Harvested wood products and landfill carbon stocks and emissions were modelled using an integrated version of the Australian Government's models.[36] The log inputs for the integrated product/landfill model were derived from the FullCAM outputs. The breakdown of roundwood by log type that was used in the model is summarised in Table C7.

**Table C7. Roundwood removal log type percentages**

| Pulplogs | Sawlogs | Other* |
|---|---|---|
| 63% | 27% | 10% |

* Other logs includes a combination of high and low quality log types. Due to a lack of data, a 50/50 split was assumed between other logs going to long-lived (poles, piles, girders, sleepers) and shorter-lived products (landscaping etc.).
Source: Macintosh, A., Keith, H., Lindenmayer, D. (2015) Rethinking forest carbon mitigation assessments to account for policy institutions. *Nature Climate Change* 5(10), 946-949; Forestry Corporation of NSW (2014-2020) Biomaterial Reports. Available at: https://www.forestrycorporation.com.au/about/pubs/timber-volumes-and-modelling/biomaterial-reports (30 September 2021); Forests Corporation of NSW (2001-2013) Integrated Forestry Operations Approval Annual Reports, Eden and Southern RFA Areas. NSW Government, Sydney.

The processing destination fractions for logs and wood waste were derived from the Australian Government's harvested wood products model, with adjustments made to account for regional industry characteristics.[37] The destination fractions provided the basis from which end-products were assigned to the product pools contained in the harvested wood products model (Table C8). The maximum age and decay rates for the product pools are summarised in Table C9.

**Table C8. Harvested wood product pools, Australian Government model**

| Pool | Product types |
|---|---|
| 1 | Paper and paper products |
| 2 | Pallets, palings, plywood formboard & hardboard packaging |
| 3 | Sleepers and other miscellaneous hardwood products & other plywood |
| 4 | Poles, piles and girders |
| 5 | Green framing, dried framing, flooring and boards, timber furniture, structural plywood & hardboard weathertex, lining, bracing and underlay |

Source: Australian Government (2021) *National Inventory Report 2019: The Australian Government Submission to the United Nations Framework Convention on Climate Change (Volume 2)*. Commonwealth of Australia, Canberra; Macintosh, A., Keith, H., Lindenmayer, D. (2015) Rethinking forest carbon mitigation assessments to account for policy institutions. *Nature Climate Change* 5(10), 946-949.

[36] Macintosh, A., Keith, H., Lindenmayer, D. 2015, "Rethinking forest carbon mitigation assessments to account for policy institutions" *Nature Climate Change* 5(10), 946-949; Australian Government (2021) *National Inventory Report 2019: The Australian Government Submission to the United Nations Framework Convention on Climate Change (Volume 2)*. Commonwealth of Australia, Canberra.

[37] Australian Government 2021, *National Inventory Report 2019: The Australian Government Submission to the United Nations Framework Convention on Climate Change (Volume 2)*. Commonwealth of Australia, Canberra; Macintosh, A., Keith, H., Lindenmayer, D. 2015, "Rethinking forest carbon mitigation assessments to account for policy institutions" *Nature Climate Change* 5(10), 946-949.

**Table C9. Harvested wood product pools, maximum age and decay rates**

| Pool | Product pool age classes | | |
|---|---|---|---|
| | Young | Mid | Old |
| *Maximum time in age class (years)* | | | |
| 1 | 1 | 1 | 1 |
| 2 | 2 | 4 | 4 |
| 3 | 10 | 10 | 10 |
| 4 | 20 | 10 | 20 |
| 5 | 30 | 20 | 40 |
| *Proportion of in use pool exposed to decay* | | | |
| 1 | 60% | 65% | 90% |
| 2 | 30% | 50% | 90% |
| 3 | 15% | 65% | 45% |
| 4 | 25% | 65% | 80% |
| 5 | 20% | 55% | 95% |
| *Annual fractional decay losses* | | | |
| 1 | 100% | 100% | 100% |
| 2 | 50% | 25% | 25% |
| 3 | 10% | 10% | 10% |
| 4 | 5% | 10% | 5% |
| 5 | 3% | 5% | 3% |

Source: Australian Government (2021) *National Inventory Report 2019: The Australian Government Submission to the United Nations Framework Convention on Climate Change (Volume 2)*. Commonwealth of Australia, Canberra; Macintosh, A., Keith, H., Lindenmayer, D. (2015) Rethinking forest carbon mitigation assessments to account for policy institutions. *Nature Climate Change* 5(10), 946-949.

The Australian Governments landfill model is based on the IPCC Tier 2 FOD model. The key parameters of the model are: the fraction of degradable organic carbon in each individual waste type (DOC); the rate of decay assumed for each individual waste type (decay function 'k'); the fraction of degradable organic carbon that dissimilates through the life of the waste type (DOCf); the methane correction factor (MCF); the methane recovery rate (proportion of methane captured for flaring and energy generation); and the oxidation factor (the proportion of methane that oxidises prior to reaching the surface of the landfill). Details of these parameters are provided in Table C10.

**Table C10. Landfill model parameters**

| | DOC | k | DOCf | MCF | Recovery (%) | Oxidation factor |
|---|---|---|---|---|---|---|
| Wood and wood waste | 0.43 | 0.025 | 0.23 | 1 | 35% | 0.1 |
| Paper | 0.4 | 0.05 | 0.49 | 1 | 35% | 0.1 |

Source: Australian Government 2021, *National Inventory Report 2019: The Australian Government Submission to the United Nations Framework Convention on Climate Change (Volume 2)*. Commonwealth of Australia, Canberra; Macintosh, A., Keith, H., Lindenmayer, D. 2015, "Rethinking forest carbon mitigation assessments to account for policy institutions" *Nature Climate Change* 5(10), 946-949.

### Fossil emissions from transport, processing and management

Fossil emissions associated with harvesting, hauling, processing and transporting wood and waste products to relevant markets, and of fossil emissions associated with forest establishment and management, were derived from a life-cycle inventory of Australian production forests and Australian Government data on fossil fuel emission factors.[38] See Macintosh et al. (2015) for further details.[39]

### Leakage

In the no logging scenario, there is the potential for the cessation of harvesting in the native forest estate to result in leakage – or the displacement of harvesting into other public or private native forests, either in NSW or other states. Previous research suggests the risk of leakage in avoided native forest harvesting projects in Australia is low.[40] However, to ensure conservative results, we applied a 5% leakage discount to the abatement estimates, consistent with Macintosh et al. (2015).[41]

### Risk of reversal buffer

Under the Emissions Reduction Fund, a 5% risk of reversal buffer discount is applied when calculating the unit entitlement of all sequestration projects. This discount is intended to mitigate the risk of reversals occurring during projects' permanence periods. Similar discounts are applied under other private offset schemes. Consistent with this, a 5% risk of reversal buffer was applied when calculating the carbon credits that could be generated under the no logging scenario.

38 Tucker, S.N. et al. 2009, *Life Cycle Inventory of Australian Forestry and Wood Products*. Forest & Wood Products Australia, Melbourne.

39 Macintosh, A., Keith, H., Lindenmayer, D. 2015, "Rethinking forest carbon mitigation assessments to account for policy institutions" *Nature Climate Change* 5(10), 946-949.

40 Whittle, L., Berry, P., Heyhoe, E. 2013, *Leakage from avoided clearing and harvesting of native forests under the CFI: A quantitative assessment*. Australian Bureau of Agricultural and Resource Economics and Sciences, Canberra.

41 Macintosh, A., Keith, H., Lindenmayer, D. 2015, "Rethinking forest carbon mitigation assessments to account for policy institutions" *Nature Climate Change* 5(10), 946-949.

# D Cost-Benefit Analysis

This Appendix provides more detail on the cost-benefit analysis input assumptions and the results of the cost-benefit analysis.

## Input estimation

**Table 11:** Direct harvest cost and benefit inputs – wood product prices

| Input | Value | Source |
|---|---|---|
| Revenue from Average Saw logs | $422.62/m$^3$ | Interviews with CEOs of the main mills in the Eden and Southern RFA regions (2011-2012). Perkins, F. and Macintosh, A. 2013, Logging or carbon credits Comparing the financial returns from forest-based activities in NSW's Southern Forestry Region, Australia Institute Technical Brief No. 23, June.<br>Inflated to 2021 values using AFWPS Export data |
| Revenue from Average Pulp logs | $134.90/m$^3$ | Interviews with CEOs of the main mills in the Eden and Southern RFA regions (2011-2012). Perkins, F. and Macintosh, A. 2013, Logging or carbon credits Comparing the financial returns from forest-based activities in NSW's Southern Forestry Region, Australia Institute Technical Brief No. 23, June.<br>Inflated to 2021 values using Timber Market Survey Dec 2020 price index |
| Revenue from Average Other logs | $201.30/m$^3$ | Interviews with CEOs of the main mills in the Eden and Southern RFA regions (2011-2012). Perkins, F. and Macintosh, A. 2013, Logging or carbon credits Comparing the financial returns from forest-based activities in NSW's Southern Forestry Region, Australia Institute Technical Brief No. 23, June.<br>Inflated to 2021 values using AFWPS Export data |

**Table 12:** Direct harvest cost and benefit inputs – FCNSW costs

| Input | Value | Source |
|---|---|---|
| Administration of harvesting and hauling contracts | $3.95/m$^3$ | FCNSW, Native Forest Harvest and Haulage Review and Benchmarking Final Report, 2021, Pg. 81 - Administration Charge |
| Harvesting Costs | $45.73/m$^3$ | FCNSW, Native Forest Harvest and Haulage Review and Benchmarking Final Report, 2021, Pg. 77 (South) |
| Hauling Costs | $43.85/m$^3$ | FCNSW, Native Forest Harvest and Haulage Review and Benchmarking Final Report, 2021, Pg. 78 (South) |

**Table 13:** Direct harvest cost and benefit inputs – mill costs

| Input | Value | Source |
|---|---|---|
| Pulp log Mill Labour Costs | $18.03/m$^3$ | Interviews with CEOs of the main mills in the Eden and Southern RFA regions (2011-2012). Perkins, F. and Macintosh, A. 2013, Logging or carbon credits Comparing the financial returns from forest-based activities in NSW's Southern Forestry Region, Australia Institute Technical Brief No. 23, June.<br>Inflated to 2021 values using ABS Wage Index |
| Pulp log Mill Electricity Costs | $3.14/m$^3$ | Interviews with CEOs of the main mills in the Eden and Southern RFA regions (2011-2012). Perkins, F. and Macintosh, A. 2013, Logging or carbon credits Comparing the financial returns from forest-based activities in NSW's Southern Forestry Region, Australia Institute Technical Brief No. 23, June.<br>Inflated to 2021 values using ABS Electricity and Fuel Index |
| Pulp log Mill Other Costs (operating costs and depreciation) | $10.67/m$^3$ | Interviews with CEOs of the main mills in the Eden and Southern RFA regions (2011-2012). Perkins, F. and Macintosh, A. 2013, Logging or carbon credits Comparing the financial returns from forest-based activities in NSW's Southern Forestry Region, Australia Institute Technical Brief No. 23, June.<br>Inflated to 2021 values using CPI |
| Saw log Mill Labour Costs | $116.31/m$^3$ | Interviews with CEOs of the main mills in the Eden and Southern RFA regions (2011-2012). Perkins, F. and Macintosh, A. 2013, Logging or carbon credits Comparing the financial returns from forest-based activities in NSW's Southern Forestry Region, Australia Institute Technical Brief No. 23, June.<br>Inflated to 2021 values using ABS Wage Index |

| | | |
|---|---|---|
| Saw log Mill Electricity Costs | $11.85/m$^3$ | Interviews with CEOs of the main mills in the Eden and Southern RFA regions (2011-2012). Perkins, F. and Macintosh, A. 2013, Logging or carbon credits Comparing the financial returns from forest-based activities in NSW's Southern Forestry Region, Australia Institute Technical Brief No. 23, June.<br>Inflated to 2021 values using ABS Electricity and Fuel Index |
| Saw log Mill Other Costs (operating costs and depreciation) | $128.26/m$^3$ | Interviews with CEOs of the main mills in the Eden and Southern RFA regions (2011-2012). Perkins, F. and Macintosh, A. 2013, Logging or carbon credits Comparing the financial returns from forest-based activities in NSW's Southern Forestry Region, Australia Institute Technical Brief No. 23, June.<br>Inflated to 2021 values using CPI |
| Other Mill Labour Costs | $44.68/m$^3$ | Weighted Average of Pulp log and Saw log estimates – weighting by mill volumes. Interviews with CEOs of the main mills in the Eden and Southern RFA regions (2011-2012). Perkins, F. and Macintosh, A. 2013, Logging or carbon credits Comparing the financial returns from forest-based activities in NSW's Southern Forestry Region, Australia Institute Technical Brief No. 23, June.<br>Inflated to 2021 values using ABS Wage Index |
| Other Mill Electricity Costs | $5.50/m$^3$ | Weighted Average of Pulp log and Saw log estimates – weighting by mill volumes. Interviews with CEOs of the main mills in the Eden and Southern RFA regions (2011-2012). Perkins, F. and Macintosh, A. 2013, Logging or carbon credits Comparing the financial returns from forest-based activities in NSW's Southern Forestry Region, Australia Institute Technical Brief No. 23, June.<br>Inflated to 2021 values using ABS Electricity and Fuel Index |

| | | |
|---|---|---|
| Other Mill Other Costs (operating costs and depreciation) | $42.55/m$^3$ | Weighted Average of Pulp log and Saw log estimates – weighting by mill volumes. Interviews with CEOs of the main mills in the Eden and Southern RFA regions (2011-2012). Perkins, F. and Macintosh, A. 2013, Logging or carbon credits Comparing the financial returns from forest-based activities in NSW's Southern Forestry Region, Australia Institute Technical Brief No. 23, June.<br>Inflated to 2021 values using CPI |

**Figure 10** depicts the expected harvest volume in the base case, where logging continues uninterrupted (left axis) and the volume of abatement that can be generated in the no logging case from reducing this harvesting (right axis).

**Figure 10:** Base case harvest volume forecast, and alternative case carbon abatement forecast

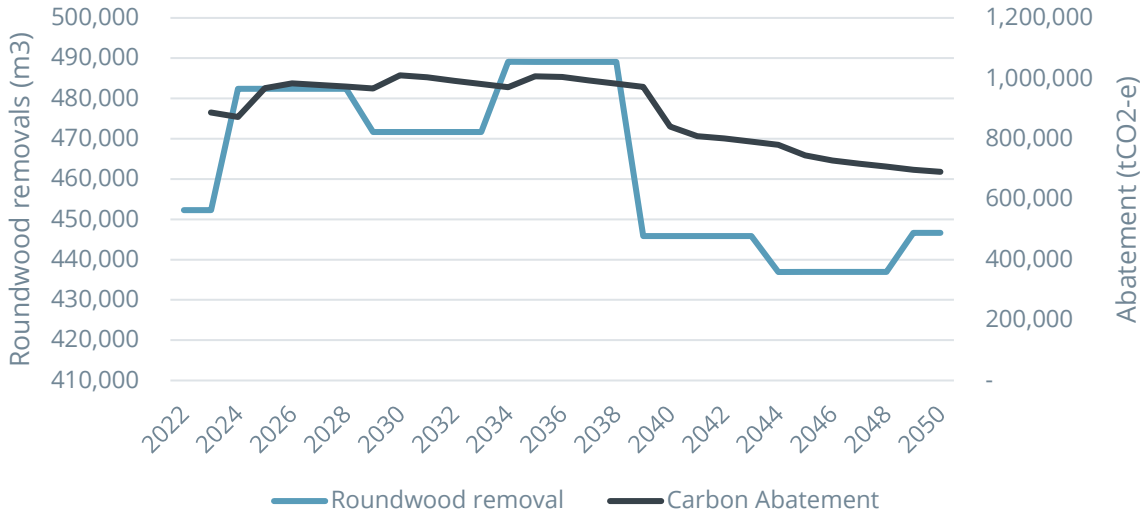


**Table 14:** Wood volume modelling inputs

| Input | Value | Source |
|---|---|---|
| Eden, average roundwood removals, 2022-2051 | 143,925 $m^3$ | Forestry Corporation of NSW (2020) *2019–20 Wildfires: NSW Coastal Hardwood Forests. Sustainable Yield Review*. NSW Government, Sydney. |
| South Coast sub-region, average roundwood removals, 2022-2051 | 234,671 $m^3$ | Forestry Corporation of NSW (2020) *2019–20 Wildfires: NSW Coastal Hardwood Forests. Sustainable Yield Review*. NSW Government, Sydney. |
| Tumut sub-region, average roundwood removals, 2022-2051 | 84,079 $m^3$ | Forestry Corporation of NSW (2020) *2019–20 Wildfires: NSW Coastal Hardwood Forests. Sustainable Yield Review*. NSW Government, Sydney. |

**Table 15:** Carbon abatement modelling inputs*

| Input | Value | Source |
|---|---|---|
| Leakage discount | 5% | Whittle, L., Berry, P., Heyhoe, E. (2013) *Leakage from avoided clearing and harvesting of native forests under the CFI: A quantitative assessment*. Australian Bureau of Agricultural and Resource Economics and Sciences, Canberra; Macintosh, A., Keith, H., Lindenmayer, D. (2015) Rethinking forest carbon mitigation assessments to account for policy institutions. *Nature Climate Change* 5(10), 946-949. |
| Risk of reversal buffer discount | 5% | Emissions Reduction Fund. *Carbon Credits (Carbon Farming Initiative) Act 2011* (Cth), s 16. |

* See Appendix C for further details on the carbon abatement modelling.

**Table 16:** Carbon cost

| Input | Value | Source |
|---|---|---|
| Carbon Price | $20/tCO$_2$-e | An approximate estimate of the average ACCUs spot price |

**Table 17:** Recreation cost and benefit inputs

| Input | Value | Source |
|---|---|---|
| Years of planning and approval | 2 years | FE Assumption |
| Delay of visitors post construction | 1 years | FE Assumption |
| Ramp up period for users | 5 years | FE Assumption |
| Time to construction of trail | 3 years | FE Assumption |
| Added mountain bike trail length | 60 km | FE Assumption |
| Local riders per annum | 5,000 riders | FE Assumption |
| Visitors per annum | 5,000 visitors | FE Assumption |
| Share of visitors stay over nights | 50% | FE Assumption |
| Nights stayed by overnight visitors | 2 nights | FE Assumption |
| Planning and Approval | $500,000 /year | Consultation |
| Cost of construction per m | $75 /m | Consultation |
| Annual maintenance cost per m | $5 /m | Consultation |
| Tourist spending - day visitors | $90 | FE Assumption based on insights from previous work |
| Tourist spending - overnight visitors | $200 | Snowy Mountain and South Coast 2020 Destination NSW research |
| Health benefits from visitor activity | $1.61 /km | Australian Transport Assessment and Planning |

## Results

Cost-benefit analysis considers the incremental value of a project, accounting for the time value of money. **Figure 11**- **Figure 12** present the annual costs and benefits from **Figure 6** - **Figure 7** after applying discounting. The sum of these discounted annual figures makes up the net present value of the project.

**Figure 11:** Discounted benefits

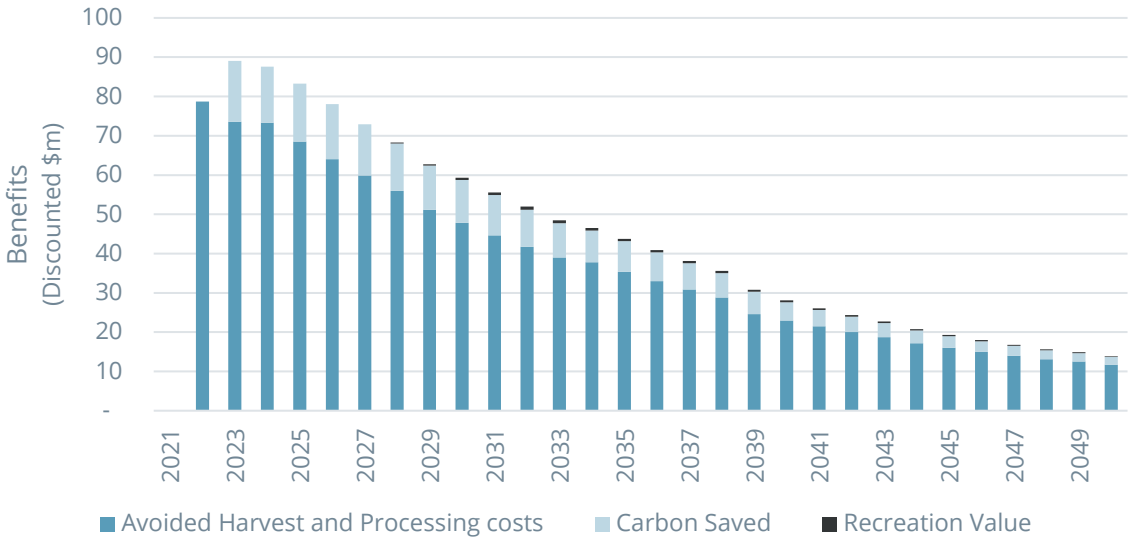
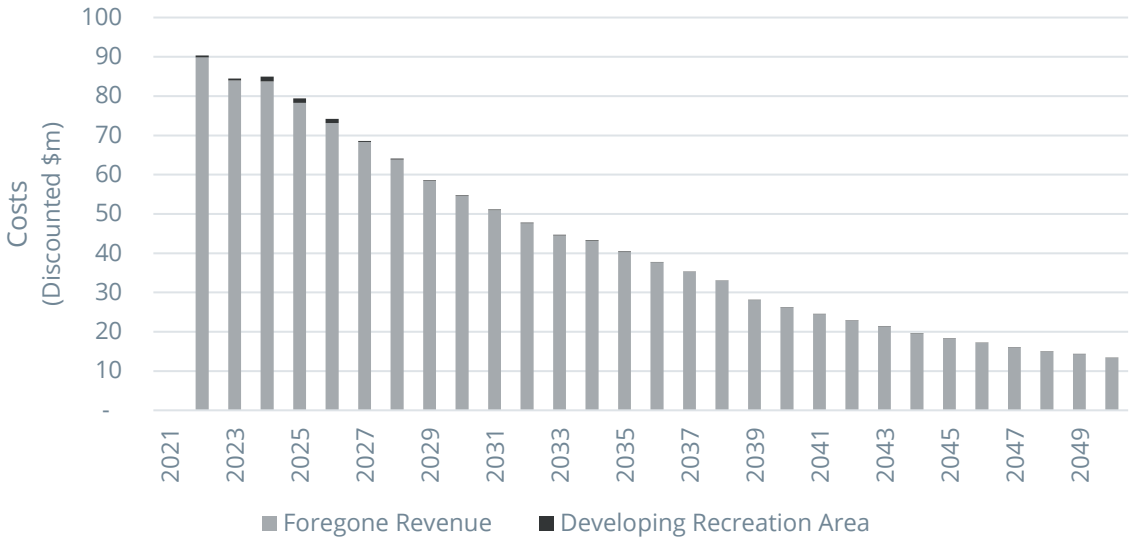



**Figure 12:** Discounted costs



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