State of the forests Tasmania 2022

Data report

A report to the Minister for Resources and to be laid on the table of each house of parliament pursuant to section 4Z of the *Forest Practices Act 1985.*

Submitted by the Forest Practices Authority in cooperation and consultation with the Department of Natural Resources and Environment Tasmania, Sustainable Timber Tasmania, the Department of State Growth, Private Forests Tasmania and the Australian Government Department of Agriculture Fisheries and Forestry.

The report covers the period 1 July 2016 to 30 June 2021 and follows the format previously agreed with the Australian Government for reporting on sustainability indicators under the Montreal Process and for the five yearly reviews of the Tasmanian Regional Forest Agreement Commonwealth of Australia (2017).

FPA
FOREST PRACTICES AUTHORITY

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Minister for Resources, Parliament of Tasmania

Dear Minister,

The Forest Practices Authority has pleasure in submitting the *State of the forests Tasmania 2022* report pursuant to section 4Z of the *Forest Practices Act 1985*.

The reporting period is 1 July 2016 to 30 June 2021, although there may be some overlap up to six months at either end of the reporting period with previous and future reports.

The report was prepared by the Forest Practices Authority in cooperation and consultation with several Tasmanian and Australian Government Departments, statutory authorities, government business enterprises, forest sector companies and individuals. I take this opportunity to acknowledge the tremendous goodwill and cooperation of all of the parties in compiling this detailed and comprehensive report.

The report follows the format previously agreed with the Australian Government for reporting on sustainability indicators under the Montreal Process and for the five yearly reviews of the Tasmanian Regional Forest Agreement. The information in this report constitutes Tasmania's contribution to the *Australian State of the Forests Report 2023* which is compiled by the Australian Bureau of Agriculture and Resource Economics and Sciences (ABARES). The report presents data and some explanation on how the data is contained, but there is limited commentary on the data.

A summary booklet highlighting the key information with graphical representation of data and figures will be produced as soon as possible.

Pamela Allan

The Hon Pamela Allan

Chair, Forest Practices Authority
November 2022

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Acknowledgement
of
Country
The FPA acknowledge the palawa people as the original owners and continuing custodians of lutruwita/Tasmania and acknowledge their skill and care in managing the land for many thousands of years.
We pay our respects to elders - past and present.

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Disclaimers

The information in this report was received from several sources. The information presented was considered relevant (by the FPA) to the aim of this report. Whilst the FPA and data providers have endeavoured to ensure accuracy, they do not warrant that the material is free of error. Consequently, the information is provided on the basis that the FPA and data providers will not be liable for any error or omission. However, should any error or omission be notified, the FPA will endeavour to correct the information.

Acknowledgements

Agencies

The content of this report was primarily provided by the following Tasmanian agencies:

- Department of Natural Resources and Environment Tasmania (NRE Tas)
- Forest Practices Authority
- Sustainable Timber Tasmania
- Private Forests Tasmania.

Other Tasmanian and Australian Government agencies also contributed information when requested by the Steering Committee. Private forestry sector information was provided independently and through Private Forests Tasmania. Data reported, to the extent possible, are for the period 1 July 2016 to 30 June 2021 however in all cases the best available data (which may be for shorter or longer periods) have been used. Data prior to 2016 is presented to assist in illustrating longer term trends.

The format of this report is similar to the 2002, 2007, 2012 and 2017 reports and uses the indicator numbering system and indicator names as shown in the Table of Contents.

Individuals

The following people contributed updates to the production of the report:

Criterion 1
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Criterion 3
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Working group

The TasSOFR Working Group: Peter Volker, Chief Forest Practices Officer, FPA (Chair) Elena Tinch, FPA and Sarah Munks, FPA (Co-ordinators), Alastair Morton, Sarah Thompson, Chantelle Ridley, Anne Kitchener, Andrew Crane, NRE Tas, Suzette Weeding, Mark Rippon, STT, Penny Wells and Murray Root, Private Forests Tasmania.

Figures

The following people contributed the figures:

- Julie Walters, FPA
- Felicity Faulkner and Lindsay Mitchell, NRE Tas
- Daniel Palmer, NRE Tas.

Front page photo: The 80-metre tall, instrumented tower in tall *Eucalyptus obliqua* forest at Warra is one of 16 Supersites in the Terrestrial Ecosystem Research Network to continuously monitor the carbon, water and energy dynamics of Australia's terrestrial ecosystems (see Case Study in Box 5.1.a.1). (T. Wardlaw)

Acknowledgement of Country photo: Research carried out by the FPA indicates that grasslands such as this one are landscapes created by burning by Aboriginal people over many thousands of years.

The FPA acknowledges the work of Sarah Munks for coordinating the contributions from many sources and the drafting of this report. The work of Jo Sasse is acknowledged for the rewrite of 6.1b and 6.4a and substantial final edit of the report. FPA staff Anne Chuter. Angela Gardner, Chris Grove and Amy Koch contributed to the final edit.

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ABBREVIATIONS AND ACRONYMS

ABARES	Australian Bureau of Agricultural Resource Economics and Sciences
ABS	Australian Bureau of Statistics
AFS	Australian Forestry Standard
AHT	Aboriginal Heritage Tasmania
ALCT	Aboriginal Land Council of Tasmania
ANZSIC	Australian and New Zealand Standard Industrial Classification
APVMA	Australian Pesticides and Veterinary Medicines Authority
ARC CFV	Australian Research Council Centre for Forest Value
AWOTE	average weekly ordinary time earnings
CAR	comprehensive, adequate and representative
CRC	Cooperative Research Centre
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DCCEEW	Department of Climate Change, Energy, the Environment and Water
DFTD	devil facial tumour disease
DPIPWE	Department of Primary Industries, Parks, Water and Environment
EPBC	*Environment Protection and Biodiversity Conservation (Act 1999)*
FHaB	Forest Health and Biosecurity subcommittee, Plant Health Australia
FPA	Forest Practices Authority
FPO	Forest Practices Officer
FPP	forest practices plan
FPPF	future potential production forest
FSC	Forest Stewardship Council
FTE	full time equivalent
FullCAM	Full Carbon Accounting Model
GIS	Geographic Information System
GPS	Global Positioning System
ILSC	Indigenous Land and Sea Corporation
IPA	Indigenous Protected Area
IPM	integrated pest management
IPMG	Integrated Pest Management Group
ISO	International Standards Organisation
IUCN	International Union for the Conservation of Nature
LiDAR	Light Detection And Ranging aerial surveying method
LIST	Land Information System Tasmania
LISTmap	Land Information System Tasmania spatial dataset
LTR	Long Term Retention reserve system on PTPZ land
LULUCF	Land Use, Land Use Change and Forestry (sector)
MIS	Managed Investment Schemes
MVEP	Tasmanian Monitoring Vegetation Extent Program
NIFPI	National Institute for Forest Products Innovation
NRE Tas	(Department of) Natural Resources and Environment
NRM	natural resource management
NVA	Natural Values Atlas
PEFC	Programme for the Endorsement of Forest Certification Scheme
PNFE	permanent native forest estate
PFT	Private Forests Tasmania
PHA	Plant Health Australia
PTPZ	permanent timber production zone

PTR	private timber reserve
PWS	Parks and Wildlife Service
R&D	research and development
RFA	Regional Forest Agreement
SAC	Scientific Advisory Committee (under the *Threatened Species Protection Act 1995*)
SCU	PWS State Compliance Unit
SOFR	State of the Forests Report (Australia)
STT	Sustainable Timber Tasmania, Tasmania's public forest manager, trading name for Forestry Tasmania
TasSOFR	State of the forests Tasmania reports
TASVEG	1:25000 statewide vegetation map of Tasmania
TERN	Terrestrial Ecosystem Research Network
TFS	Tasmania Fire Service
THR	Tasmanian Heritage Register
TRE	Tasmanian Reserve Estate
TSP	*Threatened Species Protection (Act 1995)*
TWWHA	Tasmanian Wilderness World Heritage Area
UTAS	University of Tasmania
VCA	Vegetation Condition Assessment
WTE	wedge tailed eagle

Agency Reorganisations

Sustainable Timber Tasmania is the business name for Forestry Tasmania. Forestry Tasmania is the entity that performs the functions of the Forestry Corporation under the *Forest Management Act 2013*.

Department of Primary Industries, Parks, Water and Environment (DPIPWE) ceased on 1 December 2021.

Department of Natural Resources and Environment Tasmania (NRE Tas) commenced on 1 December 2021.

Legislation changes to public forest classifications

Forestry Act 1920 defined **State forest** as land that is dedicated under this or any other Act; or purchased by or on behalf of the forestry corporation for forestry purposes; or entered in the Register of Multiple Use Forest Land.

Tasmanian Forests Agreement Act 2013 amended the *Forestry Act 1920* in relation to continuing wood supply, and to enable certain land to be reserved for the purposes of the Tasmanian Forests Intergovernmental Agreement entered into by the Commonwealth of Australia and the State of Tasmania dated 7 August 2011, to create reserves and to amend the *Nature Conservation Act 2002* for the purposes of benefiting economically from the carbon in Tasmania's forests, and to amend certain other Acts. In effect **State forest** was split into **permanent timber production zone (PTPZ) land** managed by Forestry Tasmania and **future reserve land** administered by NRE Tas.

Forest Management Act 2013 provided for the management of **PTPZ land** by the forestry corporation, to repeal the *Forestry Act 1920,* and identified **PTPZ land** that is **future reserve land**.

Forestry (Rebuilding the Forest Industry) Act 2014 repealed the *Tasmanian Forests Agreement Act 2013*, to provide for the invigoration of the forest industry and for related purposes and changed the status of **future reserve land** as identified in the *Forest Management Act 2013* to **future potential production forest (FPPF) land** and set up a mechanism to exchange with **PTPZ land**.

EXECUTIVE SUMMARY

The Forest Practices Authority (FPA) is required to report every five years on the state of Tasmania's forests pursuant to section 4Z of the *Forest Practices Act 1985*. Previous such reports have been prepared and released in 2002, 2007, 2012 and 2017. The reporting period for this report is nominally 1 July 2016 to 30 June 2021. Figures are for this reporting period unless otherwise stated.

Clause 91 of the Tasmanian Regional Forest Agreement requires the Parties to develop agreed sustainability indicators. A key requirement was that the indicators should have regard to the Montreal Process Criteria and Indicators as amended from time to time (Montreal Process Working Group, 2015). A set of indicators was developed and released in June 2000. The *State of the forests Tasmania 2022* has as its framework 42 Sustainability Indicators, and therefore also serves to meet the requirements for reporting under the Montreal Process for the five-yearly reviews of the Tasmanian RFA.

CRITERION 1: CONSERVATION OF BIOLOGICAL DIVERSITY

- In 1750, Tasmania had an estimated 4.822 million hectares (ha) of native forest, of which 63.2% remained in 2021.
- The forest extent in Tasmania decreased over the reporting period due to losses of both native forest and plantations. When comparing totals reported for this criterion in 2017 with totals reported in 2022, the native forest extent decreased by 9,600 ha and the plantation extent decreased by 19,900 ha. (*Note: The data used for this criterion is consistent with the 2005 RFA data set, which has only undergone updates related to loss of native forest through clearing and conversion. This data will have diverged over time from the forest type data reported by STT for Criterion 2, as their forest data is continually updated.*)
- In June 2021, Tasmania had 3.045 million ha of native forest, 202,000 ha of hardwood (eucalypt) plantation and 79,000 ha of softwood (radiata pine) plantation. *(Note: Figures derived from the FORGROUP plantation dataset provided by STT for SoF reporting in Dec 2019 and June 2020.)*
- The current extent of native forest is 94.9% of the area that was first reliably reported in 1996.
- Of the total native forest area, 1.255 million ha is in conservation and public reserves, 957,000 ha is on permanent timber production zone (PTPZ) and other publicly managed land and 833,000 ha is on private freehold land.
- Of the 2.27 million ha of native forest of known growth stage, 1.619 million ha (71%) was categorised as mature, 123,000 ha was regeneration (5%), and 523,000 ha was regrowth (23%).
- Over 72% of Tasmania has native vegetation cover and there is a high degree of connectivity within remaining forested landscapes.
- 1.786 million ha of native forest (58.7%) is now protected in formal and informal comprehensive, adequate, and representative (CAR) reserves on public and private land, an increase of 8,700 ha since 2016.
- Almost all (99%) of the wilderness identified as high-quality under the RFA is protected within the CAR reserve system. This is an increase of 261,600 ha since 1996.
- 1.047 million ha (88%) of old-growth forests are in CAR reserves. This represents an increase in reservation of 33% since 1996.

- Eight native forest communities listed as threatened under Schedule 3A of the *Nature Conservation Act 2002* have decreased in area since 2015: three of these are wet eucalypt forests, five are dry eucalypt forests. The threatened communities with the greatest percentage loss were: shrubby *E. ovata* forest (-1.9%), King Island *E. globulus/E. brookeriana/E. viminalis* forest (-1.5%) and *E. brookeriana* wet forest (-1.2%).
- The percentage of native forest associated vascular plant species with adequate information to make management decisions has improved slightly from 27% in 2016 to 28% in 2021.
- Ten new species (seven plant, three fauna) have been listed under the *Threatened Species Protection Act 1995*. Five species, all plants, were de-listed. Five species (four plant, one animal) were down-graded to a lower level of threat and four species (two plant, two animal) were up-graded to higher level of threat.
- Only one species had a change in status under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* during the reporting period: the white-throated needletail, *Hirundapus caudacutus*.
- No forest dwelling species is known to have become extinct in the reporting period.
- Monitoring data indicates that during the reporting period there was:
  - no decline in abundance of the brushtail possum, the Tasmanian pademelon, Bennetts wallaby, nine other native mammal species, or the feral cat
  - a decline in abundance of the Tasmanian devil (affected by the devil facial tumour disease, DFTD), potoroo and Eastern bettong.
- Conservation of environmental diversity, including genetic diversity in Tasmania's forests is principally catered for by the systematic reserve system on public land, a voluntary private land reserve system and management by prescription in production forests.
- Planning tools and field assessment procedures allow threatened species to be considered when forestry operations are planned and undertaken. Management actions are developed to mitigate the impact of forest operations on a species or its habitat. The FPA reports on the implementation of these procedures on an annual basis.

CRITERION 2: MAINTENANCE OF PRODUCTIVE CAPACITY OF FOREST ECOSYSTEMS

- The area potentially available for timber production on public land is defined by Sustainable Timber Tasmania's mapped provisional coupes. The area of private forest land potentially available for timber production is not mapped and varies with owner intent and therefore is not able to be reported.
- The area of native forest potentially available for timber production on public land at 30 June 2021 is 471,000 ha.
- Across all tenures, the average annual area of native forest approved for harvesting under FPPs during 2016–2021 (10,224 ha) was more than that reported in the previous 2011–2016 reporting period (7,800 ha).
- The total area of hardwood plantation reduced by 14% (32,000 ha), mostly on private land, predominantly where landowners converted the land to agricultural use after harvest of joint-venture or leased land for plantations.
- The area of softwood plantation increased by 3% (2,000 ha).

- The 1.005 million ha of privately managed forest consists of native forest (833,000 ha) and plantations (172,000 ha).
- Estimated annual cut from privately managed native forest averaged less than 200,000 t over the reporting period.
- Estimated cut from private plantations reached historic highs during the reporting period, peaking at 4.2 million t in 2019.
- The total number of hives on PTPZ land reported by STT for 2020–2021 is 9,889 and the number of apiary agreements on PWS land for 2020-2021 is 312. There is no data for private forest.
- Just over 20,000 tree fern stems were harvested per year during the reporting period, from an estimated population of 130–165 million individually trunked *Dicksonia antarctica* occurring in Tasmania's forests.
- Sustainable Timber Tasmania (STT) collected a total of 5,792 kg of native tree seed during the reporting period.
- Over the reporting period, plans for clearfelling followed by either reforestation or conversion to plantation or non-forest land use were approved for 13,962 ha of native forest through the Tasmanian forest practices system.
- During the reporting period, 59,236 ha of plantations were planned for re-establishment, 843 ha were reforested with natives and 15,515 ha were converted to non-forest land use.
- In 2020–2021, approximately 300 ha of native forest on private land was cleared without authority of a certified forest practices plan in contravention of the *Forest Practices Act 1985.*
- Reforestation after harvest of native forest on PTPZ land consistently exceeded the target of 85% of the regenerated area meeting prescribed stocking standards.
- There is no data for the reporting period on regeneration success of private native forest.

CRITERION 3: MAINTENANCE OF ECOSYSTEM HEALTH AND VITALITY

- The capacity to respond to and manage pests and diseases has been improved with the development of a Tasmanian Integrated Pest Management Group (IPMG).
- In both private and public reserved forests, the level of investment in monitoring the health of the broader native forest estate is variable.
- STT developed an annual monitoring program for the Long Term Retention (LTR) reserve system on PTPZ land in 2017.
- The Tasmanian Biosecurity Strategy 2013–2017 provides the system and structures for formulating biosecurity policy for forests and delivering it operationally.
- The main factors affecting the health of eucalypt plantations and native forest include:
  - insect defoliation (*e.g. Paropsisterna* spp. and *Gonipterus* spp., *Cardiaspina* spp.)
  - leaf diseases (*e.g. Mycosphaerella* spp., *Teratosphaeria* spp)*,*
  - root rot diseases (*Armillaria* and *Phytophthora*)
  - wood borers (*e.g. Phorocantha* spp., *Lyctus spp.)*
  - wind damage
  - weed competition
  - 'ginger tree syndrome'
  - coppice competition

  - seedling desiccation.
- For PTPZ land the area monitored area of eucalypt plantations experiencing over-threshold populations of insect pests has continued to decrease as the plantation estate has aged. Consequently, the use of pesticide for control operations has declined.
- Although myrtle rust (*Austropuccinia psidii*) was detected in Tasmania in 2015, it has not since been found in either eucalypt plantations or native forest. The Tasmanian government maintains a ban on the importation of all Myrtaceae species to prevent the introduction of the disease.
- The most frequently encountered problem across the softwood plantation estate on PTPZ land was bark stripping by wallabies. Post-planting seedling desiccation, *Sirex* wood wasp, *Diplodia pini* infection, windthrow and stem breakage due to severe wind events, the Monterey pine aphid, *Essigella californica* were some of the other main health issues reported for softwood plantations.
- The most encountered issues reported for native forest LTR reserves included old/historical fire damage, exotic weeds (including pine wildlings) and reduced canopy or midstorey vegetation condition. *Chrysomelid* defoliation of *Eucalyptus delegatensis*, *E. regnans* and *E. viminalis*, a natural phenomenon, caused higher damage scores in susceptible forest. Symptoms attributed to climatic influence were noticeable in a number of north-east reserves. These included scattered mortality and gully dieback and ginger trees, associated with heat stress and ongoing hotter-than-average temperatures.
- Illegal firewood harvesting was evident in 13% of assessed reserves.
- Climate induced issues, such as ginger tree syndrome and increased fire frequency and severity, are likely to have the greatest impact on the LTR reserve system into the future. Ginger tree syndrome is also responsible for similar symptoms occurring in native eucalypts on farmland and in private native forest. *Eucalyptus viminalis* appears to have been particularly adversely affected by ginger tree syndrome and significant mortality has been observed around the state. *E. viminalis* wet forest in Tasmania is now listed in the Critically Endangered category of the threatened ecological communities list under the *Environment Protection and Biodiversity Conservation Act 1999* and ginger tree syndrome is included as a key threat.
- Browsing of young regeneration by mammals (marsupials and deer, goats and livestock) remains a major factor affecting successful reforestation of native eucalypt forests.
- The root-rot pathogen, *Phytophthora cinnamomi*, remains the most significant biotic threat to the health of native forest in Tasmania with the potential to affect broad areas. Hygiene measures are in place to protect production forests and reserves exposed to bushwalking.
- The annual area of planned fires conducted during the reporting period ranged from 8,000 to 16,000 ha.
- The most significant unplanned fires in the reporting period were the Riveaux Road, Gell River and Great Pine Tier wildfires of 2019 which burned more than 200,000 ha including significant parts of the TWWHA.

CRITERION 4: CONSERVATION AND MAINTENANCE OF SOIL AND WATER RESOURCES

- There has been a net increase of 10,000 ha, or 3%, in the total area of native forest not available for harvest on PTPZ land.
- There has been a net increase of 7,000 ha in the total area of native forest excluded from timber harvesting on private land. This is due to the greater areas of forest becoming protected by conservation covenants or other private reserves over the last five years.
- NRE Tas maintains an extensive stream gauging and river health monitoring network in Tasmania's major rural catchments.
- Irrespective of land tenure or forest type, assessments for soil and water risks are made for all forest activities covered by *Forest Practices Act 1985* during planning for forest operations. Risk assessments may also be undertaken on public forest (including forest reserved for conservation) and large industrially managed private forest in relation to road and other site developments not falling under the jurisdiction of the *Forest Practices Act 1985*.
- The primary instrument for managing soil erosion risks, risks to soil physical properties and the associated risks to water quality and quantity is the *Forest Practices Code 2020* in which there are 54 pages describing how forest practices must be tailored to address risks to soil and water values.
- The FPA website includes a publicly available database that enables Forest Practices Officers and any member of the public, including landowners and managers, to access keys to soils and information on soil and water issues.
- The FPA's independent assessment process found consistently high scores were achieved for compliance inspections concerning soil and water issues on all tenures.
- Although the *Forest Practices Code 2020* and its associated advisory documents contain extensive prescriptions for identifying erosion-prone soils and managing risks associated with them, erosion still occurred on forestry coupes in the reporting period, mostly due to unexpected combinations of events.

CRITERION 5: MAINTENANCE OF FOREST CONTRIBUTIONS TO GLOBAL CARBON CYCLES

- Data presented in this report focuses on total biomass carbon and living biomass carbon, which are the units used in the National Greenhouse Gas Inventory. Estimates were produced using spatial simulations of land use changes detected by satellite imagery, in conjunction with the Full Carbon Accounting Model (FullCam). Since the relative and absolute abundance of Tasmania's forest types have remained largely unchanged, the carbon content of major vegetation groups and their sum has remained relatively constant over the four reporting periods.
- Recently published research has found:
  - ecosystem carbon declines by a total of about 260 t/ha as mature Tasmanian eucalypt forest transitions to rainforest
  - measured mean soil carbon stocks in Tasmanian forests are considerably lower than several previously published estimates
  - the threat to carbon dynamics of Tasmania's tall wet forest from warming temperatures and has implications for the accuracy of carbon accounting.

- The results of these Tasmania-focused studies suggest that the National Carbon Accounting estimates published in previous *State of the forests Tasmania* reports have overestimated mean carbon for all Tasmanian soils at 0–30 cm depth and that figures for biomass carbon for several Tasmanian forest types have also been overestimated.
- Tasmania's forest management system promotes and enforces sustainable forest management practices, which together with monitoring and research, ensures that the carbon stocks in the total forest ecosystem are maintained at an approximately steady level.
- There is a range of opportunities for Tasmania's forests and forest industry in the context of climate change, as forests are the most cost-effective carbon-capture technology available.
- Tasmania's forest industry has increased capacity in carbon accounting.

CRITERION 6: MAINTENANCE AND ENHANCEMENT OF LONG-TERM MULTIPLE SOCIO-ECONOMIC BENEFITS TO MEET THE NEEDS OF SOCIETIES

- The forestry industry in Tasmania has been recovering strongly over the last five years with increased production of hardwood plantation fibre, robust demand for timber construction materials and heightened interest in the carbon capture market associated with both native and plantation forests.
- The volumes of timber produced from the public forest estate has been consistent over the past five years.
- The value of logs harvested has increased by 10.7% during the reporting period.
- The apiary industry is a significant industry associated with Tasmania's forests. Honey had a farm gate value of about $7.4 million in 2018–2019. Leatherwood and manuka honey account for 85% of all honey production. The available accessible leatherwood *(Eucryphia lucida)* resource is about 705,000 ha.
- Wildlife harvesting is controlled under licenses and wildlife population trends are monitored to ensure that this remains at sustainable levels.
- Treefern harvesting is regulated by the FPA in accordance with the *Tasmanian Tree Fern Management Plan*. During the reporting period, 111,053 treefern tags were issued, with a total tag value of $148,269.
- Tasmania's forests and reserves are used for recreational activities including mountain biking, bushwalking, fishing, hunting, mineral fossicking and naturalist activities. In the twelve-month period to September 2021, around 19,300 visitors (mostly interstate due to the COVID-19 pandemic) participated in mountain biking at some point during their trip and an estimated 316,400 visitors engaged in bushwalking. This has important economic opportunities for local communities and the broader Tasmanian economy.
- The COVID-19 pandemic impacted visitor numbers to Tasmania's forests in this reporting period.
- Woodchips, predominantly from the hardwood plantation estate, were the dominant product exported from Tasmania (in terms of tonnage), with most of this commodity destined for markets in Asia. Export woodchips have been consistent over the previous five financial years.
- Whole log exports have declined since the 2018–2019 financial year to be almost 27% lower in the 2020–2021 financial year. The primary reason for this decline has been a trade issue with China.

- Newsprint export has decreased by 66% during the reporting period.
- Tasmania imports construction material and timbers not grown in Tasmania from mainland Australia and overseas.
- Recycled wood fibre includes sawdust, cardboard and paper. Apart from sawdust use as a heat source for kiln drying and some other industrial uses, there is no capacity to utilise this material in Tasmania for recycled packaging or bioenergy. However, there is a demonstration plant using sawdust to create Cyrene, a non-toxic solvent which will potentially replace petrochemical solvents. The FC5 plant operating at Boyer is being upscaled in France from the learnings made at the Boyer plant since 2019. In addition, Timberlink has recently announced they are building Tasmania's first biocomposite plant that will use plastic waste and plantation timber mill residues to produce decking and screening for commercial and residential applications.
- Twelve vegetation carbon abatement projects in Tasmania are registered with the Clean Energy Regulator under the Emissions Reduction Fund, with a total of 729,606 ACCUs issued up to April 2022.
- Tasmanian forest managers have a culture of continuous improvement which includes:
  - ensuring all forest practices (harvesting of timber, establishment of forests, clearing of trees and clearing and conversion of threatened native vegetation communities) are authorised
  - continuous improvement in operational standards associated with harvesting, reforestation and conservation of natural and cultural values
  - widespread uptake of certification. Most industrial forest areas are accredited under the Responsible Wood Forest Management (AS4708:2013) and/or other independently audited environmental management systems such as ISO 14001. A large area of Tasmania's plantation estate is Forest Stewardship Council (FSC) certified.
- A wide range of public and private forest organisations invested and expended monies in forest management in Tasmania in the reporting period. This included investment into research investigating the substitution of wood for other less environmentally friendly materials.
- Owners of private land gifted 445 ha of land, including dry forest, to the Tasmanian Aboriginal community.
- There were 40 new Aboriginal heritage sites identified during surveys required by the *Forest Practices Code 2020* and the prescriptions contained in the 'agreed procedures' document P*rocedures for managing Aboriginal Cultural Heritage when preparing Forest Practices Plans*.
- As at 30 June 2021 about 20,200 ha of PTPZ land was allocated for Indigenous and non-Indigenous cultural heritage special management (of which about 5,900 ha was zoned for Indigenous cultural heritage value and the balance for other cultural heritage values).
- The *Forest Practices Code 2020* and the 'agreed procedures' defined in *Procedures for managing historic cultural heritage when preparing Forest Practices Plans*, require that all non-indigenous heritage sites found during the preparation of FPPs are reported. There were 140 new non-indigenous cultural heritage sites detected, which have been recorded on the Historic Sites Register.
- The Tasmanian Wilderness World Heritage Area (TWWHA) Management Plan was completed and approved in 2016.

- During 2018, the Tasmanian Government invited the Tasmanian community to have its say about the model for returning land to the Aboriginal communities.
- Two courses have been run on Bruny Island to train FPOs in the identification and documentation of Aboriginal cultural heritage.
- Formal Aboriginal involvement in reserve management continued through dedicated Aboriginal community representation on reserve advisory committees, including the statutory National Parks and Wildlife Advisory Council and the Arthur-Pieman Conservation Area Management Advisory Committee.
- An estimated 3,346 full-time equivalent (FTE) people were directly employed in the forest industry in 2021, similar to the 3,212 people estimated in 2016. The forestry sector represented a total of 1.6% of all persons employed in Tasmania in 2021, no change from 2016 but a decline from ten years ago, when approximately 5% of the workforce was in the forestry sector. However, it remains a major employer in regional communities, and there are flow-on effects to other economic sectors.
- Direct employment in reserved forest management includes 373 FTE Parks and Wildlife staff as well as those employed in the hundreds of businesses operating in reserves.
- There was a general decline in injury frequency rates in forests over the reporting period.

CRITERION 7: LEGAL, INSTITUTIONAL AND ECONOMIC FRAMEWORK FOR FOREST CONSERVATION AND SUSTAINABLE MANAGEMENT

- The Tasmanian Regional Forest Agreement (RFA) is a 20-year bilateral agreement between the Tasmanian and Australian governments, signed on 8 November 1997. The Tasmanian RFA was varied on 18 August 2017 to extend its life to 8 November 2037 and establish an automatic rolling life mechanism with subsequent five-yearly extensions contingent to satisfactory completion of five-yearly reviews.
- The *Forest Practices Code 2020* was reviewed and updated in 2020 and came into force on 1 January 2021. It provides a practical set of guidelines and standards for forest management, timber harvesting and other forest operations.
- The area of Private Timber Reserves (PTRs) established under the *Forest Practices Act 1985* decreased to 434,181 ha. The gradual decline in area under PTRs can be attributed to the harvesting of many managed investment scheme (MIS) plantations on private land and land use change, usually to agriculture.
- The revised Tasmanian Government Policy for Maintaining a Permanent Native Forest Estate came into force on 1 June 2017. The revision simplified the Policy prohibiting broadscale clearing and conversion of native forest, other than in limited prescribed circumstances.
- The institutional framework supporting the conservation and sustainable management of forests in the current reporting period continued through the CAR reserve system, the development and maintenance of skills, non-legislative organisational policies, formal environmental management systems, certification, community consultation, enforcement of laws, regulations and guidelines.
- FPA annual reports provide detail on governance, compliance and auditing of forest practices and implementation of research and advisory programs for natural and cultural heritage.

- A large proportion of *National Parks and Reserves Management Regulations 2019* court files related to the illegal taking of firewood and some significant commercial-scale operations were disrupted as a result.
- The transition to greater reliance on plantation resources, and the reduced size of the production native forest estate, necessitated ongoing investment in research and development to maximise productivity. The National Institute of Forest Products Innovation (NIFPI) was established in Launceston in 2017.
- Government agencies and private industrial forest companies have formal and informal systems in place which contribute to the level of knowledge necessary to monitor and report on the sustainability of forest management in Tasmania. The findings of biodiversity related monitoring projects were reported annually by the FPA.
- Tasmania's capacity to conduct and apply research to improve the scientific understanding of forests and delivery of forest products further decreased over the reporting period. For 2020–2021, Tasmania reported a total of 4.5 FTE forest researchers in government agencies, compared to 43.6 FTE in 2010–2011 and 9.3 FTE in 2015–2016.
- Much of Tasmania's ongoing forest-related research effort during the reporting period occurred through the ARC Centre for Forest Value at the University of Tasmania. STT and forest companies also undertake research primarily associated with forest management and production activities.
- The FPA and industry associates received FWPA support to examine the effectiveness of prescriptions in the *Forest Practices Code 2020* to protect five model threatened species. The FPA supported several post graduate students across Australia in socio-economic, natural and cultural heritage projects.
- STT and the Parks and Wildlife Service managed the Warra Long-term Ecological Research Site in southern Tasmania between 2016–2021.

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INTRODUCTION

Tasmania's forests are diverse and highly valued, and are among the state's most important natural resources, containing a range of unique flora and fauna. They occur in a broad range of geographic landscapes and climatic environments and contain many endemic species. Tasmania's forests deliver a wide range of environmental, social, and economic values. Forests provide ecosystem services such as clean water and soil protection, as well as providing opportunities for recreation, tourism, scientific and educational pursuits. Tasmania's forests hold important cultural, heritage and aesthetic values and provide wood and non-wood products that are used by all Tasmanians and Australians in their everyday lives.

The Tasmanian Regional Forest Agreement (RFA), which was first signed in 1997, provides a framework for the sustainable management of Tasmania's public and privately owned forests. The RFA seeks to balance the economic, social and environmental demands on Tasmania's forests. In accordance with clause 91 of the RFA, the Tasmanian and Australian Governments (the parties) jointly developed and agreed upon a set of sustainability indicators. These Sustainability Indicators, are aligned with the Montreal Process Criteria and Indicators (as further required by clause 91 of the RFA), as adapted to Australia through the Montreal Process Implementation Group. The Montreal indicators are internationally agreed criteria for the conservation and sustainable management of temperate and boreal forests (Montreal Process Working Group, 2015).

To meet the requirement of clause 72 of the RFA, Tasmania's agreed sustainability indicators are reported on every five years in the *State of the forests Tasmania* reports (TasSOFR). As noted in clause 9D of the RFA, the *State of the forests Tasmania 2022* report will be a key source of information for the next RFA five-yearly review, which will formally commence in late 2022.

As well as meeting the requirements of the RFA, this report satisfies section 4Z of the *Forest Practices Act 1985*, which requires the Forest Practices Authority (FPA) to report every five years on the state of Tasmania's forests. This 2022 report builds on previous TasSOFRs released in 2002, 2007, 2012 and 2017. The TasSOFR series allows the state of Tasmania's forests to be compared across a range of social, economic, and environmental forest-related indicators.

Information from the TasSOFR is fed into the Australian *State of the Forests Report* (SOFR), which is also produced every five years. In turn, the SOFR provides data directly to international processes including the Global Forest Resources Assessment led by the Food and Agriculture Organization of the United Nations, the United Nations Sustainable Development Goals, and the Global Forest Goals of the United Nations Forum on Forests.

Tasmania's forests and forest industry have continued to evolve since the last reporting period. Notably, the COVID-19 pandemic has had an impact upon the multiple socioeconomic benefits delivered by Tasmania's forests. As highlighted within Criterion 6 in this report, the pandemic has caused severe disruptions to forestry supply chains as well as the tourism industry.

The policy and legislative framework within which Tasmania's forest and forest industry operates has remained relatively stable over the last five years (see Criterion 7 for further detail). A detailed up-to-date overview of Tasmania's forest management system is available on the Department of Natural Resources and Environment's website (Department of State Growth, 2021). Changes to the system over the past five years include:

- updates to the *Forest Practices Code* – launched October 2020 and in force as at 1 January 2021)
- minor amendments to the *Forest Practices Act 1985* (late 2019)
- publication of the *Tasmanian Special Species Management Plan 2017*

- development of the Threatened Flora Adviser tool. This has since been combined with the Threatened Fauna Adviser to create the Threatened Species Adviser, available on the FPA's website.

When it comes to the natural environment, our forests have been and will continue to be impacted by a changing climate. Extreme and unprecedented weather events are increasing in their frequency and severity. Current climate forecasts predict that we are likely to experience extreme weather conditions that exceed the bounds of historical norms and concurrent climate hazards are likely to compound the overall climate risk for sectors and regions across Australia and the globe. Climate change is also expected to increase the risk of biological pathogens and disease.

The Sixth Assessment Report from the United Nations Intergovernmental Panel on Climate Change (Pörtner et al., 2022) makes it clear that the climate change is expected to become more prevalent over the next century as emissions continue to increase. This is a trend that will have consequences for the health of forests worldwide. Climate change can alter and create new habitats for tree species and make existing habitats unsuitable which will change forest structure and geographic ranges across the landscape.

Changes in water availability and annual rainfall are predicted to occur with climate change as well. Annual rainfall in Australia varies due to natural conditions, but there has been a long-term shift towards lower rainfall in the south-west and above-average rainfall in the north. These rainfall patterns are expected to lead to an increase in flash flooding in northern Australia and drought conditions in southern and eastern Australia.

Tasmania's forests are exposed to these risks from climate change and increased bushfire risks created from a warming planet. It is already being reported that Tasmania's forest ecology is changing (Wardlaw, 2022b) (see Box 5.1.a.1, Criterion 5). There are however also a range of opportunities for Tasmania's forests and forest industry in the context of climate change, as forests are the most cost-effective carbon-capture technology available. Carbon markets are expected to grow substantially over the coming decades as economies look to achieve net-zero emission economies. Tasmania's forest industry is well prepared to participate in carbon markets given its advancements in carbon accounting. In 2021, Forico become the first forest company in Australia to publicly release natural capital accounts. Tasmania's public forest manager, Sustainable Timber Tasmania (STT), is also actively engaged in carbon accounting (see Criterion 5).

HOW TO USE THIS REPORT

The reporting period for this current report is nominally 1 July 2016 to 30 June 2021. All information relates to this period, unless otherwise stated.

This report is organised under a framework of seven criteria for sustainable forest management, and associated indicators:

(i) Conservation of biological diversity

(ii) Maintenance of productive capacity of forest ecosystems

(iii) Maintenance of ecosystem health and vitality

(iv) Conservation and maintenance of soil and water resources

(v) Maintenance of forest contributions to global carbon cycles

(vi) Maintenance and enhancement of long-term multiple socio- economic benefits to meet the needs of societies

(vii) Legal, institutional and economic framework for forest conservation and sustainable management.

Each criterion is presented as a separate chapter of this TasSOFR. Case studies are presented within indicators to illustrate the information reported. The executive summary provides an overview for the seven criteria. Previous TasSOFRs are available at the FPA website.

For the purpose of this report 'forest' is defined as

> *'An area, incorporating all living and non-living components, that is dominated by trees having a single stem and a mature or potentially mature stand height exceeding 2 metres and with existing or potential crown cover of overstorey strata about equal to or greater than 20%. This includes Australia's diverse native forests and plantations, regardless of age. It is also sufficiently broad to encompass areas of trees that are sometimes described as woodlands.'* (Montreal Process Implementation Group for Australia and National Forest Inventory Steering Committee, 2018)

Note that multiple agencies participated in the preparation of this report, resulting in provision of data from a variety of sources for each criterion. The report aims to keep consistency in data used for a particular criterion/indicator between reporting periods. Consequently, where there is some overlap between criteria, there may be discrepancies in the numbers reported for a similar indicator. This is largely due to differences in the original datasets used for reporting different criteria, variations in the update data gathered (e.g. imagery versus mapped boundaries), updates to historical data due to remapping, and/or the analysis undertaken to derive a particular figure. Attempts to clarify any discrepancies have been made throughout the report.

CRITERION 1: CONSERVATION OF BIOLOGICAL DIVERSITY

1.1 ECOSYSTEM DIVERSITY

This sub-criterion measures the current extent of forest cover, by forest type and growth stage, and its distribution across land tenures and reserve types.

The area and growth stage of each forest community provides a measure of the extent and diversity of ecosystems, while the land tenure and reservation status provides a measure of the comprehensiveness, adequacy and representativeness of the conservation reserve system.

Land tenure broadly reflects the intended use and legislative rights and responsibilities under which land and forests are managed. The tenure groups reported in this sub-criterion reflect the public land classification system implemented by the Tasmanian *Regional Forest Agreement (Land Classification) Act 1998* (Tasmanian Government, 1998). Land tenure is recorded as at 30 June 2021, and is based on the Department of Natural Resources and Environment's (NRE Tas) land classification mapping.

Reservation status for conservation purposes is more specifically reported under Indicator 1.1.c. Reservation status is recorded as at 30 June 2021 and is based on the Tasmanian Reserve Estate dataset (Figure 1.1.a.1). This spatial layer is a composite of public and private reserve data across all land tenures.

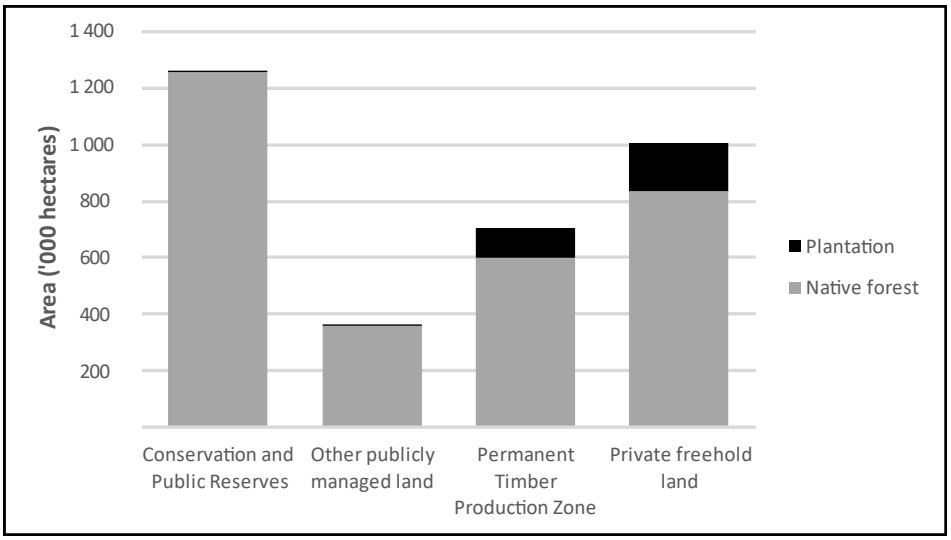

Figure 1.1.a.1 Area of forest by tenure as at June 2021

This Ecosystem Diversity sub-criterion is broken down into five indicators, which are reported separately below.

Indicator 1.1.a Extent of area of forest types

The extent of each of the different vegetation communities is a measure of the forests' biological diversity at the species and ecosystem levels. As part of the development of the Tasmania Regional Forest Agreement in 1996 (RFA) (The State of Tasmania and Commonwealth of Tasmania, 1997), the

state's native forest was classified and mapped into 50 (now 51[a]) communities, and further grouped by broad vegetation types as a basis for assessing their extent and conservation status and for monitoring change (Figure 1.1.a.2).

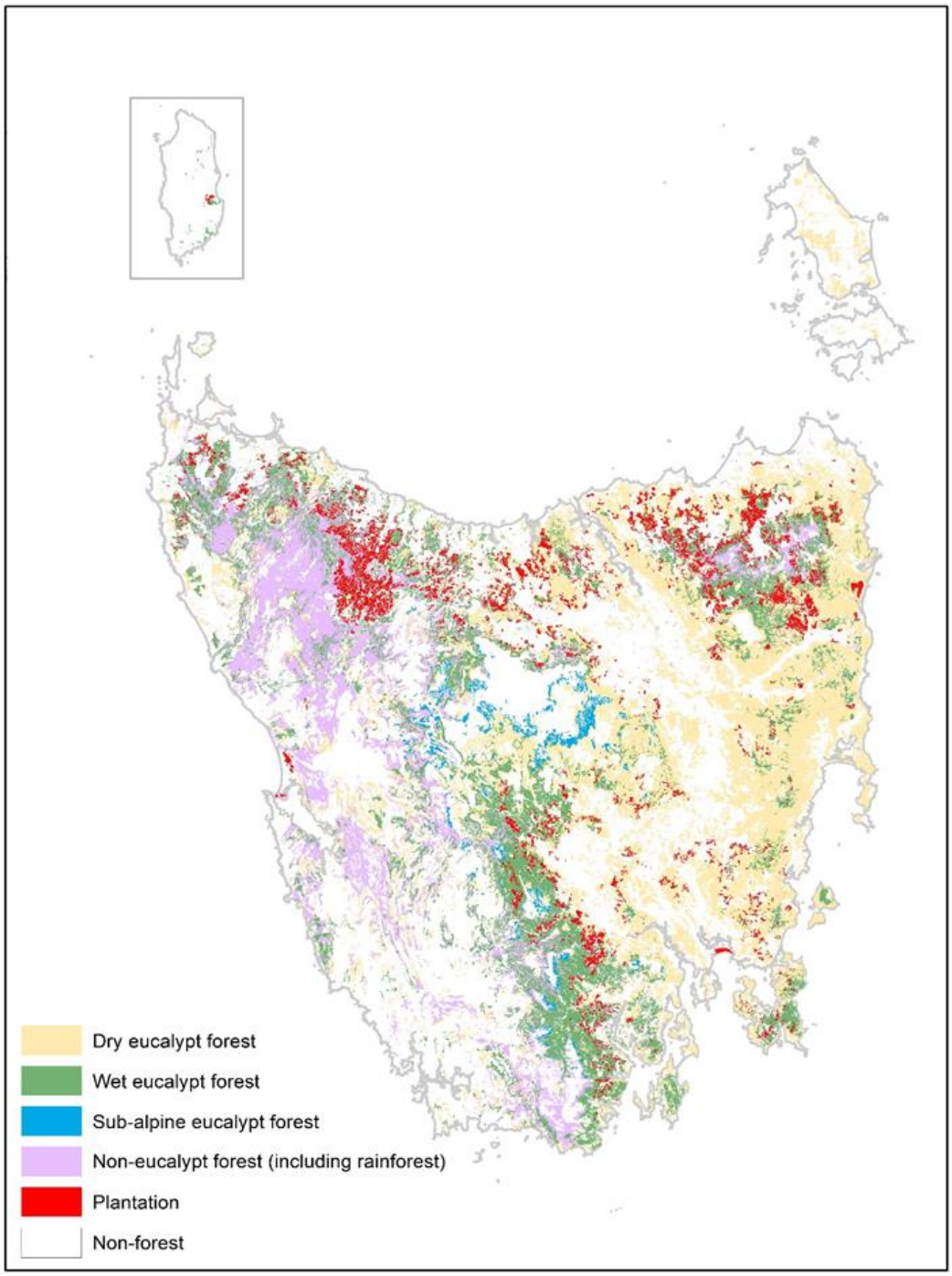

Figure 1.1.a.2 Distribution of broad forest types in Tasmania as of June 2021

[a] During 2005-06, inland *Eucalyptus amygdalina* forest was separated into 'Inland *E. amygdalina* – *E. viminalis* – *E. pauciflora* on Cainozoic deposits' and '*E. amygdalina* forest on mudstone'.

Under the RFA, a comprehensive, adequate, and representative (CAR) forest-reserve system was established for a revised land-tenure system to ensure that each forest community is securely protected for conservation purposes (Department of Natural Resources and Environment Tasmania, 2021). Forest communities listed as threatened under the *Nature Conservation Act 2002* are also protected on public land outside the reserve system wherever prudent and feasible and managed on both public and private land in accordance with the *Forest Practices Act 1985* (FPA, 2022b). The 2017 Policy for Maintaining a Permanent Native Forest Estate (PNFE, Department of State Growth, 2017) prohibits broadscale clearing and conversion of native forest, other than in limited prescribed circumstances (e.g. limited clearing for agricultural purposes).

The data used for indicator 1.1a is derived from the 2005 RFA data set, which has only undergone updates related to loss of native forest through clearing and conversion. This data will have diverged over time from the forest type data reported by STT, as their forest data is continually updated. This explains why the figure for PTPZ land in Figure 1.1.a.1 (706 000 ha) is different to the figure (812 000 ha) reported in other indicators.

For this assessment of forest change, data are as at the first quarter of 2020 – not mid 2021 – due to the time required to analyse the satellite imagery. Under the Monitoring Vegetation Extent Program (Department of Natural Resources and Environment Tasmania, 2022e), changes in the extent of forest communities between 2015 and 2020 were mapped by analysing satellite imagery annually, and compiling the clearing and conversion to alternative land use detected over private land for the five-year period. Changes for any reason are detected, not only those changes recorded within forest practices plans (FPPs). Changes greater than 0.5 ha were individually validated by trained operators using the best available high-resolution imagery. The MVEP results indicated a decrease in the mapped extent of native forest in the RFA vegetation communities of 9,300 ha, for the 2015 to 2020 period, separately from any decrease arising from clearing native forest for new plantations. Hereafter in this indicator, the period over which forest change is referred to in general terms is between the start of the reporting period (July 2016) and end of the reporting period (June 2021) and will be referred to as 2016 and 2021, to match the tenure and reserve data.

In line with the recommendations of the original MVEP, the results of the MVEP clearing and conversion data for 2005, 2010 and 2015 have been revised using aerial photography that is now readily available, and the statistical inferences that were previously applied, have been removed. A new 2015 baseline has been established based on this revision. This has resulted in small variances in the extent figures of this report compared with previous TasSOFRs, but by no more than 500 ha across any forest community. A full comparison of the effects of this revision is available on request. Following categorisation of the changes detected for the 2015 to 2020 period, these data were applied to the revised 2015 RFA vegetation maps to develop a new forest extent map as at 2020.

The changes in the extent of communities reflected in this indicator are not readily comparable with data used by the FPA for reporting on the permanent native forest estate (PNFE). The PNFE provides data to monitor the area of native forest types in each bioregion and is informed by multi-year FPPs. Combined, the FPPs give the gross areas planned and approved for future clearing and conversion to an alternative land use (e.g. clearing for agriculture). Approved FPPs may not be implemented yet or the land manager for a variety of reasons may decide not to implement a part or all of a particular plan. Indicator 1.1.a maps the actual forest extent by monitoring woody change using validated satellite imagery.

The workflow now used for analysing Landsat images, developed by the Queensland Remote Sensing Centre (DSITI, 2016), includes an image compositing technique that enables the detection of change that would otherwise be obscured by cloud or cloud shadow. However, there may still be

some areas of change that remain undetected. Data for each forest community as of June 2021 are summarised in Table 1.1.a.1 and in greater detail in Appendix 1. To reflect the resolution of forest mapping, areas are generally quoted to the nearest 1,000 ha; areas smaller than 1,000 ha are quoted to the nearest 100 ha and areas smaller than 100 ha are quoted to the nearest 10 ha.

The main differences over time (Table 1.1.a.1) are:

- Plantation on permanent timber production zone land (PTPZ) land has decreased by approximately 4,000 ha.
- Dry eucalypt forest on other public land has decreased by approximately 1,000 ha. Some areas that were previously Crown land are now private land.
- On private land, the extents of dry eucalypt and wet eucalypt forests have decreased.
- Plantation extent has decreased on private land.

The main trends evident from the data used for this indicator are:

- The trend in total forest extent from 2016 to 2021 reflects a 0.9% decrease in the extent of both native forest (reduced by 9,600 ha or 0.3%) and plantations (reduced by 19,900 ha or 6.6%). Total native forest extent has decreased by 162,600 ha (5.1%) since 1996. On private freehold land, 450 ha of native forest was converted to plantation during the reporting period.
- The native forest communities with the largest total area decreases during the reporting period, were coastal *E. amygdalina* dry sclerophyll forest (1,600 ha or 0.9%); tall *E. obliqua* forest (1,200 ha or 0.3%); *E. amygdalina* forest on dolerite (1,000 ha or 0.6%) and dry *E. obliqua* forest (800 ha or 0.5%).
- Five native forest communities decreased in area by greater than or equal to 1% of their extent in 1996 during the reporting period; two of these are wet eucalypt forests and three are dry eucalypt forests.
- Eight native forest communities listed as threatened under Schedule 3A of the *Nature Conservation Act 2002* have decreased in area during the reporting period: three of these are wet eucalypt forests, five are dry eucalypt forests. The threatened communities with the greatest percentage loss are: shrubby *E. ovata* forest (-1.9%), King Island *E. globulus/E. brookeriana/E. viminalis* forest (-1.5%), *E. brookeriana* wet forest (-1.2%), inland *E. amygdalina* forest (-1%) and inland *E. tenuiramis* forest (-1%).

Table 1.1.a.1 Extent of forest by tenure[a] and change since 1996 and 2015

RFA forest vegetation community	Land classification (tenure)						
	Conservation and public reserves[b] (k ha)	PTPZ [c] (k ha)	Other publicly managed land (k ha)	Private freehold land (k ha)	Total (k ha)	Change since 1996 %	Change since 2015[d] %
Dry eucalypt	455	199	170	673	1,497	-4.7	-0.5
Wet eucalypt	287	306	100	109	802	-8.1	-0.2
Sub-alpine eucalypt	51	3	5	7	65	0.0	0.0
Non-eucalypt	463	91	82	45	681	-2.7	-0.1
Native forest total	**1,255**	**600**	**357**	**833**	**3 045**	**-5.1**	**-0.3**
Plantation	2	107	1	172	282	92.5	-6.6
Total forest	**1,256**	**706**	**358**	**1,005**	**3,327**	**-0.8**	**-0.9**

a) Forest extent is as at the first quarter of 2020 and tenure is as of 30 June 2021
b) Nature Conservation Act, Crown Lands Act reserves
c) The data used for forest extent, including PTPZ land was originally derived from the 2005 RFA data set, which has only undergone updates related to loss of native forest through clearing and conversion. This data will have diverged over time from the forest extent data reported by STT (e.g. 1.1.b.1), as their forest data is continually updated
d) For the comparison with 2015 extents, the new 2015 baseline has been used

Indicator 1.1.b Area of forest by growth stage

The spread of age classes across forest communities is a measure of ecosystem diversity, since the structure and species composition of a forest changes as it grows older. The maintenance of a full range of age-classes across the forest estate is a key component of sustainable forest management. This indicator is intended to reflect the general distribution of the growth stages of the different forest communities across broad tenure categories.

Old-growth forest is defined as an ecologically mature forest where the effects of disturbances are now negligible (ANZECC/MCFFA, 1997). In comparison, forests are classified as mature when they are about 100 years old and begin to develop structural features typically found in older forests (FPA, 2016). Thus, this indicator considers areas of older forest that contain important structural attributes even when the trees are not highly senescent, and irrespective of the disturbance history of the forest. The reservation status of old-growth forest for conservation purposes is reported under Indicator 1.1.e.

The age of a natural forest can be difficult to define. For the purpose of broad-scale categorisation, the crown characteristics of trees are a reliable surrogate for growth stage, particularly for eucalypt species.

In Tasmania, aerial photo-interpretation (PI) has historically been used to classify eucalypt forests into three growth stages: young regeneration, regrowth (typically aged 20–100 years), and mature forest (including over-mature or senescent stands) (Stone, 1998). State forest was historically remapped on a rolling 20-year cycle. However, statewide growth stage mapping of forest on all tenures was last completed in 1996. As there is no longer a current program of growth stage re-mapping over all private property and conservation reserves, the full effects on forest structure of fire and other natural processes are not reflected in the data for these tenures.

Changes in forest structure and type due to harvesting, regeneration, and other forestry operations are recorded. STT maps changes in the extent of native forest and plantations on permanent timber production zone (PTPZ) land annually using information from ground surveys. Private Forests

Tasmania (PFT) also maps changes due to harvesting, regeneration, and plantation operations on private land, annually. For private land, this re-mapping is done using available imagery based on the location and information submitted to the FPA for individual FPPs as certified. This could result in errors, usually an over-estimate of harvesting area, as the planned operations may not proceed to the extent indicated in the approved plan. On public land this re-mapping also covers partial harvest boundaries where there hasn't been aerial photography and therefore can also lead to overestimation of harvested areas.

The practical limitations of growth-stage mapping continue to limit interpretation of the data.

In 1996 there was a high degree of spatial congruence between the RFA vegetation mapping and PI-type mapping, because RFA vegetation mapping was based on PI-type derived polygons. As a result, few areas were then classified as 'Unknown'. Since then, there have been changes in mapping methodologies. Additionally, because the growth-stage mapping and the forest community group mapping are compiled independently and use different definitions and attributes of forests, there are some areas mapped as eucalypt communities for which no growth-stage can be determined. Lastly, growth stage cannot readily be mapped for most non- eucalypt communities.

Despite these limitations, the data provide a good overview of the 2021 distribution of growth stages by forest type and tenure. The results of the 2021 growth-stage analysis are summarised in Table 1.1.b and Figures 1.1.b.1 and 1.1.b.2 below. To reflect the resolution of forest mapping, areas are generally quoted to the nearest 1,000 ha.

Salient points from the 2021 data are as follows:

- 40% of mature eucalypt forest, across all land tenures are in conservation reserves.
- For forests of known growth stage (largely eucalypt forest), 6% are regeneration, 23% are regrowth, and 71% are mature forest.
- In dry eucalypt forests of known growth stage, the proportion of regeneration and regrowth is relatively low. The highest proportion of these younger dry eucalypt forests falls on private land (42%).
- In the wet eucalypt forest of known growth stage, the proportion mapped as younger growth stages (i.e., regeneration and regrowth) across all tenures is significantly higher than in the dry eucalypt forest. This is due in part to the ecology of wet eucalypt communities, which tend to grow in single-aged stands in which regrowth is readily identifiable. Dry eucalypt forest usually grows in multi-aged stands, so that even forests mapped as mature growth stage usually contain a proportion of younger trees.
- Within the wet eucalypt forest, the highest proportions of younger growth stages are on PTPZ land. On private land, only a low proportion of total forest is wet eucalypt, but over half of this is in the younger growth stages.

Table 1.1.b.1 Area (k ha) of native forest types by growth stage and tenure groups[a,h]

RFA forest vegetation community by tenure group[d]	Growth stage[c]				
	Regeneration	Regrowth	Mature (including overmature)	Unknown	TOTAL
Conservation reserves[e]					
Dry eucalypt	0	60	384	0	444
Wet eucalypt	5	53	225	0	284
Sub-alpine eucalypt	0	11	36	0	47
Non-eucalypt[b]	0	0	0	459	459
Total	5	124	646	459	1,234
PTPZ land[f]					
Dry eucalypt	17	67	108	0	192
Wet eucalypt	60	121	116	0	296
Sub-alpine eucalypt	0	0	2	0	3
Non-eucalypt[b]	0	0	0	88	88
TOTAL	77	188	225	88	579
Other publicly managed land[g]					
Dry eucalypt	7	24	133	0	163
Wet eucalypt	7	29	62	0	98
Sub-alpine eucalypt	0	1	3	0	4
Non-eucalypt[b]	0	0	0	80	80
TOTAL	13	53	198	80	345
Private freehold land					
Dry eucalypt	18	108	503	0	629
Wet eucalypt	9	49	42	0	99
Sub-alpine eucalypt	0	1	5	0	6
Non-eucalypt [b]	0	0	0	40	40
TOTAL	27	158	549	40	774
Total all tenures					
Dry eucalypt	42	259	1,128	0	1,428
Wet eucalypt	81	251	445	0	777
Sub-alpine eucalypt	0	13	46	0	59
Non-eucalypt[b]	0	0	0	668	668
Total all types	123	523	1,619	668	2,933

a) Native forest growth stage is derived from photo-interpreted forest type (PI-type) classification mapping as at 30 June 2021 on publicly managed land, and 31 December 2020 on private land

b) Non-eucalypt communities cannot readily be mapped by growth stage

c) Rounded to nearest thousand ha

d) Tenure as at 30 June, 2021

e) Nature Conservation Act and Crown Lands Act *Reserves*

f) Forest Management Act 2013

g) Publicly managed land includes land managed by public authorities

h) The data used for forest extent has diverged over time from the forest extent data reported in 1.1.a.1 due to the different data source

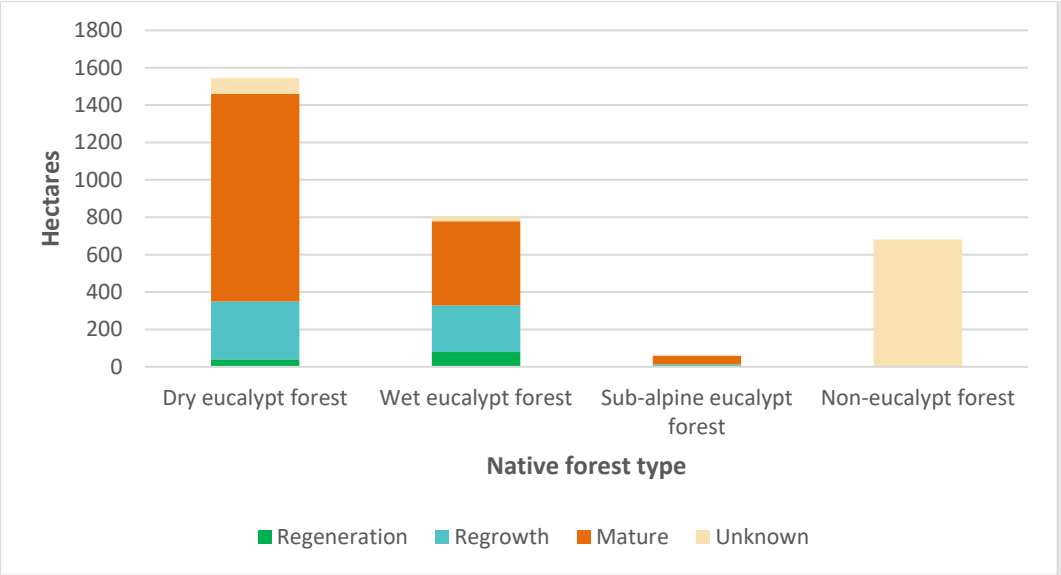
1800
1600
1400
1200
1000
800
600
400
200
0
Hectares
Dry eucalypt forest
Wet eucalypt forest
Sub-alpine eucalypt forest
Non-eucalypt forest
Native forest type
Regeneration
Regrowth
Mature
Unknown

Figure 1.1.b.1 Growth stages of native forest types as at June 2021

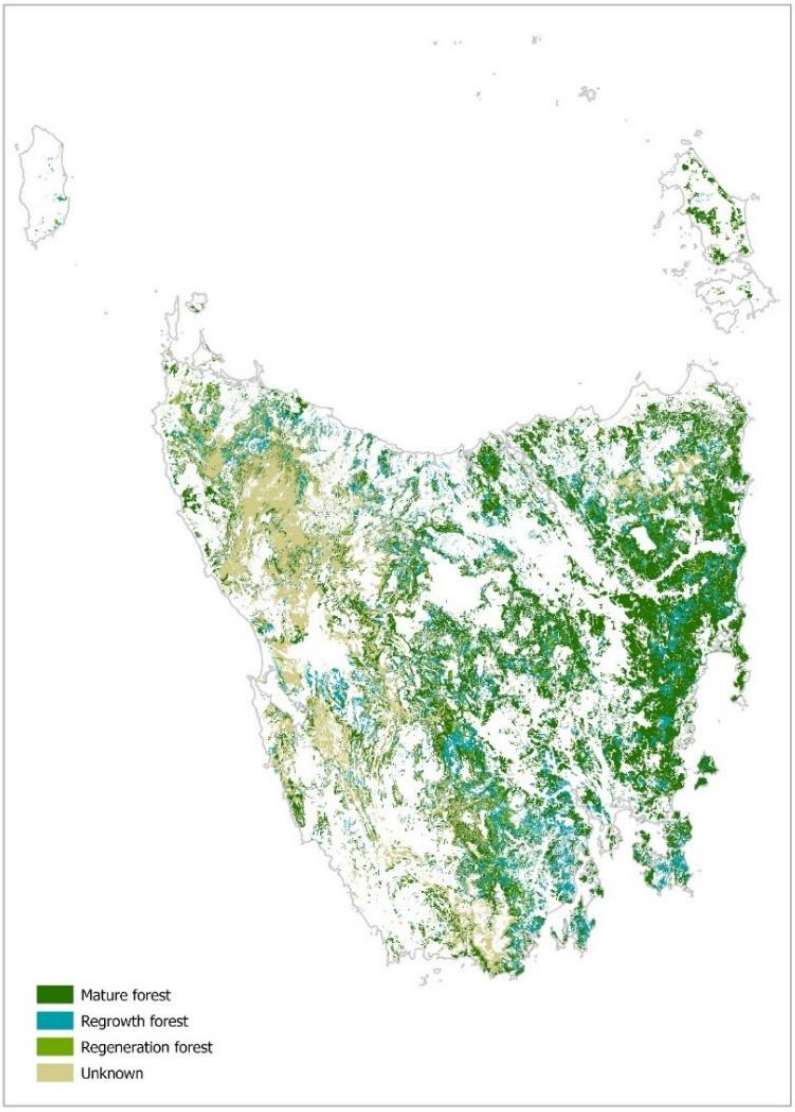

Figure 1.1.b.2 Growth stage of native forest as at June 2021

Indicator 1.1.c Extent of area by forest type and reservation status

The extent of reservation of different forest vegetation communities is a measure of the degree of protection of biological diversity at the species and ecosystem levels.

Under the Tasmanian RFA, a comprehensive, adequate, and representative (CAR) forest-reserve system was established for a revised land-tenure system to ensure that each forest community is securely protected for conservation purposes (Department of Natural Resources and Environment Tasmania, 2021). CAR reserves are those reserves designated to meet the RFA objective. They can include both formal and informal reserves, on both public and private land. Some forest communities are also protected on public land outside the reserve system wherever prudent and feasible. Forest communities identified as rare, vulnerable, or endangered (threatened) in the RFA process are protected from clearance and conversion on both public and private land under the Tasmanian forest practices system other than in exceptional circumstances (FPA, 2022b).

The RFA recognised four components of reservation:

- Formal reserves on publicly managed land tenures that cannot be revoked without parliamentary approval; of these, dedicated formal reserves exclude reserves where mining is allowed which are classified as other formal reserves.
- Informal reserves on public land that are protected through administrative instruments by public authorities.
- Private CAR reserves on private land that are managed in the long-term for the protection of CAR values under secure arrangements, including proclamation under legislation, contractual agreements such as management agreements and covenants, and reserves set aside under independently certified forest management systems.
- Values managed by prescription – these areas outside of other reserves are not recorded as reserves for the purposes of this indicator.

The National Wilderness Inventory in 1996 identified sixteen separate areas of high-quality wilderness (HQW) in Tasmania. These were used as the basis for reservation analysis under the RFA. Appendix 2 provides updated reservation levels for these high-quality wilderness areas.

As at June 2021, 99% of high-quality wilderness areas were protected within the CAR reserve system. This is an increase of 261,600 ha (13%) since 1996. For the first time, Appendix 2 provides information about the area of forest, and reserved forest within each high-quality wilderness area. The only change since 2016 data is in the Cradle-Central Plateau HQW area. The increase in informal and private reserves area (up from 1900 ha to 2400 ha) in the Cradle-Central Plateau HQW area was due to the registration of the trawtha makuminya conservation covenant in January 2017.

Indicators 1.1.a and 1.1.b provide details on how changes in forest extent are mapped over time. Changes in reservation status are recorded within the Tasmanian Reserve Estate spatial layer and are recorded as at 30 June 2021. This spatial layer is a composite of public and private reserve data across all land tenures.

Forest extent by the International Union for Nature Conservation (IUCN) categories is summarised in Table 1.1.c.1. The IUCN categories (IUCN, 1994) are as follows:

ia – strict nature reserve: protected area managed mainly for science

ib – wilderness area: protected area managed mainly for wilderness protection

ii – national park: protected area managed mainly for ecosystem conservation and recreation

iii – natural monument: protected area managed for conservation of specific natural features

iv – habitat/species management area: protected area managed mainly for conservation through management intervention

v– protected landscape/seascape: protected areas managed mainly for landscape/seascape conservation and recreation

vi – managed resource protected areas: protected area managed mainly for the sustainable use of natural ecosystems.

The reservation status of forests whose extent was mapped as at the first quarter of 2020 are summarised in Tables 1.1.c.2 and 1.1.c.3 below and presented in more detail in Appendix 1. The change in the reserved area of broad forest types between 1996 and 2021 is illustrated in Figure 1.1.c.1 and the current area of reserved forest is illustrated in Figures 1.1.c.2.

The CAR reserve system comprises 3.428 million ha of land, equivalent to 50.3% of the total land area of Tasmania. Approximately half contains forest. Public land reserves comprise 3.266 million ha and private land reserves cover 162,000 ha.

The main contributions to the increase in reserved land since 2016 have been new conservation covenants on private land (approximately 13,000 ha), including both voluntary covenants and covenants established to meet regulatory requirements. Additionally, Stewardship Agreements have been created through the Midlands Conservation Fund, representing over 7,000 ha (Tasmanian Land Conservancy, 2013).

Trends evident from the data are:

- Implementation of the CAR reservation framework agreed under the RFA has resulted in an extended system of public and private terrestrial reserves. Within this framework, 1.786 million ha of forested land, or 58.7%, of Tasmania's native forest, is now protected, up from the 1996 extent of 977,900 ha. This represents an increase of 808,100 ha above the 1996 area, and by 8,700 ha since 2016.
- Progress has been made in implementing protected areas on private freehold land.
- Most protected forests are on public land: 70% of reserved native forest are in formal reserves, of which 37% is unavailable for mining and 33% is subject to the *Mineral Resources Development Act 1995*. Informal reserves and private CAR reserves account for the remaining 30%.
- The slight decrease in reserved extent of non-eucalypt forest between 2016 and 2021 was due to a decrease in the area of fixed-term reserves on private land (Figure 1.1.c.1).

Table 1.1.c.1 Area (k ha)[(a)] of native forest type protected by IUCN category of reserve

RFA forest vegetation community	IUCN Category									
	Ia	II	Ib	II/Ib	III	IV	V	VI	Not Classified [(b)]	Total
Dry eucalypt	11	75	0.2	127	12	143	18	134	201	721
Wet eucalypt	0.5	30	3	134	3	47	21	55	143	437
Sub-alpine eucalypt	0	5	0.2	28	0	0.5	5	11	4	55
Non-eucalypt	0.4	12	0.3	230	10	69	23	121	108	573
Total	**12**	**122**	**4**	**519**	**26**	**260**	**67**	**320**	**456**	**1786**

a) Forest extent is as at the first quarter of 2020 and IUCN category is as at 30 June 2021
b) The areas listed having a 'Not Classified' IUCN category are other reserves within the CAR reserve system

Table 1.1.c.2 Area (k ha)[(a)] of native forest type protected by reserve class

RFA forest vegetation community	Reserve type						
	Public land			Private land			
	Dedicated formal reserve	Other formal reserve[(b)]	Informal CAR reserve	Unreserved public land[(c)]	Private CAR reserves	Other private land	Total
Dry eucalypt	227	224	188	184	81	592	1 497
Wet eucalypt	165	121	138	269	12	97	802
Sub-alpine eucalypt	33	17	4	3	0.4	6	65
Non-eucalypt	242	220	101	72	9	36	681
Total	**669**	**583**	**431**	**528**	**103**	**730**	**3 045**

a) Forest extent is as at the first quarter of 2020 and reserve class is as of 30 June 2021
b) Subject to the Mineral Resources Development Act 1995
c) Includes PTPZ land

Table 1.1.c.3 Change in reservation status of native forest types

RFA forest vegetation community	Total area (k ha)	Total area in CAR reserves (k ha)	Existing forest now in reserves (%)	Change in percentage since 1996 (%)	Proportion of pre-1750 forest extent in reserves (%)	Change in percentage since 1996 (%)
Dry eucalypt	1,497	721	48.2	26.7	26.9	14.3
Wet eucalypt	802	437	54.5	28.2	34.7	16.5
Sub-alpine eucalypt	65	55	85.0	13.5	78.8	12.9
Non-eucalypt	681	573	84.2	32.0	71.0	25.8
Total	3,045	1,786	58.7	28.2	37.0	16.8

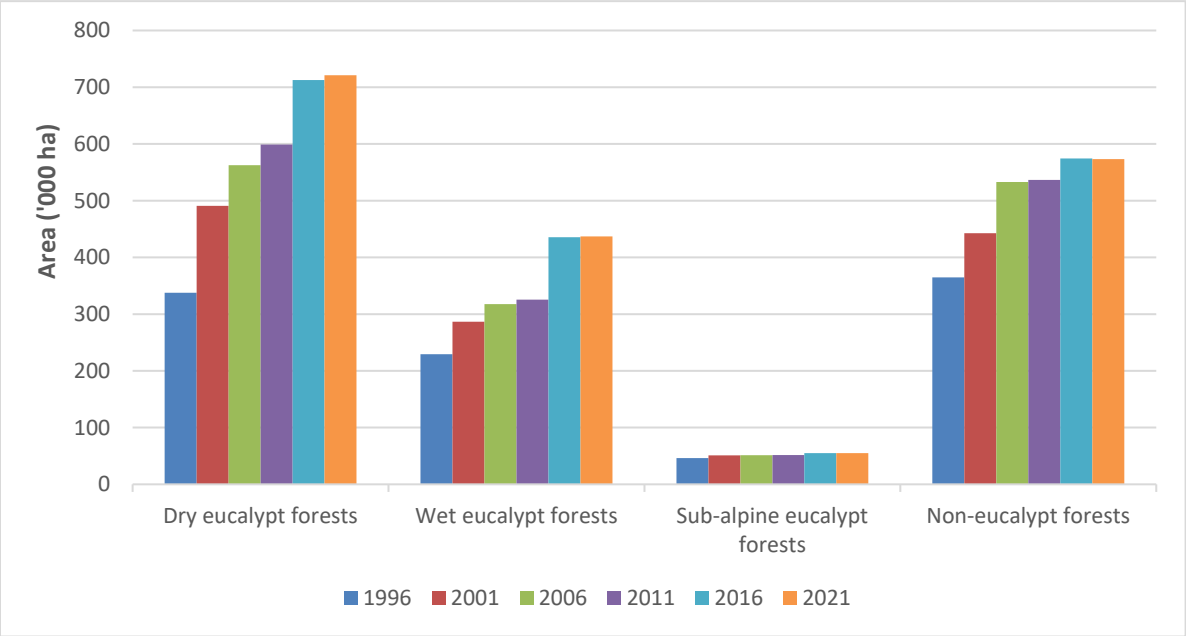

Figure 1.1.c.1 Change in reserved area of broad forest types, 1996–2021

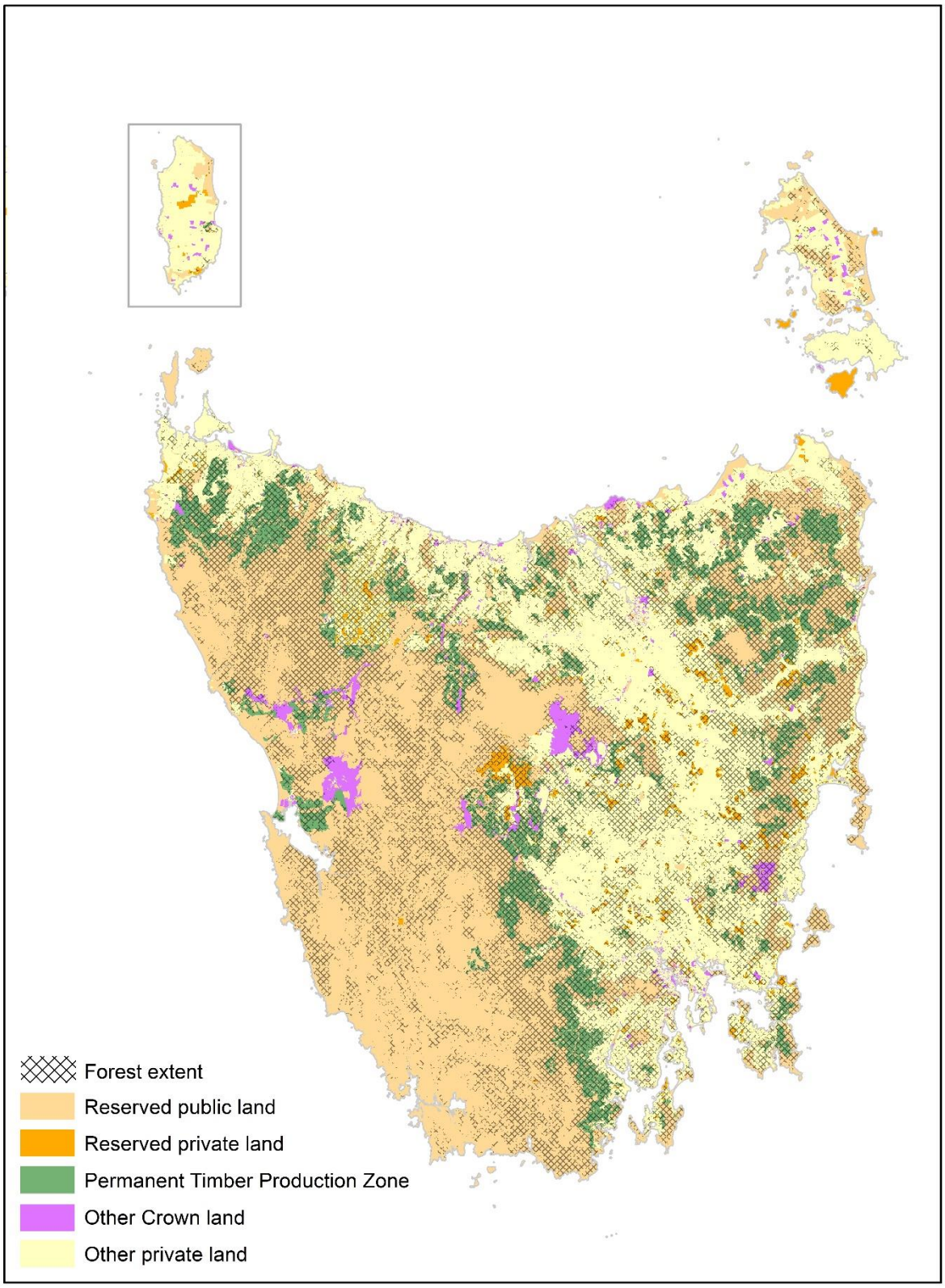

Figure 1.1.c.2 Distribution of forest by tenure as of June 2021

Indicator 1.1.d Fragmentation of forest cover

This indicator considers the size, shape and connectivity of forest. It is also concerned with size of forest remnants and their susceptibility to exotic species invasions; correlation between size of remnants and numbers of species and population viability; and possible impacts on pollination, seed dispersal, wildlife migration and breeding.

Forest fragmentation was not specifically considered during the studies leading to the RFA. Consequently, there is very limited information concerning the relevant attributes that are reported nationally and internationally. The information presented here is from the TASVEG forest extent layers 2005, 2010, 2015 and 2020 which show forest and woodland occurrences down to patches of about one hectare. This mapping provides a good record of forest patchiness, but careful interpretation is required.

All patches of forest and woodland within the TASVEG extent layers were allocated to patch sizes consistent with those used in Australia's State of the Forests Report 2003 (National Forest Inventory, 2003). The proportion of the total area of forest was calculated for all patches in each of the patch size classes for the years 2005, 2010, 2015 and 2020; the results are presented in Figure 1.1.d.1. If a large area of forest was bisected by a major road or a river, it was counted as two patches.

Over 45% of Tasmania's forests occur in patches larger than 50,000 ha. A further 33% of total forest area occurs in patches between 5,000 ha and 50,000 ha. If plantations were incorporated, the proportions of forest in the five largest patch size classes would increase. The remainder is distributed right across the range of remaining size classes below 5,000 ha. Approximately 8% of Tasmania's total forest area occurs in patches less than 200 ha in size.

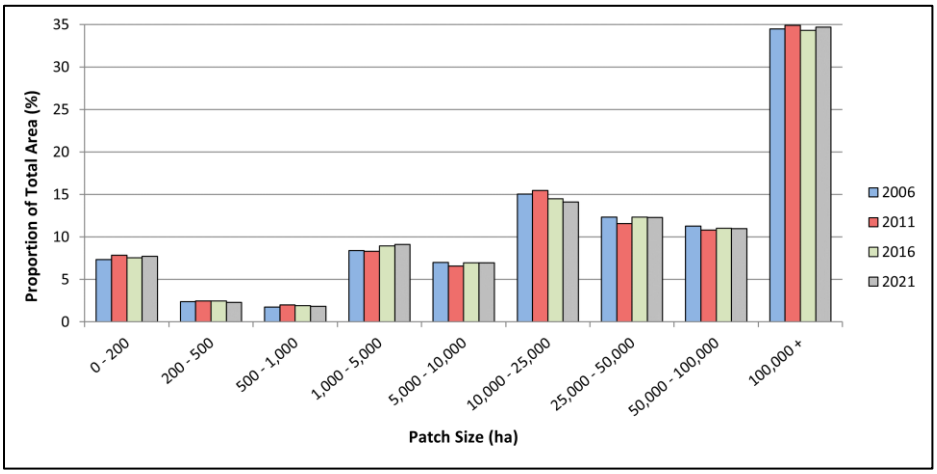

Figure 1.1.d.1 Proportion of total area of Tasmanian forest, by patch size 2006–2021

Forests may be naturally fragmented where they occur in a matrix of non-forest communities, as is the case in vast tracts of the Tasmanian Wilderness World Heritage Area. Many of these smaller forest patches are likely to be forest copses occurring naturally amongst native non-forest vegetation such as in south-west Tasmania. In parts of this area, where fire intervals have been very long, there may also be a process of coalescing forest patches. There is a qualitative difference between such fragmented patches within contiguous native vegetation and the situation where forest patches/remnants occur within a cleared agricultural landscape.

Even in some areas of the dry Midlands, open grasslands have persisted since European settlement interspersed in some cases with dry forest and woodland.

Over 72% of Tasmania has native vegetation cover and there is a high degree of connectivity within remaining forested landscapes.

Indicator 1.1.e Area of old growth by forest type and reservation status

The spread of age-classes across forest communities is a measure of ecosystem diversity, since the age structure and species composition of a forest change as it grows older. Sustainable forest management requires the maintenance of a full range of age-classes across the forest estate.

The concept of 'old-growth' is defined in the RFA as ecologically mature forest where the effects of disturbances are now negligible (ANZECC/MCFFA, 1997). During the development of the RFA in 1996, old-growth was mapped by classifying forest vegetation types according to the proportion of senescent crowns in each stand and their history of disturbance by fire, harvesting and grazing.

There has been no broad-scale re-mapping of old-growth forest since 1996. In the 1996–2001 and 2001–2006 reporting periods (FPB, 2002, FPA, 2007), the area and extent of old-growth forest was reported as the 1996 area less the area that had been recorded as harvested since 1996. In the 2006–2011 period (FPA, 2012), the area of old-growth forest was identified using a combination of satellite remote sensing of forest change attributed to wildfire and unspecified disturbance, and harvesting activity. In the 2011–2016 period (FPA, 2017b) and this current reporting period, the 2001 method is used, as per the RFA five-yearly review indicator criteria for harvesting of old-growth forests. This approach allows for uniform assessment of old-growth harvesting over the five-year reporting periods.

Reservation status is reported as at 30 June 2021 and is based on the Tasmanian reserve estate (Department of Natural Resources and Environment Tasmania, 2021). This spatial layer is a composite of public and private reserve data across all land tenures. See Indicator 1.1c for the four reservation categories recognised under the Tasmanian RFA.

All tenures have had past harvesting updated by remapping the underlying photo-interpreted forest structure (Stone, 1998) spatial layer using more accurate satellite imagery. This remapping has changed some of the previously reported areas across various tenures, including private CAR reserves. The results for the area of old-growth forest forests for this report has been updated for harvesting on public land up to June 2021, and on private land up to December 2020, as summarised in Tables 1.1.e.1 , 1.1.e.2 and 1.1.e.3.

A large component of the difference in total area of old-growth between 1996 and 2021 is explained by the retrospective remapping, including large areas of the midlands which were eucalypt low forest (ELF, Kitchener and Harris, 2013) but are now dead or gone due to dieback and subsequent clearing. Losses of old-growth may also be explained by recent fire damage.

The main trends evident from the data are:

- As at June 2021, 1.047 million ha of old-growth forest, or 88% of Tasmania's old-growth forests, are in CAR reserves (Figures 1.1.e.1 and 1.1.e.2). Since 1996, the area of old-growth in the CAR reserve system has increased by 365,400 ha (32.8%) (Figures 1.1.e.3 & 1.1.e.4).
- Most (72%) old-growth forest is in gazetted conservation or other reserves on public land. A further 8% is found on PTPZ land; 11% on other publicly managed land and 9% of all old-growth forest is found on private freehold land.
- Of the 43 old-growth forest communities mapped for the RFA, 35 have at least 60% of their old-growth extent reserved. Of these, 14 have over 90% of their old-growth in CAR reserves. Of the old-growth forest types, 94% of non-eucalypt old-growth forest is reserved; 93% of sub-alpine old-growth forest; 88% of wet eucalypt old-growth forest and 78% of dry eucalypt old-growth forest.
- Nine old-growth communities have >95% of their extent reserved within CAR Reserves: pencil pine with deciduous beech, pencil pine forest*, E. subcrenulata* and tall *E. nitida* (all

100% reserved); and thamnic rainforest on less fertile sites, Huon pine forest, King Billy pine forest, King Billy pine with deciduous beech, dry *E. nitida* forest (95–99% reserved).

Table 1.1.e.1 Area and change in area of old-growth community[a] by forest type and tenure[b]

RFA old-growth forest vegetation community	Conservation & public reserves[c] (k ha)	PTPZ land[d] (k ha)	Other publicly managed land[e] (k ha)	Private freehold land (k ha)	Total (k ha)	Change since 1996 (%)
Dry eucalypt	240	25	53	86	404	-4.1
Wet eucalypt	165	33	22	5	225	-10.6
Sub-alpine eucalypt	35	1	2	2	39	-1.4
Non-eucalypt	423	39	56	10	528	-1.1
Total	862	98	133	103	1,196	-4.0

a) Old-growth forest extent as at 30 June 2021 on publicly-managed land, and 31 December 2020 on private land
b) Tenure as at 30 June 2021
c) Nature Conservation Act and Crown Lands Act Reserves
d) Forest Management Act 2013
e) Publicly-managed land includes land managed by Public Authorities

Table 1.1.e.2 Area (k ha) of old-growth[a] by forest type and reserve type[b]

	Reserve Type					
	Public land			Private land		
RFA old-growth forest vegetation community	Dedicated formal reserve	Other formal reserve [c]	Informal reserve	Other public land [d]	Private CAR reserve	Other private land
Dry eucalypt	135	104	64	14	13	73
Wet eucalypt	111	54	33	22	1	4
Sub-alpine eucalypt	24	11	2	1	0	2
Non-eucalypt	233	190	70	25	2	7
Total	504	358	169	62	16	87

a) Old-growth forest extent as at 30 June 2021 on public land and 31 December 2020 on private land
b) RFA reservation as at 30 June 2021
c) Subject to mining
d) Publicly-managed land includes land managed by Public Authorities

Table 1.1.e.3 Area and change in reservation[a] status of old-growth[b] by forest type

RFA old-growth forest vegetation community	Total area (k ha)	Total area in CAR reserves (k ha)	Proportion of existing old-growth forest now in reserves (%)	Increase in reservation since 1996 (%)
Dry eucalypt	404	317	78.3	34.2
Wet eucalypt	225	199	88.4	36.8
Sub-alpine eucalypt	39	37	93.3	13.0
Non-eucalypt	528	495	93.8	31.2
Total	**1,196**	**1,047**	**87.5**	**32.8**

a) RFA reservation as at 30 June 2021
b) Old-growth forest extent as at 30 June 2021 on public land and 31 December 2021 on private land

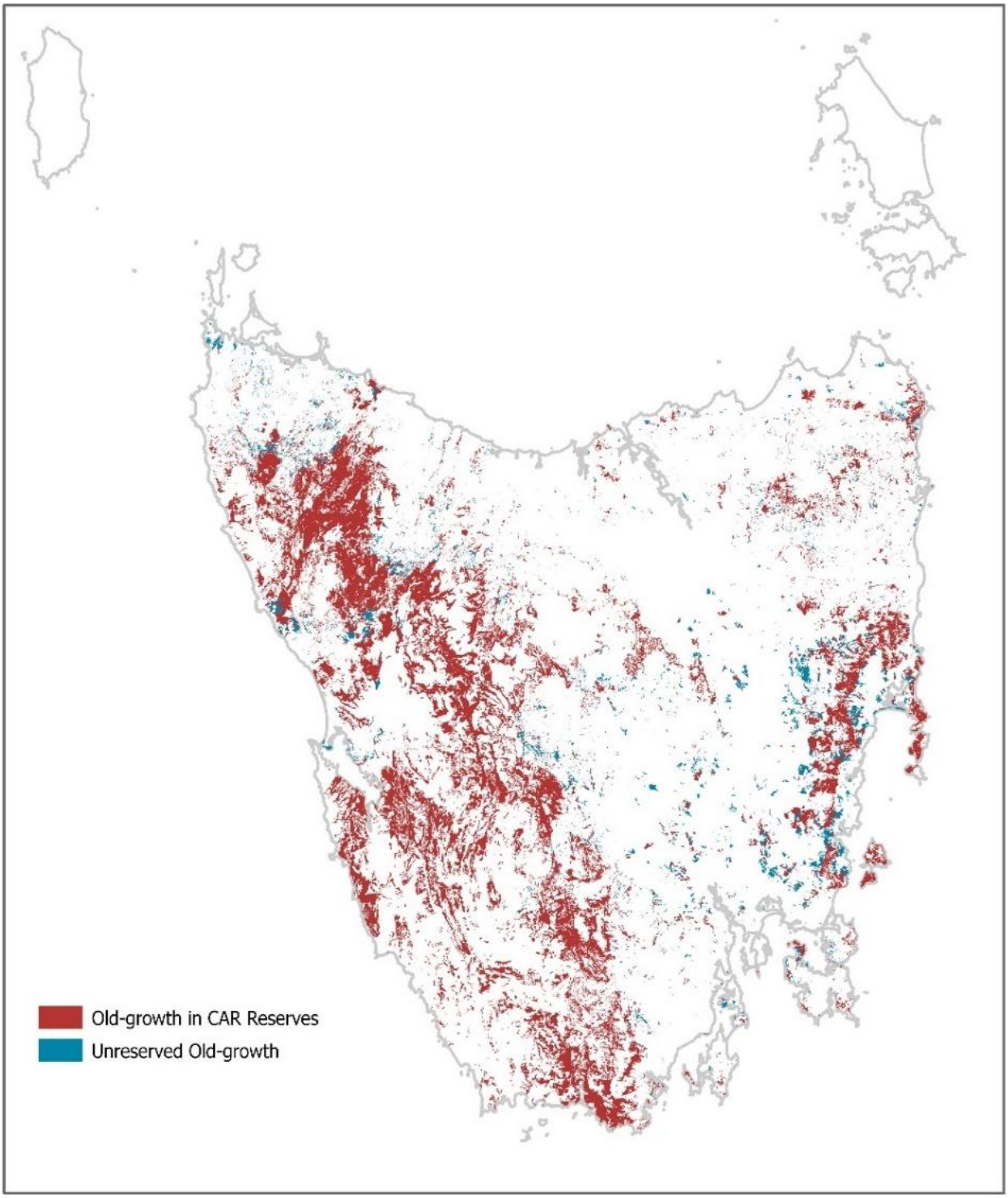

Figure 1.1.e.1 CAR reservation status in Tasmania as at June 2021

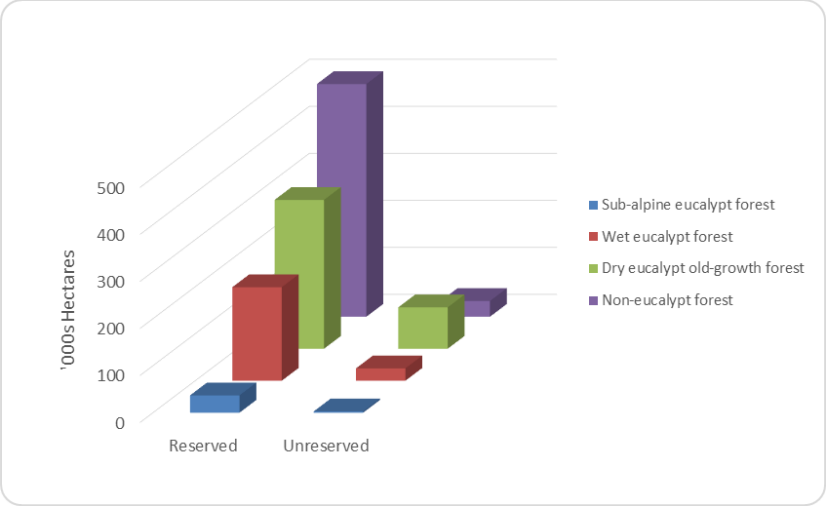

Figure 1.1.e.2 Old-growth forest types by CAR reservation status.

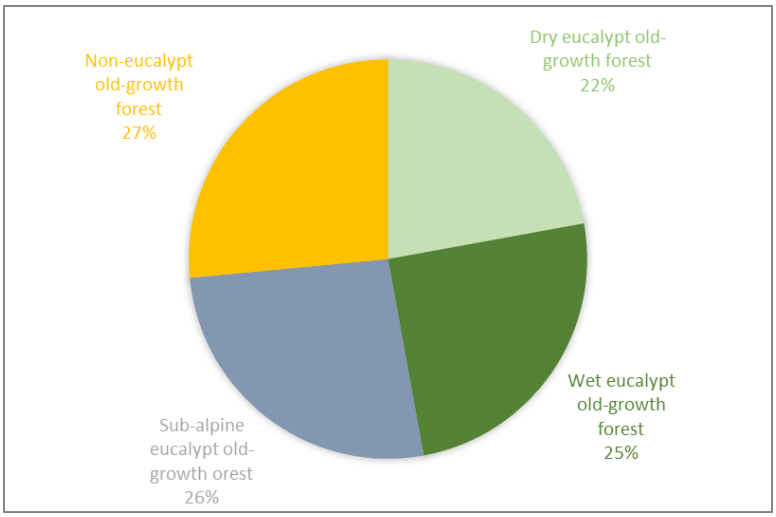

Figure 1.1.e.3 Percentage increase in reservation of old-growth by forest type since 1996

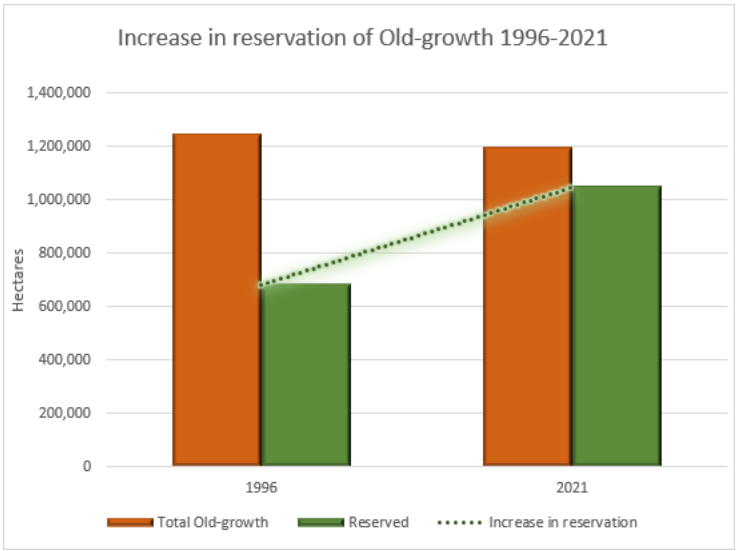

Figure 1.1.e.4 Area of old-growth forest in reserve in 1996 and 2021

1.2 SPECIES DIVERSITY

This sub-criterion monitors the knowledge base for forest-dwelling species, the status of these species and the population levels of a range of representative species across a range of habitats at scales relevant to forest management. The focus of reporting is on vertebrates and vascular plants except where species are listed as rare, vulnerable, endangered, or extinct.

Indicator 1.2.a Forest-dwelling species for which ecological information is available

This indicator tracks the degree of knowledge relevant to the conservation management of forest dwelling species. Vertebrate species and vascular plants have been chosen as indicator species because they comprise a conspicuous and often physically dominant component of forest ecosystems. Research that includes examples from Tasmanian forests has demonstrated that overall biodiversity levels are closely linked to the genetic diversity of dominant species in forests (Whitham et al., 2006). This is because of the reliance of other species in the ecosystem on microhabitats created by dominants as well as breakdown products on which other species depend. In addition, a lack of information on invertebrates and lower plants makes their current use as indicator species problematic and of limited practical use for adaptive management.

A list of forest dwelling vertebrate fauna species is provided from the Tasmanian Natural Values Atlas (NVA, Department of Natural Resources and Environment Tasmania, 2022b), a web-based atlas for flora and fauna records maintained by the Department of Natural Resources and Environment Tasmania (NRE Tas). The NVA provides authoritative, comprehensive information on Tasmania's natural values through a web-based portal to make natural values data, information and reports findable, accessible, interoperable, and reusable. A diverse range of stakeholders – including Commonwealth, State and local government and regional bodies, NGOs, industry, business, emergency services and private stakeholders – use the NVA data to underpin assessment, reporting, planning, and research needs pertaining to natural values. The information on the NVA platform also supports the requirements of the *Nature Conservation Act 2002, Threatened Species Protection Act 1995, Environmental Management and Pollution Control Act 1994* and the Australian *Environmental Protection and Biodiversity Conservation Act 1999*. New location records are added to NVA from data through formal agreements with other repositories, including the Atlas of Living Australia, and through incidental observations by NRE Tas staff and others, including regular updates from the FPA, STT, private consultancies, non-government organisations and individuals. The NVA also publishes data via the LIST (Land Information System Tasmania) and LISTmap - Tasmania's authoritative source of spatial datasets.

Numbers of forest dwelling vertebrates are summarised in Table 1.2.a.1. Between 2017 (FPA, 2017b) and 2021, no new forest- dwelling vertebrate fauna species were identified, nor was any forest dwelling species believed to have become extinct. Of the 1,919 vascular plant taxa indigenous to Tasmania (including subspecies and varieties), 1,158 (60%) are known to be forest dwelling. These are tagged in the NVA and are unchanged since 2017 (FPA, 2017b). These flora species are summarised in taxonomic groupings by order in Table 1.2.a.1.

Table 1.2.a.2 summarises the level of information available for vascular plants and different categories of vertebrates. Even for those groups where a larger amount of information is available, there are some species for which little is known. The percentage of native forest associated vascular plant species with adequate information to make management decisions is estimated to have improved slightly from 2016 (27%) to 2021 (28%), with the publication of new note sheets. The NVA holds distribution information on all native vascular plant species in Tasmania and the Threatened Species Link website provides additional habitat and management information (however, the website is not regularly maintained). Newly listed taxa have an accompanying Listing Statement,

which provides detailed information relating to the conservation listing and management needs of those species.

Species that are 'possibly threatened' (an informal category) are tagged in NVA and those with little or no information to inform management decisions may be tagged on the 'native watch list' in the NVA. Taxa that have little or no information available include those deemed extinct, species with uncertain status in Tasmania, very new species, taxa that are difficult to identify, or taxa for which observations have mostly been made at the species level rather than infraspecies (subspecies) level. This should initiate improved information to assess the conservation status of these species. Survey guidelines and habitat descriptions for all threatened flora species are available on the FPA website and supported by the Threatened Species Link, enabling focused surveys and management of priority species.

Table 1.2.a.1 Numbers of forest dwelling taxa within each group

Group	Number of taxa
Vertebrate fauna	Total: 139
Fish	13
Amphibians	8
Reptiles	15
Birds	69
Mammals	34
Vascular plants	Total: 1158
Dicotyledons	724
Monocotyledons	335
Pteridophytes	86
Gymnosperms	13

Table 1.2.a.2 Number of native forest associated species and proportion (%) with none, partial or comprehensive information to inform management decisions

		The level of habitat, disturbance and life history information available on which management decisions are based[a]		
Taxa	Number of native forest associated species	None[b]	Partial[c]	Comprehensive[d]
Fish	13	0	46	54
Amphibians	8	0	50	50
Reptiles	15	0	73	27
Birds	69	3	30	67
Mammals	34	0	68	32
Vascular Plants	1158	3	69	28

a) The percentage estimates are based on publications such as listing statements, note sheets and technical papers with management information included, scientific papers, and expert opinion
b) Little or no information is available to inform management decisions
c) Some information is available
d) Information is adequate to make management decisions

Indicator 1.2.b The status of forest-dwelling species at risk of not maintaining viable breeding populations, as determined by legislation or scientific assessment

This indicator describes any changes in the status of Tasmanian RFA priority species. RFA priority species are forest-associated species listed in the schedule of the Australian *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act) or the Tasmanian *Threatened Species Protection Act 1995* (TSP Act) or in the original Attachment 2 of the RFA (The State of Tasmania and Commonwealth of Tasmania, 1997).

Forest-associated species are those species that may use habitat within a forest ecosystem for all or part of their lifecycles, including aquatic species that use forested waterways. Species are categorised as 'forest associated' based on published material, expert advice, and state and territory agency advice derived from biological survey results. Changes to the status of RFA priority species may indicate whether protection and management measures are improving, maintaining, or failing to improve the conservation status of given species. Some species may change listing status as new information is available. Up-listing or down-listing is independent of the protection or management effort towards a species.

Listings of priority species from the RFA, EPBC Act and TSP Act are provided in Appendix A of *Further assessment of matters under the Australian* Regional Forest Agreements Act 2002 *relating to the 2017 variation of the Tasmanian Regional Forests Agreement* (Commonwealth of Australia, 2017). A complete list of RFA priority species status under the TSP Act and the EPBC Act as at December 2021 can be found on the NRE website.

Changes to the status of RFA priority species on the TSP Act from 30 June 2016 to 30 June 2021 are summarised in Table 1.2.b.1. Description of the changes are provided in Table 1.2.b.2. These changes were based on information provided to the Threatened Species Scientific Advisory Committee (SAC) through nominations from the community or draft Listing Statements, supplemented by information collated and held by NRE Tas. The SAC's criteria for listing are based on the International Union for the Conservation of Nature criteria and approved by the Secretary of NRE Tas.

Table 1.2.b.1 Summary of changes in listing status under TSP Act of RFA priority species (30 June 2016 to 30 June 2021)

	Flora	Fauna
Number of species with changed TSP Act listing status	6	3
Number of species which have moved to a higher category of risk	2	2
(number of species now determined to be extinct)	(0)	(0)
Number of species which have moved to a lower category of risk	4	1
(number of species now rediscovered from extinct status)	(1)	(0)
Number of species added to the TSP Act list	7	3
(number of species now determined to be extinct)	(0)	(0)
Number of species de-listed	5	0
(number of species previously listed as extinct)	(0)	(0)

Table 1.2.b.2 Details of changes in listing status under *Threatened Species Protection Act 1995* of RFA Priority Species (30 June 2016 to 30 June 2021)

Species	Common name	Change	Reason
Flora			
Ozothamnus floribundus	flowery everlasting bush	new listing, now endangered	small population
Pomaderris pilifera subsp. *talpicutica*	moleskin dogwood	downlisted to vulnerable from endangered	improved information
Juncus amabilis	gentle rush	delisted from rare	improved information
Rytidosperma indutum	tall wallaby grass	delisted from rare	improved information
Thelymitra mucida	plum sun-orchid	uplisted to endangered from rare	small population
Bossiaea heterophylla	variable bossiaea	new listing, now endangered	restricted distribution and decline of habitat
Thelymitra inflata	inflated sun-orchid	new listing, now endangered	small population
Thelymitra lucida	glistening sun-orchid	new listing, now endangered	small population
Veronica notabilis	forest speedwell	downlisted to endangered from extinct	improved information
Gratiola pubescens	hairy brooklime	downlisted to rare from vulnerable	improved information
Austrostipa scabra	rough speargrass	delisted from rare	improved information
Scleranthus brockiei	mountain knawel	delisted from rare	improved information
Thismia rodwayi	fairy lanterns	delisted from rare	improved information
Fauna			
Antechinus vandycki	Tasman Peninsula dusky antechinus	new listing, now vulnerable	new taxon
Castiarina insculpta	Miena jewel beetle	downlisted to vulnerable from endangered (2019)	new information about range size
Castiarina insculpta	Miena jewel beetle	uplisted to endangered from vulnerable (2020)	Bushfire impacted a large area of habitat and part of population

Table 1.2.b.3 summarises changes to the status of forest-associated species listed as threatened under the EPBC Act. Data includes forest-dwelling species listed as threatened under the EPBC Act with a change in status as at 30 June 2021. Change in status was assessed for species listed at any time between 1 July 2016 to 30 June 2021 against listings as at 1 July 2016, and assigned based on information sourced from the listing information for the species. The Species of National Environmental Significance (public grids) (DAWE, 2022) were used to identify species that occurred in Tasmania. More information can be found in (Davey, 2018a) and (Davey, 2018b).

Only one species had a change in status under the EPBC Act between 1 July 2016 and 31 December 2021: the white-throated needletail, *Hirundapus caudacutus* (Table 1.2.b.4) which was listed as vulnerable due to a continued substantial reduction in population for reasons that are not understood (Threatened Species Scientific Committee, 2019). One Tasmanian ecological community was listed as a Threatened Ecological Community (TEC) under the EPBC Act (Department of the Environment and Energy, 2019) (Box 1.2.b).

Table 1.2.b.3 Changes in listing status under the *Environmental Protection and Biodiversity Conservation Act* (30 June 2016 to 30 June 2021), not including ocean fauna or shore birds or Macquarie Island taxa

	Flora	Fauna
Number of species with changed EPBC Act listing status	0	1
Number of species which have moved to a higher category of risk (number of species now determined to be extinct)	0	0
Number of species which have moved to a lower category of risk (number of species now rediscovered from extinct status)	0	0
Number of species added to the TSP Act list (number of species now determined to be extinct)	0	1
Number of species de-listed (number of species previously listed as extinct)	0	0

Source: DAWE, 2022.

Table 1.2.b.4 Changes to the *Environmental Protection and Biodiversity Conservation Act* status of RFA-Priority Species

Species	Common name	Change	Reason
Flora – no changes			
Fauna			
Hirundapus caudacutus	white-throated needletail	List as Vulnerable	continued substantial reduction in population for reasons that are not understood

Source: DAWE, 2022.

Box 1.2.b Ecological communities listed as threatened under the EPBC Act 1999

During the reporting period, one Tasmanian ecological community was listed as a Threatened Ecological Community (TEC) under the *Environment Protection and Biodiversity Conservation Act 1999*. 'Tasmanian Forest and Woodlands dominated by black gum or Brookers gum (*Eucalyptus ovata* / *E. brookeriana*)' was listed as critically endangered in 2019.

This TEC corresponds closely with two other TECs that were already listed as threatened under the *Tasmanian Nature Conservation Act 2002*. The assessment of this community identified several key threats, including:

- historic clearance for forestry and agriculture and on-going clearance for urban and infrastructure development
- weed invasion
- climate change
- altered hydrology
- grazing pressure
- altered fire regimes
- disease and dieback.

The assessment concluded that the extent of this TEC had declined by about 90% and recommended a number of actions to protect it, including preventing further clearance, fragmentation or detrimental modification of remaining patches and ensuring landscape connectivity is maintained. This will benefit both the community and the many fauna that benefit from or depend upon it (Department of the Environment and Energy, 2019).

Eucalyptus ovata forest on public land at Lake Leake. On fertile soils trees grow to over 20m and are moderately dense. (Photo: M Wapstra)

Indicator 1.2.c Representative species from a range of habitats monitored at scales relevant to regional forest management

This indicator is a broad measure of the conservation status of a variety of representative species across habitats. It reflects elements of ecosystem and genetic diversity and can be quantified using population information or information on population level surrogates such as habitat or range.

Trend monitoring

For vascular flora, population information is collated by preparing Listing Statements under provisions of the TSP Act, for RFA priority species. Flora Listing Statements can be updated every five years or as new information becomes available. The detail contained in flora Listing Statements is enhanced as the amount of population data for threatened species in the NVA database continues to increase.

For fauna, long-term monitoring of abundance has been carried out for the brushtail possum, the Tasmanian pademelon, Bennetts wallaby, nine other native mammal species, and the feral cat. The graphs in Figures 1.2.c.1–5 below indicate no decline in abundance for most of these monitored species. The exceptions are the brushtail possum, for which the trend is skewed due to a very high estimated population density in 2005, the Tasmanian devil, which has been severely affected by the devil facial tumour disease (DFTD), the potoroo and the eastern bettong. The graphs for the brushtail possum, Tasmanian pademelon and Bennetts wallaby are the output of distance modelling and show a density estimate while the graphs for the common wombat and Tasmanian devil are based on simple encounter rates (records per transect across the state) (Department of Natural Resources and Environment Tasmania, 2022b).

Statewide trends in the abundance of the Tasmanian pademelon, Bennetts wallaby, brushtail possum, common wombat, and Tasmanian devil are shown for the period up to 2021 based on the availability of data. Statewide trend lines include 95% confidence limits for brushtail possum, Tasmanian pademelon and Bennetts wallaby.

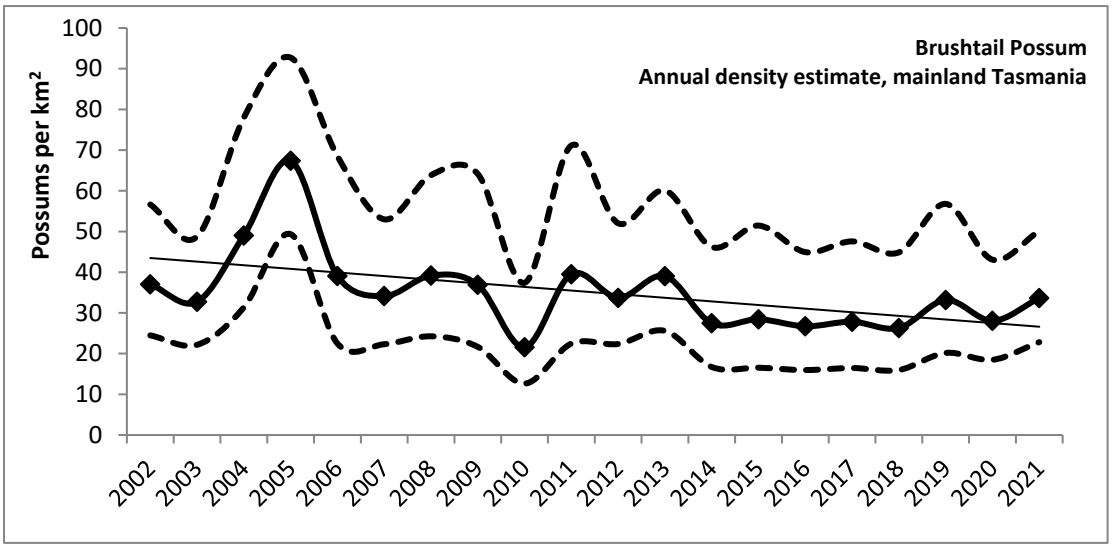

Figure 1.2.c.1 Brush-tailed possum – annual spotlight survey data; 2002–2021

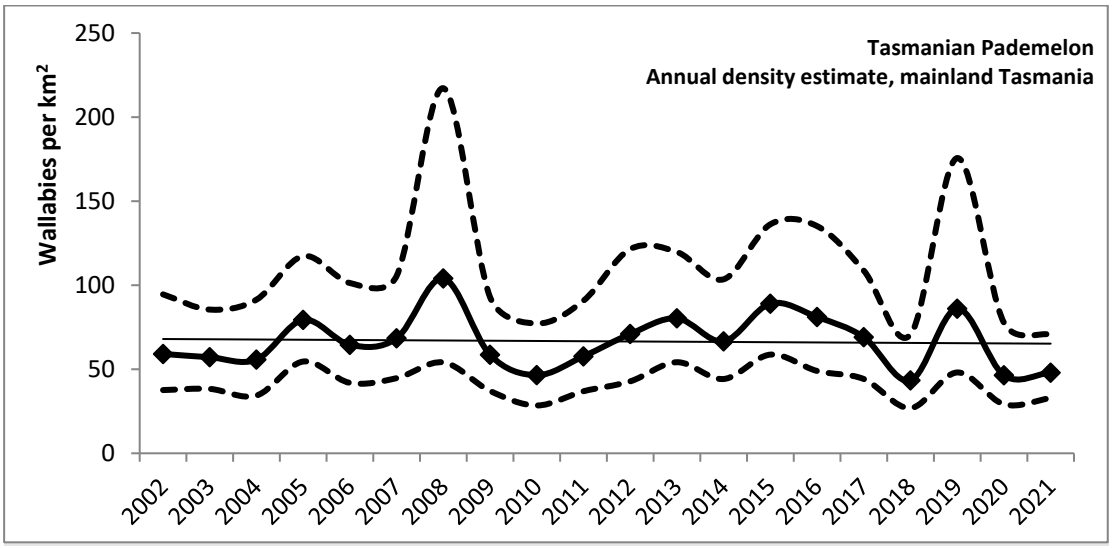

Figure 1.2.c.2 Tasmanian Pademelon – stable (annual spotlight survey data; 2002–2021)

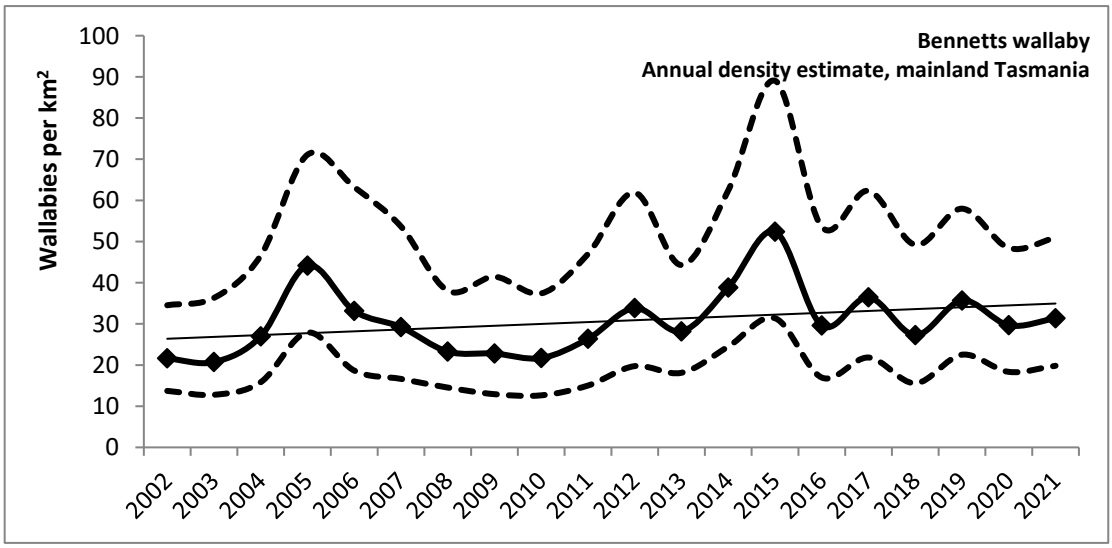

Figure 1.2.c.3 Bennetts wallaby – stable (annual spotlight survey data; 2002–2021)

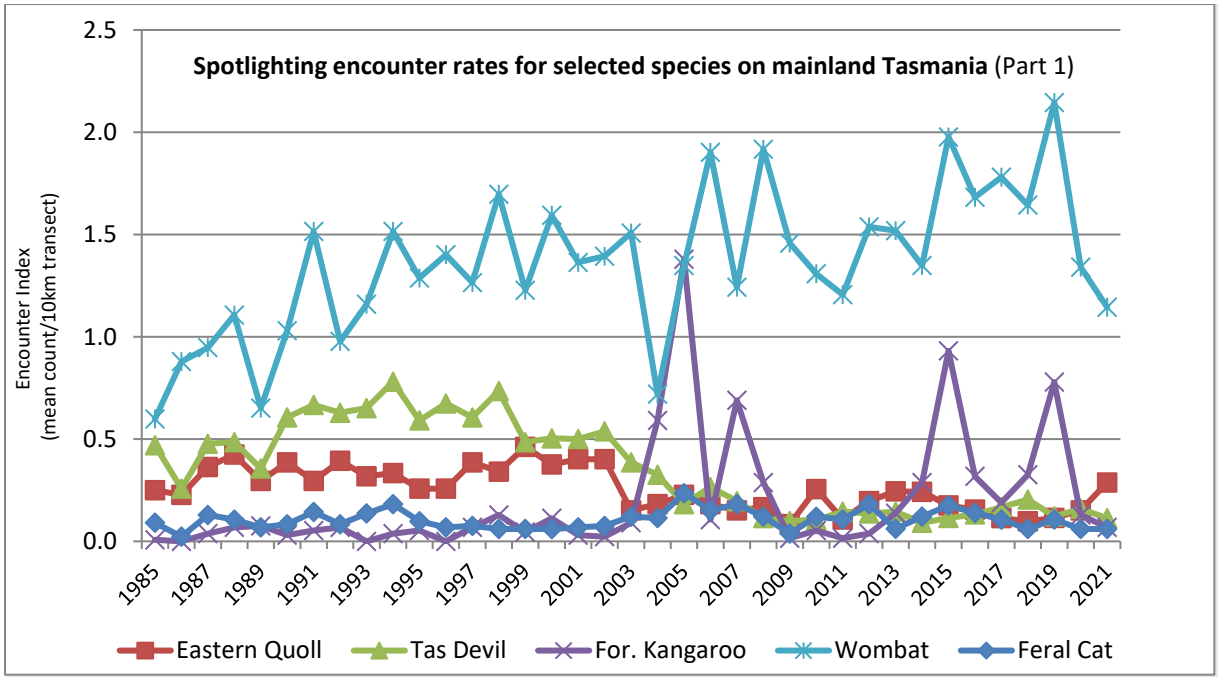

Figure 1.2.c.4 **Encounter rates for selected species on mainland Tasmania (Part 1), based on the 132 transects conducted continuously since 1985**

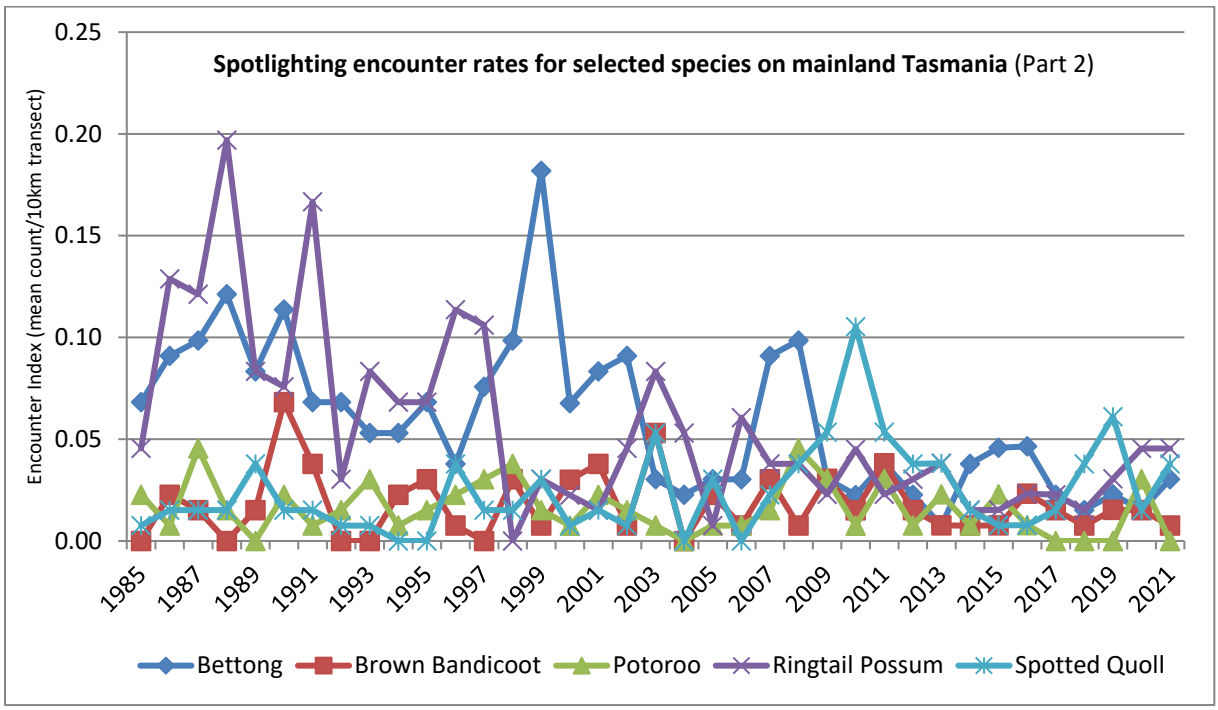

Figure 1.2.c.5 **Encounter rates for selected species on mainland Tasmania (Part 2), based on the 132 transects conducted continuously since 1985**

Monitoring of threatened species

Recovery teams for threatened species continued to meet during the reporting period. Monitoring continued for many of these species and summaries of the relevant work for some are provided here. Studies that monitor the effectiveness of actions taken for biodiversity values, including threatened species, in areas covered by the forest practices system, have been summarised annually since 2013 in a series of biodiversity reports (FPA, 2014-2021).

Tasmanian devils

The size of the Tasmanian devil population when DFTD was first reported over 25 years ago (actual emergence of DFTD likely pre-dated the first observation) is not precisely known, however declines in density of 77%, on average, have been recorded in monitored sites. Current best estimates suggest there are approximately 17,500 individual devils (between 12,000 and 22,000) in the wild today. Further declines are likely as DFTD moves into remaining disease-free areas with predictions that the population may plateau out at a low of 10,000 individuals (approximately 7,000 – 12,000). The Zoo and Aquarium Association-managed zoo-based insurance population consists of approximately 550 individual devils.

The Save the Tasmanian Devil Program (STDP) is a comprehensive science-based and adaptive program, that ensures that the appropriate research, monitoring and management actions are undertaken to protect the Tasmanian devil. The STDP is focused on identifying effective strategies to restore the depleted wild devil population. By 2024, the goal of the Wild Devil Recovery (WDR) research program is to understand whether supplementing depleted wild devil populations with genetically diverse devils is an appropriate adaptive management strategy. If supplementation is determined to appropriate, the program will inform the scale and nature of future actions across the state.

Since 2015, more than 150 wild devils – carrying more than 120 pouch young – have been released from the intensively managed Maria Island population, which houses a disease-free population of between 60 and 90 individuals. These releases have supported targeted research at five study locations across the state. The disease-free Forestier Peninsula population is isolated by a partial barrier at Dunalley and can potentially provide an additional source of suitable devils for future releases if a review of the research results supports the continuation of this strategy.

In addition, the STDP continues to support the Menzies Institute for Medical Research in the development and trialling of effective vaccines for DFTD; and University of Tasmania (UTAS) research into how devils and DFTD are evolving together, and how that might continue to inform alternative and appropriate intervention strategies.

A UTAS PhD project aims to discover how Tasmanian marsupial carnivores respond to forestry landscapes and operations, to identify ways that production forests could be managed to enhance their conservation. In 2020–2021 a network of remote cameras across three production forest landscapes was used to determine the distribution and abundance of devils and quolls. Biological samples from live-trapping were taken to provide measures of carnivore health across these landscapes. Transmitters were attached to several devils in a plantation-dominated landscape to assess how they use the landscape at a finer scale (Koch, 2021).

New Holland mouse and Tasman Peninsula dusky antechinus

The New Holland mouse (*Pseudomys novaehollandiae*) is a small, nocturnal, native rodent recognised nationally as being vulnerable to extinction. Up until 2021, the last known confirmed New Holland mouse in Tasmania was trapped near wukalina / Mt William in the state's north-east in 2004 and the last hard evidence of the species was obtained in 2010 in the form of hair samples, collected at Waterhouse Conservation Area. However, in October 2021 a single mouse was detected

using a camera trap on Flinders Island. Several images were obtained of the species as it walked in front of a remote camera to sniff a stick dipped in peanut butter and sit atop a bait cannister. Following the discovery, remote cameras and hair tubes were installed and a second mouse detected. The sighting and further survey work is helping to inform a national recovery plan for the species.

The study on Flinders Island is part of a broader survey across north-eastern Tasmania for the New Holland mouse which so far has covered eight regions and included setting up more than 259 cameras at different locations. As part of the conservation assessment, NRE Tas hosted a national workshop in late 2021 to discuss potential causes for decline of this species, compare management practices across the species' national range and identify key knowledge gaps to guide more effective future management. Several threats have been identified for the New Holland mouse including changes in fire regimes, severe fire events, changes in rainfall patterns, degradation of heathlands because of *Phytophthora cinnamomi* infection, fragmentation of habitat, and predation by and competition with introduced species including feral cats and house mice.

The Tasman Peninsula dusky antechinus (*Antechinus vandycki*) was newly listed as a threatened species in 2019. FPA conducted a series of expert workshops to review literature, assimilate species knowledge and design a management approach for the species (Koch, 2021). Only a small number of *A. vandycki* have been located, all within wet forest. A project was initiated in 2021 by researchers from UTAS, NRE Tas and FPA to explore the distribution and ecology of this poorly known species. It is expected that a range boundary will be identified for *A. vandycki*, as well as evidence of the habitat(s) that the species occurs in and how this might differ from closely related species in the genus. The results of this work will be used to inform forest management and land-use decisions.

Orange-bellied parrot, swift parrot and the forty-spotted pardalote

The orange-bellied parrot breeding population is counted precisely each year. Monitoring and conservation work in Tasmania is currently managed by NRE Tas (Department of Natural Resources and Environment Tasmania, 2022d). Captive breeding of birds for release is undertaken by NRE Tas at a new breeding facility at Five Mile Beach in the state's south and by government and non-government partners on the Australian mainland. The use of novel population supplementation techniques has seen the population of the orange-bellied parrot in the wild increase during the reporting period, with 70 birds returning to breed in Tasmania in spring 2021 – the highest number in 15 years.

The risk of extinction of the critically endangered swift parrot was reinforced by recent genetic evidence published by researchers from the Australian National University (Stojanovic et al., 2018). In the summer of 2020–2021, the FPA became aware of new information that suggested that *Eucalyptus brookeriana* was likely to constitute an important foraging resource for swift parrots in the Eastern Tiers area. The FPA, in consultation with NRE Tas, have evaluated the new information and modified the management approach for swift parrot habitat within the Eastern Tiers region. This includes the identification of *E. brookeriana* as potential swift parrot foraging habitat and focuses on retention of *E. brookeriana* dominated forest, as well as retention of larger *E. brookeriana* individuals, as these trees have the potential to contribute a more substantial foraging resource. This approach has been endorsed by the FPA and NRE Tas in accordance with the procedures for the management of threatened species under the forest practices system (Department of Natural Resources and Environment Tasmania, 2022a, FPA & DPIPWE, 2021) and is recommended through the FPA Threatened Species Adviser (FPA, 2014b). It is recognised that further research and monitoring is needed to address knowledge gaps on the distribution and flowering characteristics of *E. brookeriana* in the Eastern Tiers and new information will continue to inform the management approach.

NRM South's 'Protecting the Breeding population of Swift Parrots' project, funded through the Australian Government's National Landcare Program, aims to improve conservation outcomes for swift parrots. The project has two main components: 1. Protecting high-value swift parrot habitat on private land through the establishment of conservation covenants. 2. Developing a method to control sugar gliders populations in swift parrot breeding habitat to reduce in-nest predation pressure on swift parrots. Work delivered to date includes: two conservation covenants, protecting a total area of 114.6 ha, and three field trials to better understand the impact of sugar gliders on breeding swift parrots and to test control programs.

A recent publication on the threatened forty-spotted pardalote found that refuge locations for this species are vulnerable to multiple threats including climate change and recommended reintroducing the species to some parts of its historical range (Webb et al., 2019). This work builds on the PhD study (Edworthy, 2017) which supported a population estimate made by Bryant (2010) of 1,500 individuals, and which identified multiple key threats, including prolonged drought resulting in habitat deterioration. Other threats include a decline in food resources such as lerps, reduction in white gum health and consequent increases in competing species, and the impact of a native ectoparasitic fly (*Passeromyia longicornis*) as a major source of nestling mortality. Further work on the impact of the fly, and feeding behaviours, has led to novel methods of fumigating nests using the birds as vectors, to mitigate against the impact of the parasites (Alves et al., 2021). New information is used by the FPA and NRE Tas to inform continual improvement of management recommendations delivered through the Tasmanian forest practices system (FPA, 2022b, Munks et al., 2020).

Wedge-tailed eagle

No changes to the population estimate for the wedge-tailed eagle have been made in this reporting period (2016-2021) as no new data is available. The most recent estimate was 1,000 to 1,500 birds (DPIPWE, Threatened Species Section, 2006), derived from an estimated 426 territories of which approximately 50% were occupied each year.

Researchers have developed a citizen science project (Where? Where? Wedgie!) to monitor wedge-tailed eagle population changes and inform an updated estimate of population size (Nature Trackers, 2022). An ARC-funded project will combine the citizen-science data with eagle tracking and genetics to estimate the abundance and distribution of the population, which will facilitate ongoing monitoring. The project will:

- develop behavioural models to predict risk of wedge-tailed eagle collisions with turbines
- measure the effects of disturbance on breeding wedge-tailed eagles
- rigorously estimate the abundance and distribution of the wedge-tailed eagle population
- build a spatially-explicit demographic model to define conservation priorities for the wedge-tailed eagle population.

The FPA Eagle Research and Monitoring Program was initiated in 2007 with the aim of monitoring the rate of nest success and the timing of breeding season events (Koch et al., 2013). The work was revised during 2015 to focus on surveys required to establish the timing of the breeding season. Nest survey techniques – involving the use of helicopters rather than fixed-wing aircraft – have been introduced to reduce risk of errors or disturbance to nesting eagles, and to improve the safety of observers. Table 1.2.c.1 provides data on breeding activity in the current reporting period for nests that are assessed in response to stakeholder requests. Stakeholders request nest activity checks for various reasons including planned operations within the identified breeding season exclusion zone. Nests are identified as active (for breeding) where the nest contains either a young chick, egg or adult in an assumed incubation pose. Typically, the majority of observed nests are inactive.

Table 1.2.c.1 Breeding activity in a selection of Tasmanian wedge-tailed eagle nests 2018–2021[(a)]

Nest status	2018	2019	2020	2021
Active	85 (23%)[(b)]	58 (15%)	93 (32%)	78 (25%)
Not active	287 (77%)	318 (85%)	200 (68%)	232 (75%)
Total	**372**	**376**	**293**	**310**

a) Data unavailable for 2017
b) Percentages in brackets are the proportion of nests observed in that year in either category

In 2020, the FPA collaborated with a UTAS researcher who is attempting to understand what factors influence eagle behaviour by attaching transmitters to 50 adult eagles. The research aims to provide guidance on how to manage threats like windfarms, powerlines and forestry operations. Detailed data on the activity of birds and machinery during harvest operation will be used to assess the types of activities, and distances from the nest at which breeding eagles are disturbed, and thereby assess the effectiveness of current management.

Tasmanian masked owl

An Australian National University PhD project commenced which was aimed at identifying factors that influence the occurrence of the masked owl across the landscape. However, low detection rates hindered the development of confident occupancy predictions (Cisterne et al., 2020). To improve detectability of masked owls for future monitoring studies, there is a need to develop novel survey techniques that better account for the ecology of the species. The study also explores the potential to combine novel census approaches that exploit different aspects of masked owl ecology to obtain more robust and detailed data.

King Island birds

Australian and Tasmanian government funded surveys of the King Island scrubtit and King Island brown thornbill have established and subsequently confirmed baseline information on the populations and habitat requirements of both species (Webb and Crates, 2019). This work has established that the population of the King Island scrubtit is close to previous estimates of approximately 50 birds. The surveys confirmed the presence of the King Island brown thornbill, of which there were very few documented records since it was described more than 100 years ago, with only a handful of isolated sightings over the past 50 years (Box 1.2.c). The King Island brown thornbill was previously considered ‘possibly extinct’ (Garnett, 2021, Garnett et al., 2011) and identified as Australia’s most likely bird to become extinct in the next 20 years (Geyle et al., 2018).

Tasmanian galaxias species

The Inland Fisheries Service (IFS) continued to undertake surveys for threatened Tasmanian galaxias species, including the Swan galaxias (*Galaxias fontanus*), golden galaxias (*Galaxias auratus*), Clarence galaxias (*Galaxias johnstoni*).

The Swan galaxias is a Tasmanian endemic species that is found in small pockets of rivers or streams that are free of trout and other native fish. Low rainfall and warm temperatures have greatly reduced Swan galaxias habitat during the last 10 years. This has had a negative effect on their numbers, and consideration has been given to translocating this species, as has previously successfully occurred for the Pedder galaxias (*Galaxias pedderensis*).

IFS provides training to the forestry industry’s Forest Practice Officers on the ecological assessment of waterways and the need to recognise and consider the presence of freshwater fish and their habitat.

Marrawah skipper

Surveys of the range and habitat for the Marrawah skipper were undertaken in 2018. These found that Marrawah skipper occupies a broad range of vegetation types though most new records were in habitat typical of its foodplant *Carex appressa*. New records of the species were found in *Eucalyptus brookeriana* wet forest, *Acacia melanoxylon* swamp forest or in disturbed habitat such as on roadsides and the edges of farm paddocks adjacent to these forest communities. The results found that the area of occupancy and area of occurrence has been substantially diminished since European settlement, but the species is more common in parts of its range than original expected (Bell, 2018).

Giant freshwater crayfish

A collaborative project involving FPA, UTAS, DPIPWE and the University of Canberra developed a highly sensitive, highly specific genetic assay to enable detection of giant freshwater crayfish from environmental DNA (eDNA) water samples. Detections were recorded in eDNA samples from five out of eight field sites. No detection was recorded from the negative site (negative control site) (Trujillo-Gonzalez et al., 2021). An extension to the original project was done to try and determine the level of sampling required to get a specified level of confidence in the eDNA water samples. Results suggested that eDNA sampling might be more sensitive than hand searching, as eDNA was detected at some sites where field searching found no animals.

Threatened flora species

The FPA have developed habitat suitability models for some threatened plants. These models use maximum entropy modelling (MaxEnt), a stand-alone algorithm based software which estimates the relationship between presence-only species records and the environmental and spatial characteristics of those sites.

Long term monitoring of the threatened shrub *Hibbertia calycina* found that the distribution of this species is restricted to isolated clumps on highly insolated ridges and steep upper slopes of fine-grained Mathinna-series sedimentary rocks in dry sclerophyll forest. A total of nine populations with an estimated area of occupancy 43 ha and extent of occurrence measuring 9,500 ha, were documented (Turner et al., 2020).

Green and gold or growling grass frog

A Deakin University PhD project, begun in June 2017, investigated the influence of differing landuse (commercial forestry vs. cleared pasture) on the ecology of green and gold frog. Dam occupancy by green and gold frogs increased with native dry eucalypt woodland coverage. The abundance and occurrence of green and gold frogs declined significantly with increasing plantation cover within 1 km of the pond. The abundance of green and gold frogs was negatively associated with the amount of pastoral land in the surrounding landscape, but occurrence of the species was not. A related tracking study found that frogs were more likely to abandon dams with low native vegetation coverage surrounding the dam, compared to dams with abundant native vegetation.

Box 1.2.c Monitoring King Island threatened birds

In 2019, the survey protocol developed for King Island scrubtit by Webb et al. (2016) was used to continue surveys of King Island scrubtit and adapted for surveys of King Island brown thornbill in forest vegetation across King Island (Webb and Crates, 2019, Holdsworth, 2019, Webb and Bell, 2020). King Island scrubtit was detected at Colliers Swamp and Nook Swamps where it had been previously found, and at new locations on PTPZ land in Pegarah forest block. King Island brown thornbill which had been thought to be possibly extinct, was found at Pegarah forest block and at several small forest remnants on private land in the central east and south of the island (Webb and Crates, 2019, Holdsworth, 2019).

Surveys for King Island scrubtit and King Island brown thornbill in 2020 detected both species at sites known in 2019 and extended the distribution of King Island brown thornbill to Seal River Reserve, Kentford Forest Conservation Area, Grassy Harbour, and Council Hill in the north-east. In 2021, a project funded by the Australian Government and delivered through the Cradle Coast NRM extended the known distribution of King Island scrubtit to reserved and private land the in the far north-east of the island, and King Island brown thornbill to additional sites throughout in the east and the far north-east of the island (Bell, 2021). Although the distribution of King Island scrubtit and King Island brown thornbill has been extended through ongoing survey and monitoring, the estimated total population size for each of these species remains very low.

King Island brown thornbill on bark of Brookers Gum (*Eucalyptus brookeriana*)

Image: Phil Bell

1.3 GENETIC DIVERSITY

This sub-criterion focuses on two distinct areas. It monitors the loss of genetic variation in forest associated species, the potential impact on species viability and conservation mechanisms that have been implemented. Secondly, it reports on the development and implementation of genetic resource conservation mechanisms for commercially important native timber species.

Indicator 1.3.a Forest-associated species at risk from isolation and the loss of genetic variation, and conservation efforts for those species

Tasmania is naturally isolated from mainland Australia and has been so for approximately 12,000 years. This isolation has inevitably resulted in the loss of some genetic variation as the result of restricted gene flow between populations of the same species. It has also given rise to endemism. In addition to this natural process, some of Tasmania's species of native flora and fauna are likely to have lost some of their genetic variation during human occupation of the state, and particularly since European settlement. This kind of loss has mainly resulted from clearing and modification of native vegetation for agriculture, settlement, forestry and other purposes, resulting in either the loss of genetically distinct populations or the inhibition of natural gene flow. Other human-induced or natural events (e.g. wildfire, disease) may have also contributed to loss of genetic variation.

The intention of Indicator 1.3.a is to document the level of knowledge about species that now only occupy a small part of their former range, resulting in a greater risk that they may have lost genetic variation. There are considerable difficulties in dealing with this indicator – in part because of lack of detailed information on the past distribution of many of Tasmania's species; and lack of information on genetic variation in past and extant populations. There are also uncertainties about the effects of regulated activities on some species, let alone the impacts of less predictable events such as the spread of DFTD affecting Tasmanian devil populations, or the introduction of predator species, such as the sugar glider (*Petaurus breviceps*).

Analysis continues to be focused on forest-associated species that are identified as under the TSP Act, or otherwise of conservation interest. These species are the focus of this indicator because much of Tasmania's conservation-oriented research and management remains directed towards them.

For the purposes of this indicator, the term ‘species’ refers to the taxa as listed. In addition, following the approach adopted in reporting on Indicator 1.2.a, the analysis has only considered vertebrate fauna species and vascular plant species (excluding orchids – a family subject to a high degree of taxonomic change which, coupled with the ephemeral nature of most species, makes determination of extant and past distributions particularly difficult).

Knowledge of genetic variation in Tasmanian native species, and conservation measures to maintain that variation, is probably greatest in some non-threatened species which are of economic importance – the most outstanding example being the Tasmanian blue gum (*Eucalyptus globulus*). There is extensive knowledge of the patterns of genetic diversity in this species, and the effects of population fragmentation through agricultural clearing have been documented, as has the effect of tree genetic variation on the insect and fungal communities which are dependent on the species.

Eucalypt species are often capable of cross-pollination within related groups. Such hybridisation can result in viable hybrid offspring. Such hybrids are sometimes observed in nature or in seed collected from native trees where compatible species naturally co-occur. Hybridisation is a natural process and has played a role in the evolutionary history of eucalypts. Nevertheless, hybridisation can be problematic when the distribution of a species is greatly extended by human activities.

The *Forest Practices Code 2020* has provisions to ensure that conservation of genetic resources is considered in the planning of forest practices, and guidance is available on the management of exotic gene flow (FPA, 2009). A paper published in 2016 summarises the research carried out over a ten-year period which provides the biological data needed to help assess and manage the flow of genes from hardwood plantations into adjacent native forest (Larcombe et al., 2016). This paper also highlights future issues, including the need to re-assess the consequences of exotic gene flow considering global climate change.

An analysis of potential risk of genetic variation loss was covered in the *State of the Forests Report Tasmania 2017* (FPA, 2017b). Given the relative stability of the threats, and the lack of any significant change in the situation of the species assessed, this analysis is considered to remain valid. Threatened species were allocated to potential risk categories, based on known or likely loss of habitat and continuing risk of loss of genetic variation. Such risk can be inferred by substantial reduction in range and loss of disjunct populations, but other reasons for loss of genetic variation generally cannot be so readily implied – for example, when species still occur throughout most of their range, but some populations have been reduced substantially in size, or some habitats (e.g. fertile valley flats) have been preferentially cleared while other habitats in the same area (e.g. steeper slopes) remain unmodified.

The categories of potential risk are:

- **Potential High Risk**: Priority species that appear to be at high risk from isolation and loss of genetic variation as a result of past human-induced or natural events. In most instances, these species are known or likely to:
  - have lost substantial areas of habitat or known populations, to the extent that the species is absent from a large part of its former likely range, or significant outlying populations have been lost; or
  - have important populations that are susceptible to a severe and feasible threat (e.g. *Phytophthora cinnamomi* close to a disjunct population of a highly susceptible plant species).
- **Potential Moderate Risk**: Priority species that appear to be at moderate risk from isolation and loss of genetic variation as a result of past human-induced or natural events. In most instances, these species are known or likely to have lost some habitat and known populations, but:
  - the species still occur throughout their former likely range; and
  - important populations are not known to be susceptible to a severe and feasible threat.
- **Potential Low Risk**: Priority species that appear to be at low risk from isolation and loss of genetic variation as a result of past human-induced or natural events. In most instances, these species have lost relatively little habitat and known populations throughout their former likely range, including outlying populations.
- **Unknown Risk**: There are many species that cannot be reasonably placed in one of the above categories. This is mainly because of inadequate information on past or current distribution or threats. Some of these species have only been described in the last few years. These species have not been allocated to High, Medium or Low Risk categories.

It should be noted that some species (particularly plant species) which are classified as Endangered or Vulnerable on Schedules of the TSP Act have not been allocated to High Risk or Moderate Risk categories. Many of these species have localised ranges and small populations, but these do not appear to have been adversely affected by past human activities or natural causes, and there is currently a low risk from such events in the immediate future.

It should also be noted that there are difficulties in ascribing a category of genetic risk to some widespread and migratory animal species (mostly birds, such as the swift parrot, *Lathamus discolor*), which have clearly suffered large population declines since European settlement (and hence likely loss of genetic diversity) but probably occur across most of their former range. Such species have been allocated to High or Moderate Risk categories.

Results of the analysis are summarised in Table 1.3.a.1. Results for High Risk and Moderate Risk categories have been combined because the division between species attributed to these two categories is not as clear-cut as the division between Moderate Risk species and Low Risk species.

It is difficult to account for the short and long-term effects of uncertain or unpredictable events (stochastic or otherwise) on most of the species considered in this analysis, but dramatic reductions in genetic variation in susceptible species could result from some events, including: floods; fires at suboptimal intensities, seasons or frequencies; introduction or range expansion of serious diseases or pests (e.g. *Phytophthora cinnamomi*, myrtle rust (*Austropuccinia psidii*), bumblebee (*Bombus terrestris)*, European wasp (*Vespula germanica)* and sugar glider (*Petaurus breviceps*)) into disease- or pest-free locations; and large-scale geomorphic or climatic events causing disruption to localised populations.

The latter could include climatic change associated with global warming, which has the potential to adversely affect small or disjunct populations (e.g. through effects on pollinator-plant interactions, and/or changes in weather and fire patterns). Such situations have not been incorporated into the analysis for Indicator 1.3.a, but it is reasonable to suggest that the species that may be most adversely affected by such scenarios are species that are classified as Endangered or Vulnerable and species that are listed under Indicator 1.3.a as being at High Risk of isolation and loss of genetic diversity.

Formal measures to address the risk of loss of genetic variation have been initiated for many of Tasmania's threatened and priority species. They include the development of Recovery Plans (which may include ex-situ breeding and establishment programs); habitat restoration and the ‘Seed Safe’ seed collecting program for the Tasmanian Seed Conservation Centre, in partnership with the Kew Millennium Seed Bank.

Other measures include the maintenance of high biosecurity standards to prevent the introduction of threats to genetic diversity. Legislative reform has resulted in the creation of a streamlined, comprehensive *Biosecurity Act 2019*, which draws together multiple strands of biosecurity-related legislation. There has also been the implementation of specific biosecurity responses to mitigate the impacts of pest species introductions.

As an example, the fungal pathogen myrtle rust (*Austropuccinia psidii*) remains a major threat in Tasmania. This disease affects plants of the family Myrtaceae (which includes eucalypts). It was detected in Tasmania in 2015, when diagnosed from a sample taken from a private residential property near Burnie on Tasmania's north-west coast. The number of potentially impacted native and commercially significant exotic species is unknown. To date myrtle rust has been identified as affecting *Lophomyrtus*, a common hedge, screening and potted plant with common names including, Black Stallion, Red Dragon, Rainbow's End and Krinkly; and affecting Chilean guava (*Ugni molinae*) also known as Tazziberry™. NRE Tas maintains a ban on the importation of all Myrtaceae species to prevent the introduction of the disease.

A ban also exists on the introduction of reptiles to the state. This is to prevent the introduction of pest species with the potential to impact on natural ecosystems, and the introduction of reptile diseases. In the reporting period multiple requests to allow the importation of subspecies of the

blotched bluetongue skink (*Tigrea nigrolutea*) have been refused on the basis that they pose an unacceptable risk to the genetic integrity of the Tasmanian population of this species.

Table 1.3.a.1 Forest-associated threatened and priority species potentially at risk[(a)] from isolation and the loss of genetic variation, as a result of past human-induced or natural events

Group	Potential High to Moderate Risk	Potential Low Risk	Unknown Risk	Total
Vertebrate fauna				
Fish	5	5	0	10
Amphibians	2	0	0	2
Reptiles	0	0	2	2
Birds	7	5	0	12
Mammals	2	1	1	4
Total	**16**	**11**	**3**	**30**
Vascular Plants				
Dicotyledons	242	23	0	265
Monocotyledons	71	4	0	75
Pteridophytes	20	0	0	20
Gymnosperms	2	0	0	2
Total	**335**	**27**	**6**	**368**

a) A qualitative degree of risk has been estimated for vertebrate fauna and vascular plant groups (excluding orchids) that are listed as threatened in Tasmania or are identified as RFA Priority species.

Conservation of environmental diversity, including genetic diversity in Tasmania's forests is principally catered for in a systematic reserve system on public land, by a voluntary private land reserve system, and by management by prescription in production forests. A range of measures are delivered through the *Forest Practices Code 2020* to maintain genetic interchange and generally manage genetic resources. These include a network of strips and patches of unlogged forest throughout the production landscape and management prescriptions for priority forest-associated species. These measures are implemented at multiple spatial and temporal scales through Tasmania's forest practices system (Munks et al., 2020).

Databases (e.g., Natural Values Database, Department of Natural Resources and Environment Tasmania, 2022c, Biodiversity Values Database, FPA, 2014a), planning tools (e.g., Threatened Fauna Adviser, FPA, 2014b) and field assessment procedures allow threatened species to be considered when forestry operations are planned and undertaken (Munks et al., 2020). Procedures have been agreed between NRE Tas and FPA to ensure that threatened species are taken into account when forestry operations are planned (Department of Natural Resources and Environment Tasmania, 2022a). Assessments are conducted at a strategic or landscape level, and through pre-operational evaluation of specific areas (e.g. coupes or roadlines) proposed for forestry operations. Management actions are developed to mitigate the impact of an activity on a particular species or habitat. This may involve input from trained Forest Practices Officers, researchers and specialist staff of the FPA, NRE Tas, STT, tertiary institutions and proponents of proposed activities. Availability of information to inform management decisions is discussed under Indicator 1.2.a.

The FPA produces an annual FPA and NRE Tas Agreed Procedures Report (Munks and Crane, 2017, Chuter and Crane, 2018, 2019, 2020, FPA and DPIPWE, 2021), which reports on the implementation of procedures for management of threatened species under the forest practices system during the preceding year.

Box 1.3.a Case study: Fairy lanterns

The *State of the Forests Report Tasmania 2017* (FPA, 2017b)) contained a case study on fairy lanterns (*Thismia rodwayi*), a subterranean plant that occurs in wet sclerophyll forests in Tasmania, the eastern states of the Australian mainland and in New Zealand (Threatened Species Section, 2022). *Thismia rodwayi* was first discovered in the 1800s in Tasmania (Wapstra and Chuter, 2013). Since then, it was seldom seen until the early 2000s when the species came to the attention of the Tasmanian botanical community through another sighting in the Hobart area and in a proposed logging coupe in the north of the state. The species was thought to be at risk of stochastic events, such as intensive logging, and actions were implemented to ensure the population of *Thismia rodwayi* within the logging coupe was retained within areas excluded from logging (wildlife habitat clumps), and that the effectiveness of these retained areas was monitored over the next 11 years.

Following the rediscovery in 2002, the raised profile of *Thismia rodwayi* led to an increase in the number of sightings which substantially increased the extent of occurrence and the linear range of the species. The long-term monitoring project, along with other survey work, found that *Thismia rodwayi* persists in disturbed areas (Merckx and Wapstra, 2013, Wapstra and Chuter, 2013) and that management by prescription is an appropriate way to manage long- term conservation and genetic diversity of *Thismia rodwayi*. Furthermore, the interest in the species created by this work led to further sighting, indicating that the species was more widespread and abundant than has been thought. *Thismia rodwayi* was delisted from the schedules of the Tasmanian *Threatened Species Protection Act in 2019*. This outcome highlights the difficulty in inferring loss of genetic diversity for species for which there has been relatively little research effort, and which has been assumed to be threatened and/or in decline.

Indicator 1.3.b Native forest and plantations of indigenous timber species which have genetic resource conservation mechanisms in place

This indicator documents the genetic resource management mechanisms put in place to maintain the range of genetic diversity of indigenous timber species used for rehabilitation or commercial purposes, and to avoid the introgression of genetic resources from plantations into native forest stands, especially of rare and threatened species. Introgression is the movement of a gene (gene flow) from one species into the gene pool of another by the repeated backcrossing of an interspecific hybrid with one of its parent species.

The RFA provides protection through the CAR reserve system, the Policy for Maintaining a Permanent Native Forest Estate and the *Forest Practices Code 2020* for all indigenous timber species. The agreement remains the principal mechanism by which the genetic composition of indigenous timber species is maintained. Seed collections of indigenous conifers and rare eucalypts are undertaken by the Tasmanian Seed Conservation Centre, based at the Royal Tasmanian Botanical Gardens. Collecting priorities for the seed bank are informed and assisted by staff of the Biodiversity and Conservation Branch of NRE Tas.

With respect to harvesting activities in native forest and their potential impacts on genetic composition, the *Forest Practices Code 2020* requires sowing or planting a tree species composition like that of the natural forest for the site. Other species may be considered for control of forest diseases or for climate change considerations. STT maintains records for all seed collection, storage and germination activities and actively implements the *Forest Practices Code 2020* prescriptions in all native forest regeneration following harvest.

Eucalypt plantations are dominated by plantings of *Eucalyptus globulus* and *E. nitens*. There are minor plantings of *Acacia melanoxylon* and still smaller plantings of other eucalypts such *as E. regnans* and *E. viminalis*. For plantation *E. globulus*, the National Genetic Resource Conservation Centre at Mt Gambier stores key genetic material for breeding programs. Tree Breeding Australia maintains a breeding program for *E. globulus* that includes base population and advanced breeding population progeny tests on several sites throughout Australia (McRae, 2001). In Tasmania, Forico, STT and Reliance Forest Fibre maintain provenance and progeny trials. Studies of the genetic diversity in the native populations and breeding population of *E. globulus* have been undertaken at UTAS and the ARC Centre for Forest Value (ARC CFV).

The University of Tasmania and the ARC CFV have maintained active research programs investigating the genetics of indigenous timber species (Appendix 3).

CRITERION 2: MAINTENANCE OF PRODUCTIVE CAPACITY OF FOREST ECOSYSTEMS

This criterion aims to report on whether Tasmania's forests are managed in a way that maintains their capacity to continue to produce wood and non-wood products for future generations.

Indicator 2.1.a Native forest area available for wood production, area harvested and growing stock of merchantable and non-merchantable tree species

This indicator is a measure of the capacity of native forest to meet the market for wood products. Its purpose is to summarise changes in land available for timber production over time.

The native forest area available for timber production is essential to the calculation of the sustainable yield. This is the best available estimate of the area of native forested land that is likely to be harvested now or at some time in the future.

The source of information on the area potentially available for timber production on public land is Sustainable Timber Tasmania (STT)'s mapped provisional coupes. Provisional coupes define potential harvest operation boundaries by removing areas where harvesting is not allowed or is highly unlikely. In the first category are formal and informal reserves. In the second are areas restricted by, for example, *Forest Practices Code 2020* provisions, inaccessibility, uneconomic forest, silvicultural limitations, and harvesting constraints.

The area of private forest land potentially available for timber production is not mapped and therefore is not able to be reported (Table 2.1.a.1). Because adjustments of the private forest resource availability estimates are not specifically area-based, it is not possible to provide a meaningful net area estimate. For private forest, in addition to areas that are deducted due to *Forest Practices Code 2020* or other constraints, the most significant deduction results from 'owner intent', which varies from year to year and must be determined by periodic survey. Hence predicting the potential forest estate available for timber production in a reliable way is problematic.

As shown in Table 2.1.a.1, the area of native forest potentially available for timber production on public land at 30 June 2021 is 471,000 ha (Sustainable Timber Tasmania, 2016-2022), about 21% of the gross native forest area. The extent of the net area is limited by requirements of the *Forest Practices Code 2020* and assessments that some forest cannot be physically or economically harvested. The gross forest area on both private and public lands has changed very little from the previous reporting period.

Table 2.1.a.1 Gross native forest area and net native forest area available for wood production by tenure as at 30 June 2021

Tenure	Gross native forest area (k ha)	Net native forest area (k ha)
Public	2,213	471
Private	840	Not available

The area of native forest harvested on public land varies from year to year (Table 2.1.a.2). This activity is driven by sawlog supply, market conditions and silvicultural prescription. This area includes clearfell, selective harvesting and thinning operations. The area of public land harvested has remained relatively stable over the reporting period.

Table 2.1.a.2 Native forest area (k ha) harvested by tenure

Tenure	2016–2017	2017–2018	2018–2019	2019–2020	2020–2021	Average
Public	5.4	5.7	5.9	5.8	5.0	5.6
Private			NA			

A surrogate for native forest area harvested is the area of native forest approved for harvesting each year, as indicated in certified forest practices plans (FPPs) (Table 2.1.a.3). This dataset is held by the FPA and includes both public and private land tenure. It is important to note, however, that actual native forest area harvested is likely to be less than the planned area due to operational constraints. Also, harvesting operations may occur in subsequent years.

Across all tenures, the average number of ha of native forest approved for harvesting under FPPs annually during 2016–2021 (10,224 ha) was more than that reported in the previous 2011–2016 reporting period (7,800 ha).

Table 2.1.a.3 Native forest area approved for harvesting by tenure (ha)

Tenure	2016–2017	2017–2018	2018–2019	2019–2020	2020–2021
Public	7,030	6,859	5,841	7,306	8,470
Private	2,185	3,122	2,816	2,569	4,918
Total	**9,215**	**9,982**	**8,661**	**9,874**	**13,388**

Indicator 2.1.b Age class of plantations

This indicator provides a statewide summary of the progress of plantation establishment of native and exotic species over time. An increase in the size and quality of the plantation estate is a significant element in the longer-term sustainability and growth of the forest industry in Tasmania. The expected contribution of plantations to sustainable high quality eucalypt sawlog supply from PTPZ land is addressed independently in the review required by Clause 98 of the RFA.

Table 2.1.b.1 reports plantations in five-year age-classes at an aggregated state level. This area information is a compilation of GIS data layers contributed by the large forest growers, and independently collected data for the smaller private growers.

A range of species, particularly eucalypts, is planted in Tasmania. However, as the industry has developed, plantations are growing a narrower range of species: the softwood resource is dominated by *Pinus radiata*, while *Eucalyptus nitens* and *E. globulus* dominate the hardwood resource. *E. globulus* is the favoured pulping species, but it grows only in relatively frost-free sites. *E. nitens* is the preferred alternative in exposed, frosty or high-altitude sites and is the more widely planted species.

Table 2.1.b.1 Area of Tasmanian plantations in five-year age classes as at 31 December 2020

Age Class	Hardwood plantations (ha)	Softwood plantations (ha)
Unknown	1,800	100
Pre 1976	400	800
1976–1980	300	700
1981–1985	500	600
1986–1990	1,700	1 300
1991–1995	6,000	7 300
1996–2000	15,400	14 700
2001–2005	43,200	13 600
2006–2010	79,800	16 100
2011–2015	6,800	8 400
2016–2020	13,600	33 600
Total	**192,600**	**77,000**

Table 2.1.b.2 indicates the changes in plantation area since 2001. Consistent with Australia-wide trends, the area of hardwood plantations increased at a rapid rate until the most recent reporting period. The hardwood plantation estate in Tasmania peaked in about 2008, at the height of Managed Investment Schemes (MIS) and thereafter new plantings have been very small. In contrast, the area of softwood plantations in Tasmania has remained stable.

In the reporting period 2016–2021:

- The total area of hardwood plantation reduced by 14% (32,000 ha), mostly on private land, and predominantly where landowners converted the land to agricultural use after harvest of joint-venture or leased land for plantations.
- The area of softwood plantation increased by 3% (2,000 ha).

Table 2.1.b.2 Plantation area every 5 years from 2001 to 2021

Reporting Year	Hardwood plantations (ha)	Softwood plantations (ha)
2001	117,600	80,400
2006	158,900	71,500
2011	233,200	75,600
2016	224,000	75,000
2021	192,600	77,000

Indicator 2.1.c Annual removal of wood products compared to the volume determined to be sustainable for native forest and future yields for plantations

This indicator summarises the outcomes of timber harvesting activities for the five-year review period. Strategies for managing public and private timber resources were either in place during the RFA or amended subsequently. These harvesting outcomes are compared with sustainable cut levels to indicate progress of the strategies. Data for the period 2017–2021 are presented in Table 2.1.c.1 .

Clause 98 of the RFA commits the state to five-yearly reviews of the sustainable supply of high-quality sawlogs from public land. This review is reported independently of this report.

Public forest

The native forest harvest from public land is based on making available a minimum legislated high quality eucalypt sawlog supply. After enactment of the *Forestry (Rebuilding the Forest Industry) Act 2014*, the minimum volume to be made available to industry was set at 137,000 m^3 per year. Pulpwood supply arises from meeting these sawlog commitments. Under Clause 98 of the RFA, STT undertakes and makes publicly available a five-yearly review of sustainable high-quality sawlog supply levels from permanent timber production zone (PTPZ) land. This is known as the 'Sustainable Yield Review'. The last Sustainable Yield Review was published by STT in 2017 (Sustainable Timber Tasmania, 2017).

Private forest

The 1.005 million ha of privately managed forest comprises both native forest (833,000 ha) and plantation (172,000 ha). Native forest is owned and managed by thousands of individual private landowners whereas plantations are predominantly owned and/or managed by a few industrial forestry companies. Approximately 80,000 ha of these privately managed plantations are on public land (note that for the purposes of this report privately managed forest on public land are accounted for under the heading of Private Forest). Currently, most of the wood production (in terms of volume) from private forest comes from the industrial plantation estate (Table 2.1.c.1).

The latest wood resource review for private forest was published by Private Forests Tasmania in 2020 (Private Forests Tasmania, 2021). The review found that private native forest at that time carried an estimated 51 million t of harvestable volume. The review did not attempt to estimate a sustainable cut from private native forest, however the annual cut from these forests is relatively small, averaging less than 200,000 t over the reporting period (Table 2.1.c.1).

In contrast to native forest, wood production from the private plantation estate reached historic highs during the reporting period, peaking at 4.2 million t in 2019. Most of this wood came from eucalypt hardwood plantation as the first rotation plantings from the MIS plantation expansion in the late 1990s and early 2000s reached maturity.

The annual average level of softwood plantation harvest has been steady during the reporting period, averaging 1.2 million t per annum. Forecast yields from the plantation estate are not publicly available. Forecast yields would vary between forest types and the management objectives of each forest manager.

Table 2.1.c.1 Annual removal of wood from public and private forest[a]

	Public forest						Private forest[b]					
Sales Category	**2017**	**2018**	**2019**	**2020**	**2021**	**Average**	**2017**	**2018**	**2019**	**2020**	**2021**	**Average**
NATIVE FOREST												
Estimated sustainable cut eucalypt sawlog and veneer log (k m^3)	137	137	137	137	137	137	n/a[c]	n/a	n/a	n/a	n/a	
Actual cut eucalypt sawlog and veneer log (k m^3)	117	130	116	119	116	119.6	50	21	44	24	59	40
Actual cut pulpwood (k t)	938	1015	1010	929	943	967	100	101	95	246	212	151
Actual cut special species timbers sawlog (k m^3)	9	10	10	8	9	9.2	2.1	5.0	1.4	6.7	2.4	3.5
EUCALYPT PLANTATION												
Sawlogs and veneer (k m^3)	0	0	0	0	6	1.2	337	595	572	241	433	436
Pulpwood (k t)	194	162	152	244	160	182.4	2098	2209	2337	2099	1560	2061
SOFTWOOD PLANTATION												
Sawlogs and veneer (k m^3)	17	40	56	49	13	35	698	689	650	736	631	681
Pulpwood (k t)	142	152	110	138	202	148.8	566	566	592	673	513	582

a) Figures exclude minor log products
b) For the purposes of reporting in this table private forest include privately managed forest on public land.
c) Data not available.

The key points to note are:

- On public land the actual average eucalypt sawlog harvest from native forest for the period is below the requirement in the *Forest Management (Rebuilding the Forest Industry) Act 2014* for STT to make available 137,000 m^3 of sawlog.
- There is no sustainable sawlog cut determined for private native forest; predicted sawlog yields are based on recent production. The cut over the reporting period was moderately higher than the previous period but lower than previous decades. The cut of pulpwood shows a similar trend.
- On public land there was a small amount of sawlog cut from eucalypt plantation as the plantation estate begins to mature. Pulpwood yields were inconsistent over the period.
- For private eucalypt plantations, the sawlog and veneer yield has grown from approximately zero in 2016 to an annual average of 436,000 m^3 over the reporting period. Most of this volume was exported as peeler logs. The annual pulpwood yield averaged over 2 million t.
- For private softwood forests, the annual sawlog and veneer yield was between 650,000 and 740,000 m^3.

Indicator 2.1.d Annual removal of non-wood forest products compared to the level determined to be sustainable

This indicator recognises that forests are sources of non-wood products, including for use by Tasmanian Aboriginal people, and that it is important to monitor the level of use and, where practical, assess whether that level is sustainable. See Indicator 6.1.b . for report on the values, quantities and use of non-wood forest products.

While there are some statewide data for this indicator available on removal of non-wood products, the data on sustainable yields of these products are very limited. The different levels of available data reflect market driven responses where demand for non-wood products determines what, if any, monitoring systems are developed.

There is no data available on resources collected or used for Tasmanian Aboriginal cultural activities in the 2016–2021 reporting period.

As reported in 2017 (FPA, 2017b), the Aboriginal Access to Traditional Materials Policy (Sustainable Timber Tasmania, 2014a) guides how STT manages access to materials which may be of important significant traditional value to Tasmanian Aboriginal people.

Apiary industry

Honey production is dependent on seasonal conditions which determine flowering productivity. The sustainable yield of honey production from forests has not been determined. Table 2.1.d.1 reports data relating to beekeepers operating on PTPZ land managed by STT. Table 2.1.d.2 reports data relating to beekeepers operating on land managed by PWS. The total number of hives on PTPZ land reported by STT for 2020–2021 is 9,889 (Tables 2.1.d.1) and the number of apiary agreements on PWS land for 2020-2021 is 312 (Table 2.1.d.2). There is no data for the number of hives for private forest.

Table 2.1.d.1 Apiary sites and number of hives on PTPZ land (2016–2017 to 2020–2021)

Year	Number of sites	Number of hives
2016–2017	290	9,141
2017–2018	308	9,445
2018–2019	308	9,873
2019–2020	308	9,859
2020–2021	304	9,889

Source: Sustainable Timber Tasmania

Table 2.1.d.2 Number of agreements and hive capacity for apiary licences on PWS land (2016–2017 to 2020–2021)

Year	Crown land agreements	Capacity[(a)]	Reserves agreements	Capacity[(a)]	Total agreements	Capacity[(a)]
2016–2017	110	5,834	178	8,284	288	14,118
2017–2018	106	5,694	179	8,745	285	14,439
2018–2019	108	5,752	182	8,935	290	14,687
2019–2020	111	5,861	201	9,251	312	15,112
2020–2021	111	5,859	201	9,226	312	15,085

a) This data is based on site capacity and actual number of hives stipulated in agreements. In processing the raw data, replicated records were removed and missing hive data was sourced from a search of specific agreements.

Source: Property Services, NRE

Treeferns

It is estimated that there are over 130 million individually-trunked *Dicksonia antarctica* occurring in Tasmania's forests (FPA, 2017c). This figure was derived from treefern abundance data collated from a number of studies around Tasmania (Chuter, 2003, Kirkpatrick and Moscal, 1987, Neyland, 1986, Turner, 2003, Pannell, 1992). Abundance data collected in quadrats or transect samples was used to generate density estimates per hectare by wet forest type. Density estimates varied greatly, and a conservative approach was taken, where the lower values of range data were used.

Another recent population estimate (165 million) was made from information on the extent of RFA forest communities known to support *D. antarctica* and density estimates for these forest communities from past research and surveys (FPA, 2022c).

A species distribution model was developed for *D. antarctica* (Figure 2.1.d.1). The model estimates the probability that a species will occur in a location using associations between environmental variables and known presence records of species across locations and habitats of interest (Araújo and Peterson, 2012). TASVEG, geology type, elevation and eight bioclimatic variables were used in model development following the method in FPA (2020b).

Harvesting of treeferns is regulated through the forest practices system and during the reporting period, must be conducted in accordance with the FPA's Treefern Management Plan 2017 (FPA, 2017c), revised in 2022). This defines how *D. antarctica* can be harvested, transported and traded in Tasmania.

Harvesting of treeferns must be covered by a certified FPP that includes a suitable prescription. Treeferns may be harvested from native forest to be converted to another land use, native forest to be intensively logged and regenerated, existing softwood and hardwood plantations, and treefern plantations or nursery sites. A Tasmanian treefern tag must be attached to each treefern harvested within the area specified under the FPP before the treefern is removed. Treefern tags are issued by the FPA. These tags must always remain on the stems to ensure that the origin of treeferns can be tracked to approved harvesting areas.

During the current reporting period, just over 20,000 treefern stems per year were harvested (Table 2.1.d.3). These treeferns were salvaged from native forest converted to another land use such as forest plantations or agriculture, or intensively logged and regenerated native forest from locations primarily in the north-west and southern Tasmania (Figure 2.1.d.2).

Treeferns regenerate readily in coupes disturbed by harvesting (Chuter, 2003). Spores are dispersed from mature treeferns retained in streamside reserves or wildlife corridors. Regenerating treeferns grow in height at a rate of 3.5–5.0 cm per year, indicating that treeferns can reach maturity (able to produce spores) in less than 30 years (FPA, 2017c). At this stage, they are likely to be a harvestable size. if required. The available treefern resource and understanding of treefern recolonisation and growth rates indicate that current harvest levels are well within sustainable yields.

Table 2.1.d.3 Number of treefern tags issued annually between 2016 and 2021

Financial year	Number of treefern tags issued
2016–2017	14,390
2017–2018	25,300
2018–2019	14,656
2019–2020	20,420
2020–2021	36,287

Source: FPA annual reports

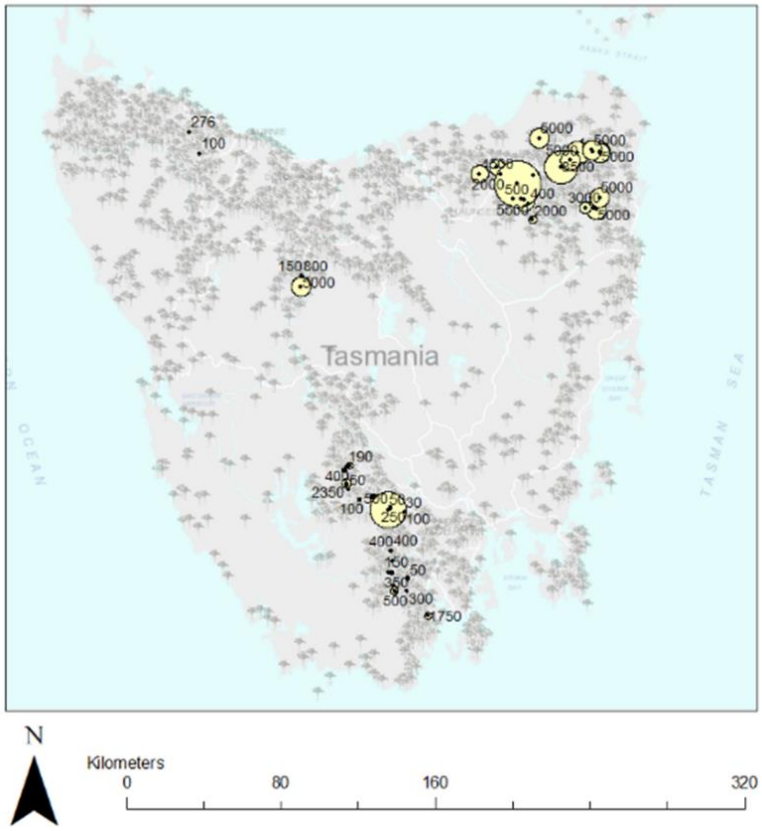

Figure 2.1.d.1 Location of treefern harvesting and number of tags purchased

Size of circle equates to number of treefern tags issued. Grey treefern symbols are Natural Values Atlas records for D.antarctica. No treefern harvesting occurred on the Furneaux islands during the reporting period.

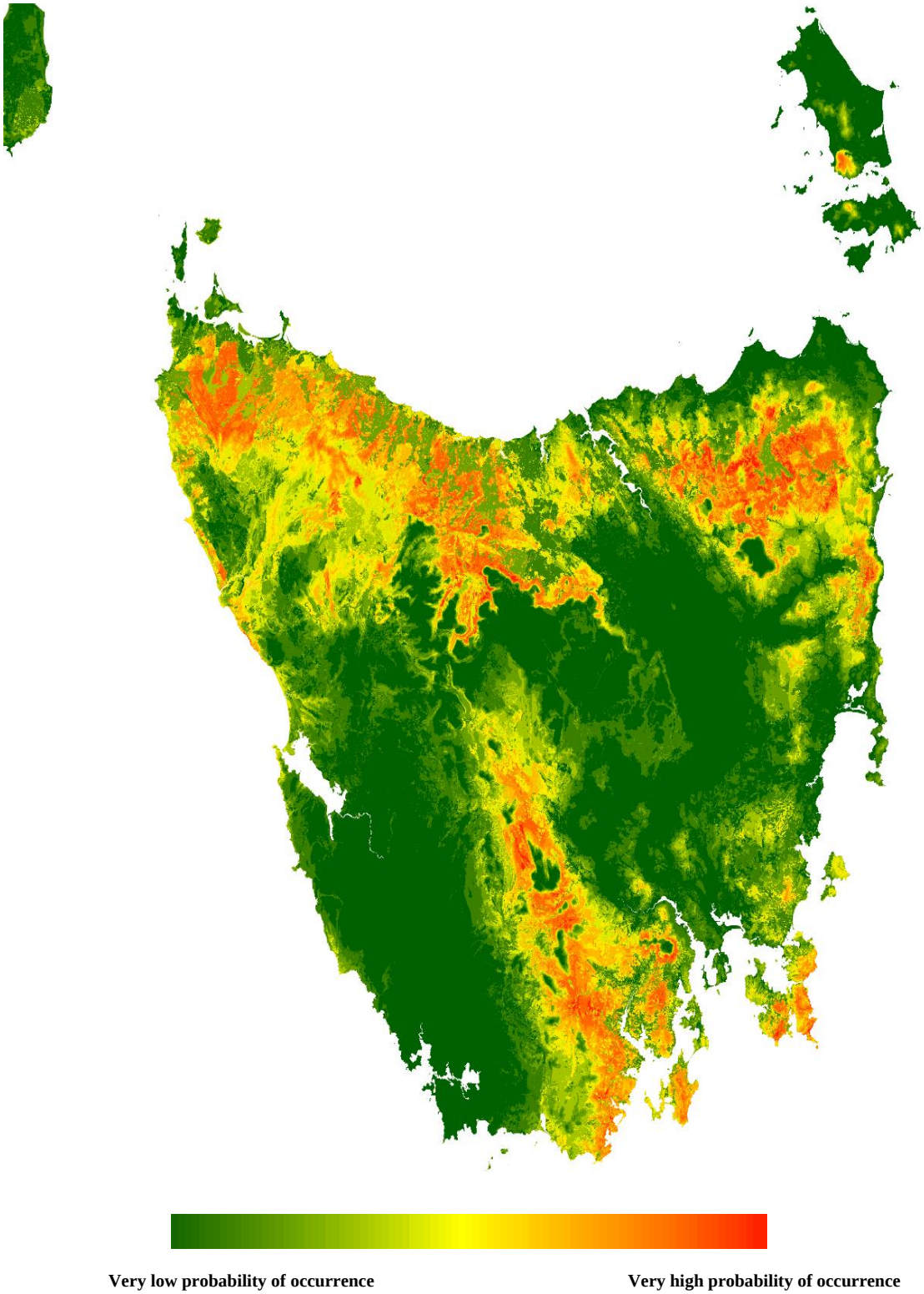

Figure 2.1.d.2 **Species distribution model for *Dicksonia antarctica*, showing the probability that a location will contain the species**

Maxent modelling using Tasveg4.0 (adapted from method in FPA, 2020b).

Native seed and flora collection

Seeds are collected by private collectors and STT principally for their own use in native forest reforestation, propagating nursery stock and the establishment of plantations. Data is available for seed collection from STT which provides information on seed weight, origins, site details and germination capacity as standard practice. The annual quantity of seed collected by STT in this reporting period is shown in Table 2.1.d.4.

Table 2.1.d.4 Annual collection of native tree seed by Sustainable Timber Tasmania

Year	Raw seed (kg)
2016–2017	1,244
2017–2018	950
2018–2019	855
2019–2020	851
2020–2021	1,892

Wildlife harvesting

Since 1985, NRE Tas has been monitoring population levels of the brushtail possum, Bennetts wallaby and the Tasmanian pademelon. These results are reported in Indicator 1.2.c and Figure 1.2.c.1 . Hunting or control has not impacted on populations levels of wallabies, pademelons or brushtail possums across Tasmania, indicating that current harvesting of these species is within sustainable levels.

There have been fluctuating markets for skins and meat over the last 25 years, with the current reporting period at the high end of commercial harvest (Tables 2.1.d.5 and 2.1.d.6). There are fluctuations in annual commercial harvest whereas non-commercial shooting license numbers have remained relatively stable (Table 2.1.d.6). Non-commercial shooting licenses are issued for control of these species where browsing in primary production areas has been a problem (see Indicator 6.1.b).

Table 2.1.d.5 Annual permits and harvest of brushtail possums

Year	Commercial permits	Estimated commercial harvest
2016–2017	69	14,913
2017–2018	55	9,824
2018–2019	39	11,504
2019–2020	27	13,358
2020–2021	24	6,486

Source: NRE Tas

Table 2.1.d.6 Annual licenses for wallaby harvests

Year	Commercial licences	Non-commercial licenses
2016	38	7,583
2017	69	7,852
2018	55	7,677
2019	39	7,614
2020	27	7,852
2021	24	7,948

Source: NRE Tas

Fallow deer in Tasmania

The European fallow deer (*Dama dama*) was introduced to Tasmania in 1836 and is now estimated to occupy a range encompassing at least 27% of the state (Figure 2.1.d.3).

In the 1970s, the deer population was conservatively estimated to be around 8,000. A 2019 survey estimated the population in the traditional range to be approximately 54,000; but the total number in Tasmania is likely to be considerably higher.

Based on long-term annual spotlight surveys, it is estimated that the annual population growth rate is in the order of 6.2% (Figure 2.1.d.4). The trend line indicates that the population has been increasing exponentially. The growing number and wider geographic distribution of fallow deer in Tasmania presents challenges for the environment, agriculture and forestry.

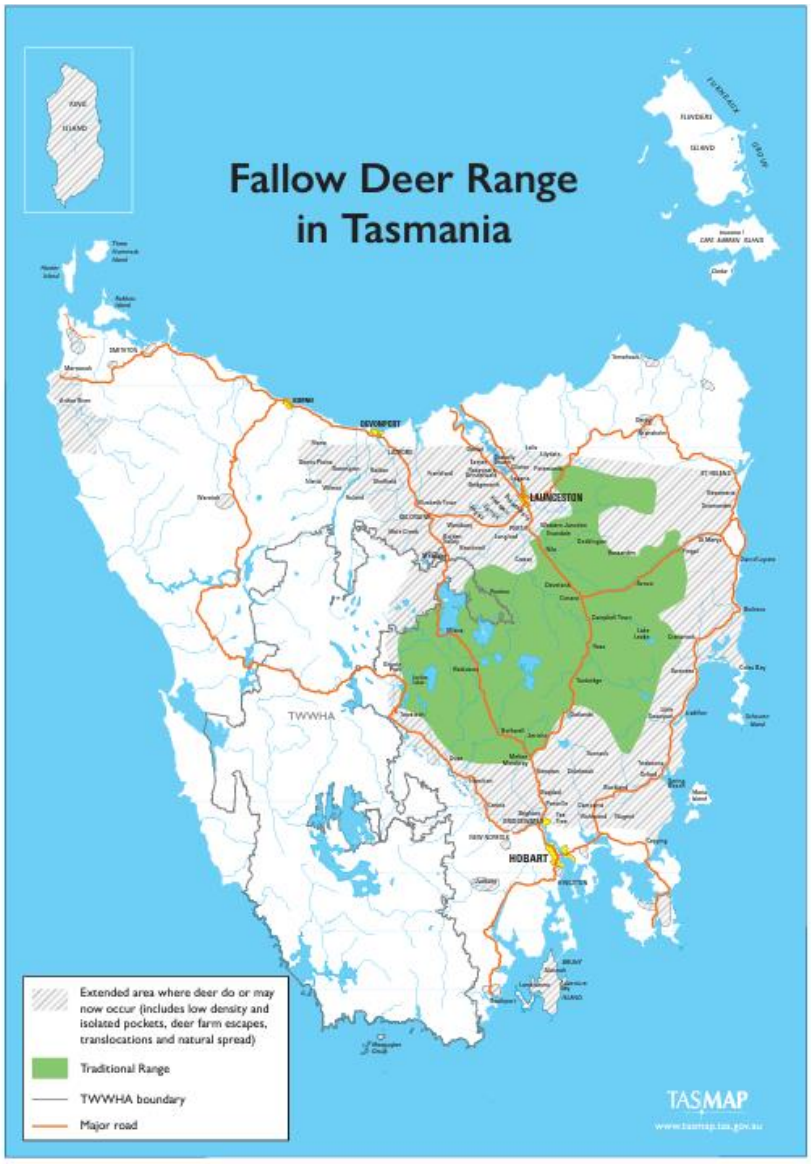

Figure 2.1.d.3 Known extent of wild deer in Tasmania (2021)

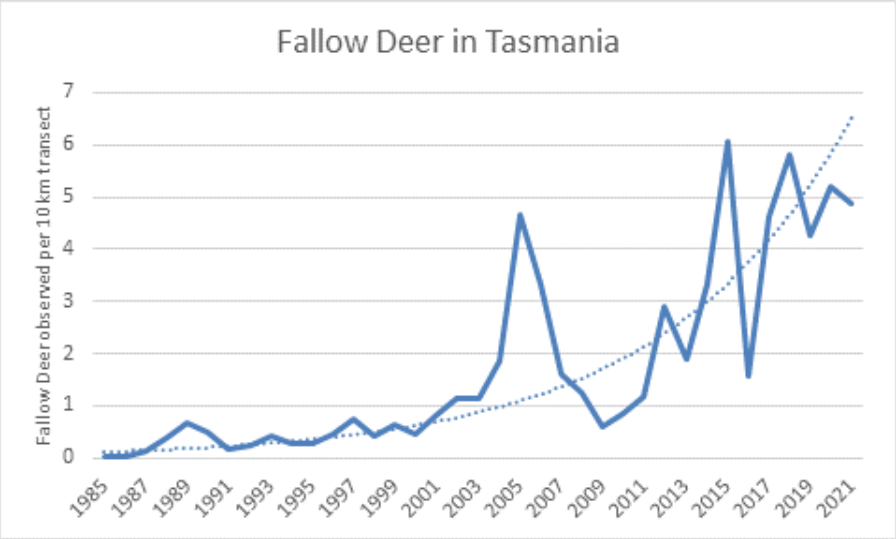

Figure 2.1.d.4 Increase in the population of fallow deer in Tasmania since 1985

Deer browsing impacts natural vegetation through changes in species composition and structure. Male deer damage trees by rubbing antlers at certain times of the year resulting in bark stripping which causes mortality or timber degrade in plantations and native forest. Browsing of seedlings in native forest and plantations reduces reforestation success. Deer can also be a vector for soil-borne pests and diseases. The impact of deer can result in the conversion of closed forests to open grassy woodlands.

A five-year management plan was released by NRE Tas in 2022 (Game Services Tasmania, 2022). The plan aims to ensure that the impact of wild fallow deer on agricultural production, conservation areas and forestry are balanced with maintaining deer as a traditional hunting resource.

Hunting is the key means by which deer populations have been managed in Tasmania to date. The number of game licenses sold during the reporting period increased significantly in 2020 and 2021, but the number of male deer taken has plateaued (Table 2.1.d.7). The number of male and female fallow deer taken for crop protection purposes has risen significantly in recent years, facilitated by changes to regulations that govern deer hunting to allow more deer to be taken (see also Indicator 6.1.b). Crop protection permits are issued by NRE Tas to farmers and foresters to control damage to forestry and agricultural crops caused by browsing and bark-stripping, but most commercial harvest of these species does not occur in forests.

Table 2.1.d.7 Annual harvest of deer from game licences only (not Crop Protection permits)

Year	Deer licences	Estimated male deer taken under game licence
2016	5,165	1,945
2017	5,171	2,401
2018	5,067	2,386
2019	5,162	2,493
2020	5,894	2,486
2021	6,028	NA

Source: NRE Tas

Indicator 2.1.e The area of native forest harvested and the proportion of that effectively regenerated, and the area of plantation clearfelled and the proportion of that effectively re-established

This indicator reports on the extent of native forest harvested and the success of re-establishing regeneration. It also compares the area of plantations clearfelled with the area effectively replanted and gives an indication of the success of the planting effort.

The Tasmanian forest practices system is designed to ensure effective reforestation of native forest and plantations where that is intended.

In native forest, the *Forest Practices Code 2020* (the Code) provides guidance on silvicultural treatments, including regeneration practices, appropriate for the forest types in Tasmania (FPA, 2020a). The Code requires sowing or planting a tree species composition like that of the natural forest for the site. Other species may be considered for control of forest diseases or for climate change considerations. The Code requires regeneration surveys to be conducted. Where surveys show survival is less than the required stocking standard, remedial treatments must be considered.

The FPA reports annually on the extent of planned forest operations as approved in certified FPPs across all tenures. However, the figures provided do not reflect actual completed area as there is often a reduction in area due to operational reasons. Table 2.1.e.1 shows the area of native forest planned and approved for clearfell harvesting followed by reforestation, conversion to plantation or non-forest land use. All forestry operations on public and private land are undertaken under a FPP, with exception for minor forestry operations or activities approved under other regulatory processes according to the Forest Practices Regulations 2017.

Native forest conversion to plantation ceased on public land in 2007. Native forest conversion to plantation and non-forest land-use since 2007 has been influenced by the Policy for Maintenance of a Permanent Native Forest Estate (Department of State Growth, 2017) which is a requirement of the RFA. That Policy is reviewed every five years. The Policy was revised in 2017 to bring broadscale clearance and conversion of native forest to an end. An exemption was provided where the clearing is for agricultural purposes and is limited to 40 ha per property per year.

In 2020–2021 approximately 300 ha of native forest on private land was cleared without authority of a certified FPP in contravention of the *Forest Practices Act 1985.*

Table 2.1.e.1 Total area (ha) of native forest (public and private) planned for clearfell harvesting and proposed for regeneration, conversion to plantations or non-forest land use[a] (2016–2017 to 2020–2021)

Reporting Year	Clearfelled followed by regeneration by seeding	Clearfelled followed by plantation	Clearfelled followed by non- forest land use[a]
2016–2017	3,115	26	488
2017–2018	2,196	72	452
2018–2019	2,108	48	468
2019–2020	2,404	4	352
2020–2021	1,691	4	534
TOTAL	11,514	154	2,294

a) Non-forest land use includes infrastructure such as roads, power lines and dams and conversion to agriculture

Table 2.1.e.2 provides information on plantations planned for re-establishment, reforestation with natives, or conversion to non-forest land use since 2016–2017. Plantation harvesting is driven by market forces. The major markets for Tasmanian softwood are domestic and export pulpwood and domestic sawlog, with some export log sales in the past five years. Tasmanian plantation hardwood

is predominantly sold into the export woodchip market (China and Japan) and the recently developed export log market primarily for rotary peeled veneer processors in China.

Table 2.1.e.2 Total planned area (ha) of plantation forest (public and private) harvested and proposed for reforestation (plantation or native forest) or converted to non-forest land use (2016–2017 to 2020–2021)

Reporting Year	Plantation reforestation	Plantation conversion to non-forest use[a]	Plantation to native forest[b]	Total
2016–2017	12,289	2,982	310	15,581
2017–2018	13,353	2,856	65	16,274
2018–2019	13,309	2,949	97	16,355
2019–2020	12,164	3,536	326	16,026
2020–2021	8,121	3,192	45	11,358

a) Non-forest land use is minor on PTPZ land and restricted to infrastructure requirements such as roads, power lines and dams – area not reported

b) Plantations clearfelled and re-established with native forest largely reflects the reforestation of streamside reserves with native species in plantations originally established prior to the introduction of the Forest Practices Code in 1987

Plantations are not always re-established following final harvesting. The drivers of land-use change depend on location, productivity, and the economics of alternative land-use. The reason for conversion to another land-use is not reported. Major drivers in recent years have been the increase in returns from agriculture, particularly livestock, combined with expansion in irrigation schemes. The collapse of Management Investment Schemes (MIS) in 2010 to 2012 left many landowners with plantations transferred to their ownership in lieu of land rental payments. On maturity of the plantations, many landowners have chosen not to reforest so the land can be returned to agricultural use. Urban expansion and infrastructure development also has an impact.

In Tasmania, industrial plantation growers have internal management systems that provide for assessment of regeneration/re-establishment stocking levels and the likelihood of success of remedial treatment.

STT reports annually on the level of regeneration achieved for all harvested native forest operations on PTPZ land. Table 2.1.e.3 shows that STT consistently exceeded its regeneration success target of 85% of the regenerated area meeting prescribed stocking standards during the current reporting period. Stocking standards specify the minimum levels of growing stock to be retained or regenerated to maintain productive native forest after harvesting operations. The required stocking standard is determined by the forest type being regenerated and is based on the number and spatial distribution of acceptable seedlings, saplings or trees that occur within the forest area being assessed. Areas that do not meet the stocking standard are assessed to determine if they are ecologically stocked, meaning that that the stocking is sufficient to maintain the forest community even though its wood productivity may be low. Very few areas fail to meet ecological stocking, especially after remedial treatments are applied.

Table 2.1.e.3 Percentage of regenerated native forest meeting the stocking standard on PTPZ land (2016–2017 to 2020–2021)

Reporting year	Regeneration year eucalypt clearfell and partial logging	Regeneration year rainforest/blackwood swamp	Total area treated (ha)	Total area which achieved standard (ha)	Area meeting standard (%)
2016–2017	2013–2014	2011–2012	4,368	4,193	96
2017–2018	2014–2015	2012–2013	4,432	4,166	94
2018–2019	2015–2016	2013–2014	4,145	3,938	95
2019–2020	2016–2017	2014–2015	5,792	5,735	99
2020–2021	2017–2018	2015–2016	3,627	3,591	99

The FPA's annual independent assessment process (as described in Indicator 7.1.b) evaluates whether an effective stocking standard is likely to be achieved following clearfelling in native forest (Table 2.1.e.4) and plantations which are to be regenerated or re-established. The certificates of compliance do not specify regeneration or re-establishment rates achieved but do indicate the level of compliance with the objective specified within an FPP. In 2016–2017 the rating system considered that a score of 3.0 was an acceptable performance for regeneration in native forest operations. In 2017–2018 the performance rating system was changed so that the acceptable rating is expressed as a percentage. The adoption of a risk-based approach to compliance assessments reduced the number of assessments and it was therefore no longer statistical meaningful to report by tenure (Tables 2.1.e.4 and 2.1.e.5).

Table 2.1.e.4 FPA's annual assessment performance rating for regeneration in native forest operations (2016–2017 to 2020–2021)

	Private industrial	Private independent	PTPZ land	All tenures
Old rating system: maximum is 3				
2016–2017	–	2.4	3.0	3.0
New rating system: percentage				
2017–2018				100%
2018–2019				87.5%
2019–2020				100%
2020–2021				100%

Source: FPA, 2016–2021

Table 2.1.e.5 FPA's annual assessment performance rating for re-establishment in plantation operations (2016–2017 to 2020–2021)

	Private industrial	Private independent	PTPZ land	All tenures
Old rating system: maximum is 3				
2016–2017	2.8	2.5	3.0	2.8
New rating system: percentage				
2017–2018				100%
2018–2019				87.5%
2019–2020				100%
2020–2021				75%

Source: FPA, 2016–2021

CRITERION 3: MAINTENANCE OF ECOSYSTEM HEALTH AND VITALITY

This criterion focuses on the impacts of pests and diseases on plantations and native forest and on the impact of both planned and unplanned fire on the forest.

Understanding the impact of pests and diseases and developing improved and more ecosystem 'friendly' control measures is an ongoing process. The current control measures are reported here, including changes in approach from those in previous reporting periods. Trends in areas affected by both planned fires and wildfires by forest type are reported.

Indicator 3.1.a Area and percentage of forest affected by processes or agents that may change ecosystem health and vitality

Native and exotic pests (vertebrate and invertebrate), pathogens and weeds can adversely affect the health and vitality of plantations and native forest; as can abiotic stresses such as extreme weather events, fire and nutrient imbalances. Damage to forests from most native insect pests and pathogens is usually widespread at low severity and has little effect on long-term tree health. However, occasional outbreaks or epidemics do occur, and the resultant damage can adversely affect commercial and ecological values, particularly in plantations, and sometimes native vegetation adjacent to plantations. It is generally considered that occasional outbreaks or epidemics by native pests and pathogens form part of normal ecosystem processes and have minimal effect on the conservation values of native forest. However, when coupled with significant stresses, such as drought or ongoing hot weather, these occasional outbreaks or epidemics can cause widespread mortality and may result in long-term change to affected native forest. Exotic pests, pathogens and weeds on the other hand pose significant threats to conservation values and can also impact adversely on amenity and commercial values.

Active management of established pests and pathogens, both native and exotic, is directed heavily towards protecting economic values in Tasmanian commercial forests. Most plantation owners routinely manage key pests (browsing mammals, leaf beetles, weeds) and formal surveillance methods are used to detect health problems in high-value plantations on permanent timber production zone (PTPZ) land.

The capacity to respond to and manage pests and diseases has recently been improved with the development of a Tasmanian Integrated Pest Management Group (IPMG). This group includes all the main forest growers in Tasmania and provides a forum for a coordinated approach to pest management and forest health surveillance, setting priorities for research and development, the dissemination of information and linkages into national bodies such as Plant Health Australia (PHA) and the Forest Health and Biosecurity subcommittee (FHaB). Current activities of the IPMG include coordinating a tenure-blind statewide invertebrate monitoring program for the plantation hardwood sector and implementing early field trials of a non-lethal systemic foliar spray as a vertebrate browsing deterrent for use in forest establishment.

In both private and public reserved forest, the level of investment in monitoring the health of the broader native forest estate is variable. For PTPZ land most pests and pathogens are not managed.

For private forest, the level of monitoring ranges from being relatively passive, to the other end of the spectrum where some larger managers are actively monitoring natural forest ecosystems on a regular basis with a view to making targeted investments in remediation of ecosystems services, and reporting on improvements over time. This work is being led by the institutional forest owners and has been previously justified within the framework of ethical investment. However, it is noted that work has now evolved to account for ecosystem performance in a more structured way through Natural capital accounting, and that this framework for rewarding good stewardship may in fact

deliver more positive change as more private growers enter this new paradigm in the management of broader ecosystem services.

For PTPZ land, until recently there has been no formal surveillance program in reserve areas. However, in 2017 STT developed and piloted an annual assessment and monitoring program for network of reserves and Long Term Retention (LTR) areas on PTPZ land (Wotherspoon, 2017). This annually conducted program assesses the health and integrity of reserves and LTR areas, such as wildlife habitat strips, streamside reserves and special management zones for biodiversity and mature habitat that form a matrix through the native production forest and plantation estate. Several focused monitoring programs have previously been conducted including myrtle wilt rate of spread plots (established in the late 1970s), montane conifer climate change monitoring plots (established in 2010–2011), and environmental monitoring of waterways for *Phytophthora* susceptible species (pilot project conducted 2009 - 10).

The Weed and Disease Planning and Hygiene Guidelines (NRE, 2015) were developed to provide guidance in weed management planning and the implementation of appropriate hygiene controls to help prevent the accidental spread of weeds or diseases that threaten the conservation values of forest ecosystems. NRM South's publication *Keeping it clean: A Tasmanian field hygiene manual to prevent the spread of freshwater pests and pathogens* (Allan and Gartenstein, 2010) is aimed at preventing the spread of freshwater pests and pathogens in Tasmanian waterways and other susceptible areas.

Limiting the establishment of additional exotic pests and pathogens through effective biosecurity and quarantine measures is an ongoing priority for all forest managers, public and private. Both the Plantation Forest Biosecurity Plan (PHA, 2013) and the Biosecurity Manual for the Plantation Timber Industry (PHA, 2015) provide comprehensive information on key threats, risk mitigation, contingency plans and the identification of high priority exotic pests and diseases. More recently there has been the development of a National Forest Biosecurity program by the Department of Agriculture, Water and the Environment (DAWE) and PHA. Details are outlined in the National Forest Biosecurity Surveillance Strategy 2018–2023 (DAWE, 2018a) and the National Forest Biosecurity Surveillance Strategy Implementation Plan 2018–2023 (DAWE, 2018b). This program is aimed at maximising the effectiveness and efficiency of the detection of exotic forest pests, mitigating the risk of exotic forest pests establishing in Australia and providing evidence to support claims of area freedom. The strategy provides for the establishment of a coordinated National Forest Pest Surveillance Program.

The Tasmanian Biosecurity Strategy 2013–2017 (NRE, 2012) provides the system and structures for formulating biosecurity policy and delivering it operationally: it is particularly important for capturing the additional biosecurity benefit provided by Bass Strait. The recently updated Plant Biosecurity Manual (NRE, 2021) was developed to help importers, exporters and the broader public understand the current requirements for the import and export of plants, plant products, and other prescribed matter. It also details regulated and unwanted quarantine pests and diseases. The Tasmanian *Biosecurity Act 2019* also introduced a new legal obligation called the General Biosecurity Duty which is aimed at reinforcing that everyone has a role to play in protecting Tasmania's environment and primary industries. Screening for exotic bark beetles is a routine component of the *Sirex* static trapping program conducted by STT in softwood plantations on PTPZ land. Additional spot checks are performed, for a limited number of target exotics with distinctive symptoms, as part of routine pine health surveillance in both public and private forest.

Where chemicals are used to control pests and diseases, the manufacturer's guidelines for use are followed, as well as any additional requirements imposed by the Australian Pesticides and Veterinary Medicines Authority (APVMA). Chemicals are applied both on the ground and by aerial spraying. The implementation of aerial spraying guidelines determines when spraying can be carried

out and represents best practice for the protection of environmental and social values. Other controls, such as aerial spraying buffers are currently being reviewed considering changes to APVMA pesticide labelling. The insecticide alpha-cypermethrin is routinely used in aerial spraying operations to control above-threshold leaf beetle populations. Substitution of alpha-cypermethrin with spinosad, a more environmentally friendly insecticide, has been largely unsuccessful because of operational difficulties and low cost-effectiveness. The Forest Pest Management Research Consortium, based at the University of the Sunshine Coast, is currently undertaking assessments of other potential alternatives to alpha-cypermethrin at a national scale, guided by a steering committee of public and private forest managers.

Main health problems affecting *Eucalyptus* plantations

The forest health statistics presented in this report are provided by STT for PTPZ land only. However, private forest also has a significant footprint and is an important environmental and economic stakeholder in forest health. Some explanatory notes regarding health of private forest are provided alongside the PTPZ land data for context and completeness.

A summary of the main factors causing moderate or severe damage to eucalypt plantations on PTPZ land between 2017–2021 is presented in Table 3.1.a.1. Expansion of the *Eucalyptus* plantation estate in Tasmania (predominantly *E. nitens*) continued until 2011 and the bulk of the plantation estate on PTPZ land is now mid- to late-rotation. Browsing damage, predominantly by native mammalian herbivores (brushtail possum, Tasmanian pademelon and Bennetts wallaby), is usually the major threat during the establishment phase of plantation management. However, given the current age of the plantation estate there has been limited planting activity in this reporting period and browsing has not been a major issue.

The use of poisons, including 1080, was phased out on PTPZ land over 15 years ago, and – for larger private forest managers – voluntarily suspended more than 10 years ago. Vertebrate browsing is now managed by:

- better quality seedlings for transplanting
- planting at the time of the year when soil conditions are moist and warm, optimising early transplant growth
- using controlled release fertilisers to supplement growth
- using netting to protect individual seedlings
- using transect based monitoring to determine browsing intensity with reference to thresholds
- where thresholds have been exceeded, the deployment of lethal animal control via trapping and/or shooting.

Poisoning using 1080 is occasionally undertaken on private land to protect forestry activities from the impacts of native animal browsing. Six such uses were permitted in the reporting period.

Table 3.1.a.1 Area (ha) of eucalypt plantations on PTPZ land affected by the main health issues causing moderate or severe damage between 2017–2021[a].

Cause	2017	2018	2019	2020	2021
Chrysomelids	1,390	2,652	2,272	725	35
Multiple causes[b]	678	156	186	122	-
Wind damage	560	94	-	293	142
Gonipterus	419	288	-	-	-
Armillaria	-	23	-	17	272
Other[c]	61	-	38	143	65
Borers - multiple	-	-	-	181	-
Other insect[d]	-	-	-	96	-
Unknown	63	-	-	-	-
Weed competition	15	-	-	-	30
Teratosphaeria	40	-	-	-	-

a) Excludes fire damage which is covered in 3.1.b
b) Most often refers to multiple defoliators such as combinations of chrysomelids, Gonipterus or Teratosphaeria
c) Includes 'ginger tree syndrome' in 2017, coppice competition and seedling desiccation (DPIPWE, 2015)
d) Damage caused by the psyllid Cardiaspina

The chrysomelids *Paropsisterna bimaculata, P. agricola* and *P. selmani* are the major insect defoliators affecting plantations post-establishment. They are the only insect pests that are routinely managed. This involves an integrated pest management (IPM) strategy based on regular monitoring during summer to detect damaging (above threshold) populations that may need controlling. There has been ongoing adaptive adjustment to the IPM which has moved to a much more targeted and risk-based approach in recent years. Monitoring is now reduced or excluded from low-risk areas of the estate while thresholds can be adjusted to help protect areas of chronic damage. The large populations of *P. selmani* seen in 2012–2013 have not been evident since.

For PTPZ land, the area monitored and the area experiencing over-threshold populations has continued to decrease as the plantation estate has aged (Table 3.1.a.2). These low populations saw a corresponding decrease in plantations suffering moderate or severe levels of damage with only 35 ha reported in 2021 (Table 3.1.a.1). Consequently, the use of pesticide for control operations has also seen a dramatic decline with no operations being conducted on PTPZ land since 2018–2019.

Table 3.1.a.2 Summary of the annual chrysomelid leaf beetle integrated pest management (IPM) program on PTPZ land (2016–2017 to 2020–2021)

	2016–2017	2017–2018	2018–2019	2019–2020	2020–2021
Area (ha) monitored	8,075	4,984	4,287	3,411	2,434
Area (ha) of plantations over-threshold[a]	1,426	895	556	38	–
(% of monitored area)	(18)	(18)	(13)	(1)	
Area (ha) over-threshold that was sprayed	585	502	77	–	–
(% of over-threshold area)	(41)	(56)	(14)		

a) Monitored populations of leaf beetle eggs and larvae that exceed economic injury levels

No other insect pest of eucalypt plantations requires routine management. The eucalypt weevil, *Gonipterus scutellatus*, caused moderate levels of damage in *E. globulus* plantations in the south of the state in 2017 and 2018 but this dropped off as populations came under the control of natural predators and no significant damage was seen over the following three years (Table 3.1.a.1). Gum leaf skeletoniser (*Uraba lugens*) is often ubiquitous but substantial damage is generally limited to edge trees, usually adjacent to native forest.

With the aging of the plantation estate on PTPZ land, the soil-borne pathogen, *Phytophthora cinnamomi*, has not been recorded as the primary causal agent for any significant mortality over the last decade. Some mortality caused by the native fungal pathogen *Armillaria* was observed in localised plantation areas in the north-east in 2021 but this tended to be in small patches or scattered at low incidence.

Fungal leaf pathogens of the genus *Teratosphaeria* (including formerly named *Mycosphaerella cryptica, M. nubilosa* and *Kirramyces eucalypti*) can occasionally cause severe defoliation and shoot death in eucalypt plantations as the result of epidemics that develop when moist, humid conditions coincide with periods of active growth. For private growers, particularly those in the far north-western Tasmania, there has been a prevalence of *Teratosphaeria* for the past decade, aligned with the timing of replanting, particularly *E. globulus*.

For PTPZ land the combination at elevation of leaf beetle damage, cold, exposure and wind damage led to large areas of chronic poor crown density in the north-eastern highlands with a consequent severe impact on wood production. In response, adaptive management was implemented using data collected during forest health surveillance to improve and strategically deploy the IPM program. Adjusted monitoring techniques and thresholds were aimed at protecting these vulnerable crowns from any further leaf beetle damage and giving them the best chance of recovery. This proved to be successful and was assisted by the general decrease in overall leaf beetle populations. A similar syndrome developed in a localised region further to the east following a very wet summer in 2014–2015. However, conducive conditions haven't been experienced during the last five years. Along with a maturing plantation estate and ongoing low leaf beetle populations this has seen a full recovery in crown density in the areas previously impacted by chronic severely thin crowns.

Myrtle rust (*Austrouccinia psidii*) became established in northern New South Wales in the autumn of 2010. It was identified as being present in Tasmania in February 2015. Both *E. globulus* and *E. nitens* are known to be susceptible as are several other eucalypt species that occur in Tasmania and a range of other Myrtaceae (Soewarto et al., 2019). While climatic conditions in Tasmania are not as suitable for epidemic disease as the more northerly states, the pathogen is still considered to pose a threat in lowland forests in northern Tasmania, particularly during years with wet summers like that experienced in 2010–2011. In response to the original incursion, STT incorporated myrtle rust monitoring in to browsing damage surveys in both plantations and native forest regeneration as well as including surveys in young eucalypt plantations as part of the forest health program. Symptoms of the disease have not yet been detected in either plantations or native forest regeneration on either private or PTPZ land.

Symptoms of 'ginger tree syndrome' (DPIPWE, 2015) in *E. globulus* plantations across the north of the state continue to be encountered at low incidence but have not been observed at the level seen following the hot, dry weather of 2012–2013.

The extensive bushfires of 2018–2019 impacted a large area of PTPZ land. The Riveaux Road fire damaged several plantations in the south of the state (see Indicator 3.1.b). Damage to private forest arising from unplanned fire is not reported here.

Main health problems affecting *Pinus* plantations

Bark stripping by wallabies remains the most frequently encountered problem across the softwood plantation estate on PTPZ land (Table 3.1.a.3). Damage primarily consists of sub-lethal bark stripping, but also includes some shoot browsing and ring-barking mortality that leads to reduced stocking in very young plantations. Research has shown a range of factors can influence the incidence and severity of bark stripping including:

- rainfall

- elevation (Wotherspoon, 2004)
- ease of access due to the type of vegetation present
- difference between the mean minimum soil and air temperatures in spring (Smith et al., 2020a)
- the levels of fructose, glucose and individual phenolics in the bark (Nantongo et al., 2022).

Ringbarking by possums can cause top death in mid-rotation plantations, but damage has generally been limited over the last five years.

Substantial areas of mortality due to post-planting seedling desiccation were encountered in 2019 and 2020.

Needle cast diseases, such as spring needle cast and *Dothistroma* have not been occurring at significant levels in recent years.

Sirex wood wasp is the main insect threat to pine plantations in Tasmania and an annual static trapping program is conducted in at-risk plantations on PTPZ land in northern Tasmania. Limited areas of low incidence mortality were seen in 2019 and 2020 but no recent mortality was seen in 2021. Apart from 2020, trap catches of *Sirex* have generally been very low. The *Sirex* parasitoid *Ibalia leucospoides* was usually present, although none were trapped in 2021. Inoculation of several plantations with the nematode *Beddingia siricidicola*, which is a very effective biological control agent, were conducted to help maintain its population.

Ethanol lures are used to attract bark beetles, but no exotic beetles, including *Ips grandicollis* which is a problem on the mainland, have been detected during the screening process.

Top death due to *Diplodia pini* infection tends to be closely associated with dry conditions. Limited activity has been seen in recent years although in recent years aerial surveillance was hampered by COVID-19 restrictions.

Significant windthrow and stem breakage were seen in localised areas in 2021 due to severe wind events.

The Monterey pine aphid (*Essigella californica*) remains restricted to plantations in southern Tasmania; no activity has been observed on PTPZ land in the north of the state.

Spot checks for the target high-risk exotic pests and diseases (giant pine scale – *Marchalina hellenica*, pine pitch canker – *Fusarium circinatum*, western gall rust – *Endocronartium harknessii*) detected no characteristic symptoms.

Table 3.1.a.3 Summary of the main health issues causing moderate or severe damage (area affected - ha) in pine plantations on PTPZ land (2017–2021)[a].

Problem cause	2017	2018	2019	2020	2021
Mammal bark stripping	651	280	376	254	335
Other[b]	1	-	362	100	31
Spring needle cast	-	310	-	-	-
Magnesium deficiency	-	-	58	58	95
Drought	96	90	-	-	-
Sirex	-	-	70	104	-
Diplodia	42	-	68	-	-
Wind damage	10	-	-	-	97
Weeds	39	39	-	-	-
Multiple causes[c]	46	1	-	7	-
Phytophthora	-	-	47	1	-
Possum bark chewing	33	4	-	-	-
Unknown[d]	11	-	18	-	-
Other fungus[e]	-	4	4	4	4

a) Excludes fire damage which is covered in 3.1.b
b) Largely post-plant seedling desiccation
c) Mainly a combination of Phytophthora *and* Hylastes *activity*
d) Primarliy where it was difficult to distinguish between dead tops caused by Diplodia *or possums from the air*
e) Strasseria geniculata

Native forest

In 2016–2017 STT conducted a pilot program aimed at developing a practical and efficient way of monitoring and assessing the health and integrity of reserves set aside for long-term retention (LTR) on PTPZ land. It aimed to provide a gross indication of vegetation health and assess the impact of key threatening processes such as pests, weeds and diseases. Targeted reserves, including wildlife habitat strips and streamside reserves which form a network through both plantation and native forest areas, are set aside for the protection of a range of conservation values. This is now an annual program which also includes the establishment and monitoring of a number of fixed photopoints. To date, sampling has taken place across an area representing approximately 22,300 ha of LTR reserves.

Averaged across all disturbance and damage categories statewide, 75% of assessed LTR reserves were categorised as having no or negligible symptoms. A further 20% were categorised as low severity with only 4% moderate and <1% severe (Wotherspoon 2021*).* The most commonly encountered issues included old/historical fire damage, exotic weeds and reduced canopy or midstorey vegetation condition (Fig. 3.1.a.1). These were largely rated as low severity and combined moderate/severe scores were consistently seen in less than 10% of assessments. Damage always needs to be interpreted in context. Crown condition was generally good but chrysomelid defoliation of *Eucalyptus delegatensis*, *E. regnans* and *E. viminalis*, a natural phenomenon, caused higher damage scores in susceptible forest types and tended to be the driver of reduced canopy condition. However, symptoms attributed to climatic influence in the north-east were noticeable in a number of reserves. These included scattered mortality and gully dieback, associated with a recent extended dry period, and scattered ginger trees, associated with heat stress and ongoing hotter-than-average temperatures (see also Box 5.1.a.1 in Criterion 5). Also notable was evidence of illegal firewood harvesting or ‘wood hooking’ in 13% of assessed reserves, although the impact was generally of low severity.

Additionally, the Riveaux bushfire in 2018–2019 provided the opportunity to assess the cumulative impact following a major disturbance on the LTR reserve system. The southern reserves that were originally assessed in 2018 were reassessed in 2020. In fire-affected reserves, the condition of the understorey was assessed as severely damaged in over 80% of the sites examined (Fig. 3.1.a.2) while in other areas only a couple of sites had severe damage (Fig. 3.1.a.1). The midstorey had a more even distribution of moderate and severe damage while the overstorey was significantly impacted but to a lesser extent (Fig. 3.1.a.3), with 42% of assessments categorised as moderate or severe.

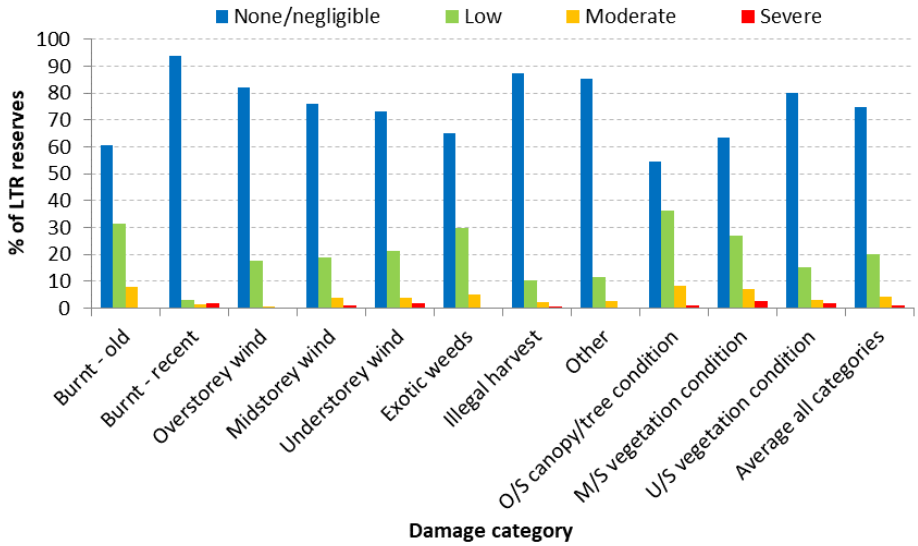

Figure 3.1.a.1 **For each damage category used to assess the health and integrity of the reserve system on PTPZ land, the percentage of LTR reserves assessed 2017–2021 (excludes 2020 re-assessment of reserves impacted by the Riveaux bushfire in 2018–2019) classified in each symptom severity class**

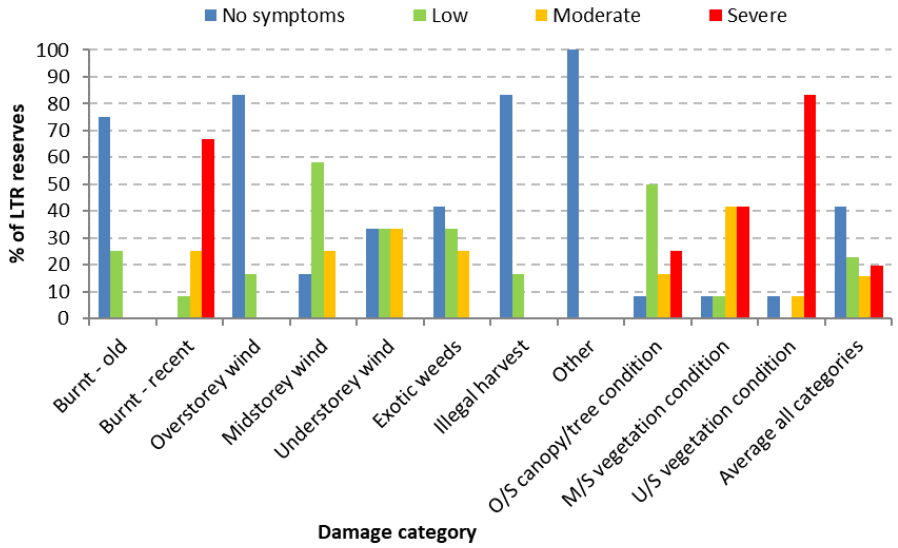

Figure 3.1.a.2 **For each damage category used to assess the health and integrity of the reserve system on PTPZ land, the percentage of LTR reserves impacted by the Riveaux bushfire 2018–2019 classified in each symptom severity class**

Figure 3.1.a.3 Severe fire damage to wildlife habitat strips caused by the Riveaux bushfire. Most of the understorey and midstorey had been killed with variable levels of damage through the overstorey (Photo: K Wotherspoon).

The general condition of LTR reserves assessed so far gives an overall picture of a largely healthy network with only limited impact from surrounding operational disturbance. The very low incidence of moderate or severe damage symptoms would suggest little in the way of widespread, significant adverse impacts. As such, it appears that the LTR reserve system is functioning in a manner consistent with conservation objectives.

By way of comparison, climate induced issues such as ginger tree syndrome (DPIPWE, 2015), coupled with the potential impact of increased fire frequency and severity, are likely to have the greatest impact on the LTR reserve system into the future. Ginger tree syndrome is also responsible for similar symptoms occurring in native eucalypts on farmland and in private native forest. *Eucalyptus viminalis* appears to have been particularly adversely affected and significant mortality has been observed around the state. *E. viminalis* wet forest in Tasmania is now listed in the Critically Endangered category of the threatened ecological communities list under the *Environment Protection and Biodiversity Conservation Act 1999* and ginger tree syndrome is included as a key threat (DAWE, 2020).

Browsing of young regeneration by native mammals (marsupials and deer, goats and livestock) remains a major factor affecting successful reafforestation of native eucalypt forests. Browsing is a particular risk in coupes harvested and regenerated using variable retention silviculture and coupes that are being managed primarily for blackwood (*Acacia melanoxylon*). Browsing management generally relies on regular monitoring and culling to protect regeneration from the cotyledon stage through until the seedlings have reached a safe height (about 1 m tall). During the period 2017–2021 some 13,956 ha of regenerating native forest on PTPZ land were monitored for browsing damage and control operations were conducted across approximately 10,620 ha (STT internal data). For blackwood coupes, fencing is the primary method of protection from browsing.

Myrtle wilt caused by the native pathogen *Chalara australis* is the most significant factor affecting the health and vitality of *Nothofagus cunninghamii*-dominated rainforest. Long-term monitoring of the activity of myrtle wilt commenced in the north-west in 1978 and plots were last assessed in 2004 (Elliot *et al*. 2005). Transient myrtle wilt mortality was observed at a photopoint in one of the LTR reserves in the north-west (Wotherspoon, 2019a, Wotherspoon, 2018) and occasionally active disease expression has been observed in regenerating or understorey myrtle in some of the wetter LTR reserves (Wotherspoon, 2019b).

The root-rot pathogen, *Phytophthora cinnamomi*, remains the most significant biotic threat to the health of native forest in Tasmania with the potential to affect broad areas. The movement of gravel for road and other civil construction is a major vector for the spread of *P. cinnamomi*. STT has a comprehensive quarry hygiene survey program (STT, 2021b) based on the requirements of the *Forest Practices Code* (FPA, 2020a). Quarries used for roading in forests on PTPZ land are regularly monitored to determine their *Phytophthora* and exotic weed status. This helps to ensure that *P. cinnamomi* is not spread into areas of susceptible vegetation. Other land managers are adopting the quarry monitoring system used for PTPZ land and require that material used for roading and civil construction are sourced from quarries that have been determined to be *Phytophthora*-free. Washdown of all roading, harvesting, and site preparation equipment is required before it is moved from one area to another, to reduce the spread of soil borne weeds and diseases.

The fungal pathogen myrtle rust (*Austropuccinia psidii*) remains a major threat in Tasmania. This disease affects plants of the family Myrtaceae (which includes eucalypts) and was first detected in Tasmania in 2015, when it was diagnosed from a sample taken from a private residential property near Burnie on Tasmania's north-western coast. The number of potentially impacted native and commercially significant exotic species is unknown. To date, myrtle rust has been identified as affecting *Lophomyrtus*, a common hedge, screening, and potted plant; and Chilean guava (*Ugni molinae*) also known as Tazziberry™. NRE Tas maintains a ban on the importation of all Myrtaceae species to prevent the introduction of the disease.

Wet forests are highly resistant to weed invasion beyond post-fire or harvesting disturbances, although bird-dispersed species are capable of invading undisturbed wet forests. Riparian areas are most at risk. Dry forests are threatened by a greater range of invasive species, grassy dry forests tend to have a greater diversity of weeds than those with shrubby or heathy understories. Exotic weed incursions are one of the most frequently encountered issues in the LTR reserve monitoring program, although they are generally of low severity and limited to isolated or scattered plants along the edges.

STT has a comprehensive weed mapping system for PTPZ land to ensure they meet the requirements of the *Forest Practices Code* (FPA, 2020a). Weed infestations detected during routine forest operations, formal forest health surveillance or LTR reserve monitoring guide the development of work programs for weed management. This has been formalised through the development of a weed strategy (STT, 2021a). During the period 2017–2021, over 500 new exotic weed detections were recorded (STT internal data). The weeds of most concern declared under the *Weed Management Act 1999* are gorse (*Ulex europaeus*) and pampas grass (*Cortarderia* spp). These are managed through direct action keeping infestations to low levels. Other commonly encountered declared weeds of concern include Spanish heath (*Erica lusitanica*), broom (primarily canary broom, *Genista monspessulana,* but also English broom, *Cystus scoparius*) and California thistle (*Cirsium arvense*).

Wildling pines are a significant invasive threat in dry forests adjoining pine plantations. Infestations are impacting several forest reserves and remedial action has been undertaken in several cases.

Rehabilitation of non-commercial areas of pine plantation to native forest is underway in two plantation areas on PTPZ land in Scamander and Branches Creek.

Indicator 3.1.b Area of forest burnt by planned and unplanned fire

This indicator reports the area and percentage of forest types and tenures burnt by both planned and unplanned fires. Fire is a natural and important part of forest ecosystems in Australia. It may have either a positive or negative impact on forest health and vitality depending on how it occurs and the characteristics of the area. In any forest type the total area burnt, and the proportions of that area burnt by planned and unplanned fires are good measures of management success.

Fire is managed co-operatively by land managers, including the Parks and Wildlife Service (PWS), STT and the Tasmania Fire Service (TFS), under the Inter-Agency Fire Management Protocol. This operates seamlessly across land tenures and provides a best practice model for such activity in Australia.

Data for burnt areas is primarily sourced from STT, PWS and TFS records, with other entities such as local councils, private landholders and researchers providing additional information where available. Burnt area records are combined into a single 'Fire History' dataset that is deconflicted, curated and updated annually by the Emergency Services GIS section within NRE Tas. This dataset identifies planned and unplanned fires and serves as the best official record for burnt area within Tasmania. Whilst the Fire History dataset is comprehensive, it does not capture all fires that have occurred within the state. Spatial records of planned and unplanned burning on private land are captured to varying degrees depending on involvement from the fire management agencies. Burnt area records for this tenure are generally considered to be the least comprehensive and are therefore underestimated within the official record.

Planned fires

Planned fires are defined as those started in accordance with a fire management plan or some other type of planned burning program. Reasons for such fires include:

- fulfilling the ecological requirements of flora and fauna
- protecting life and property
- maintaining and promoting sustainable production values
- maintaining cultural resources and practices.

Table 3.1.b.1 and Figure 3.1.b.1 summarises area burnt by planned burns.

Both STT and the PWS maintain records of areas burnt by planned and unplanned fires. Table 3.1.b.1 summarises area burnt by planned burns conducted by STT and PWS, including multiple-tenure fuel reduction burning completed in cooperation with other land managers. There is no requirement that landowners notify the TFS of planned burning operations outside of the fire permit period, or the results of a planned burn. However, land management agencies register all burning with the TFS all year round, recording details of vegetation type and area burnt.

The measurement of the area of softwood and hardwood plantations treated by planned burning does not include areas where (a) non-forest communities have been converted to plantation, or (b) the establishment of second rotation plantations, as it has been assumed that burning does not occur in these situations.

Table 3.1.b.1 Area (ha)[a] of forest types burnt[b] by planned fires

Tenure [c]	Forest Type [d]	Year 2016–2017	2017–2018	2018–2019	2019–2020	2020–2021
PTPZ land	Dry eucalypt	3,000	3,000	3,000	500	3,000
	Wet eucalypt	4,000	4,000	2,000	2,000	3,000
	Other native	200	300	90	100	70
	Plantation	200	300	1,000	400	700
Conservation & public reserves	Dry eucalypt	3,000	800	700	800	2,000
	Wet eucalypt	50	10	200	30	10
	Other native	10	60	40	60	40
	Plantation	-	-	-	-	-
Other publicly managed land	Dry eucalypt	600	1,000	1,000	400	1,000
	Wet eucalypt	60	70	50	20	80
	Other native	-	-	30	-	20
	Plantation	-	-	-	-	-
Private land	Dry eucalypt	2,000	3,000	2,000	1,000	1,000
	Wet eucalypt	100	300	90	100	60
	Other native	100	200	30	100	10
	Plantation	3,000	3,000	1,000	1,000	2,000
Total	**All**	**16,000**	**16,000**	**13,000**	**8,000**	**13,000**

a) Figures rounded to nearest 10,100 or 1000 ha
b) Fire extent is for forested (as mapped in RFA vegetation communities) land only
c) Tenure for all fire seasons as at 30 June 2021
d) Vegetation mapping for all seasons as at first quarter of 2020
e) Totals are rounded sums of actual totals

Most of the planned burns on PTPZ land in the above table reduced post-logging fuel loads and created a suitable seed bed for the regeneration of native forest. The remainder of the planned burns were conducted for strategic fuel management purposes.

Pre-plantation establishment burning on PTPZ land is no longer undertaken due to STT's decision in 2006 to cease the conversion of native forest to plantation.

A coordinated smoke management strategy (CSMS) was established in 2008 to minimise the risk of high concentrations of smoke within individual airsheds. Under the CSMS, restrictions may be imposed upon the forest industry, PWS, TFS or other participating members of the CSMS to limit or ban burning on days when weather forecasts predict poor smoke dispersal.

Unplanned fires

Unplanned fires are defined as those started naturally or accidentally that are not in accordance with planned fire management prescriptions. Usual causes of such fires include: lightning strike; escaped campfires or BBQs; fires accidentally started as a result of sparks from equipment or machinery; fires which are deliberately lit without the necessary permits or authority (and those lit with malicious intent); and escaped planned burns. Table 3.1.b.2 and Figures 3.1.b.2 and 3.1.b.3 summarise area burnt by unplanned fires.

Table 3.1.b.2 Area (ha) [(a)] of forest types by tenure burnt [(b)] by unplanned fires

Tenure [(c)]	Forest Type [(d)]	Year 2016–2017	2017–2018	2018–2019	2019–2020	2020–2021
PTPZ land	Dry eucalypt forest	2,000	1,000	5,000	7,000	500
	Wet eucalypt forest	80	400	22,000	3,000	200
	Other native forest	-	-	2,000	600	-
	Plantation	10	-	4,000	2,000	-
Conservation & Public Reserves	Dry eucalypt forest	700	60	10,000	3,000	200
	Wet eucalypt forest	10	10	19,000	300	10
	Other native forest	-	-	8,000	80	-
	Plantation	-	-	-	-	-
Other publicly managed land	Dry eucalypt forest	70	5,000	2,000	4,000	500
	Wet eucalypt forest	-	400	1,000	2,000	20
	Other native forest	-	-	1,000	200	-
	Plantation	-	-	-	-	-
Private land	Dry eucalypt forest	3,000	2,000	16,000	8,000	300
	Wet eucalypt forest	30	30	3,000	700	10
	Other native forest	20	10	3,000	200	-
	Plantation	100	50	1,000	400	90
Total	All	6,000	9,000	98,000	33,000	2,000

a) Figures rounded to nearest 10,100 or 1000 ha
b) Fire extent is for forested (as mapped in RFA vegetation communities) land only
c) Tenure for all fire seasons as at 30 June 2021
d) Vegetation mapping for all seasons as at first quarter of 2020
e) Totals are rounded sums of actual totals

The total land area for each of the tenure classifications used in Table 3.1.b.1 and Table 3.1.b.2 has changed during the reporting period. Year to year comparisons of the percentage area burnt by tenure reflect both changes in tenure and fire activity.

Tasmania experienced large-scale wildfires in 2019. Fires, including the Riveaux Road fire, Gell River and Great Pine Tier bushfires, burned more than 200,000 ha (forest and non-forest) including significant parts of Tasmania's World Heritage. The total area of these fires, as well as fires of smaller extent in the state’s north-east and north-west, exceeded that of 2015–2016 (approximately 120,000 ha), and the 140,000 ha which burnt in 1971–72.

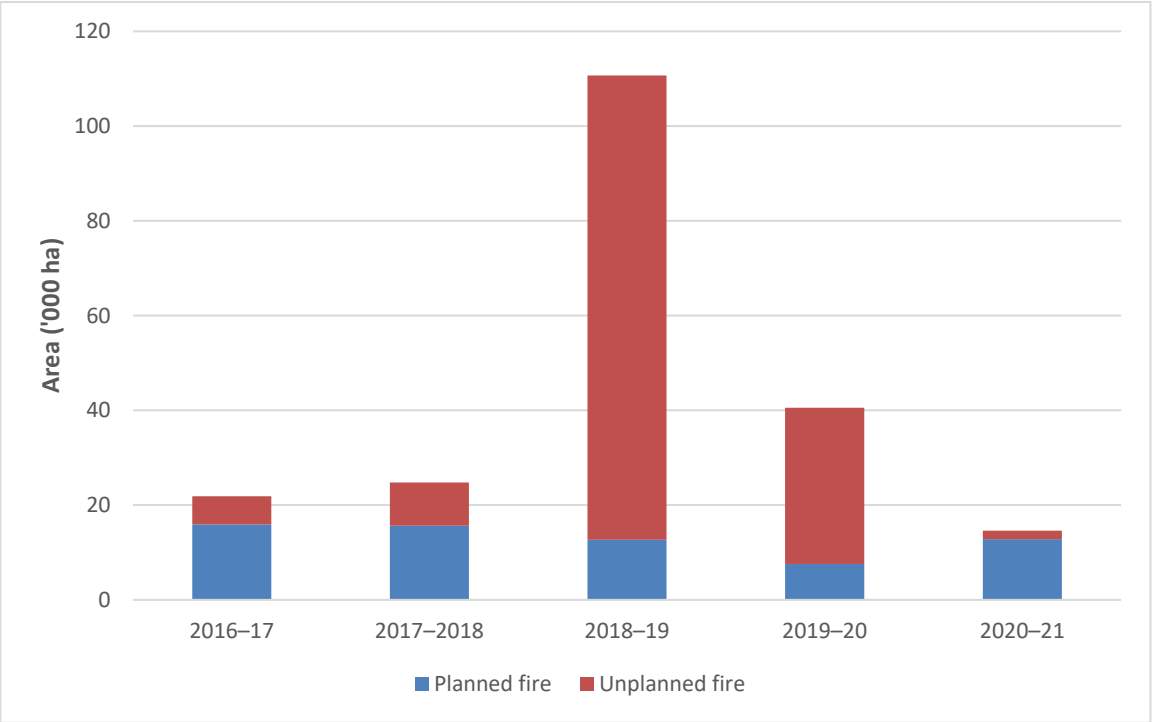

Figure 3.1.b.1 Area of forest burnt by planned and unplanned fire

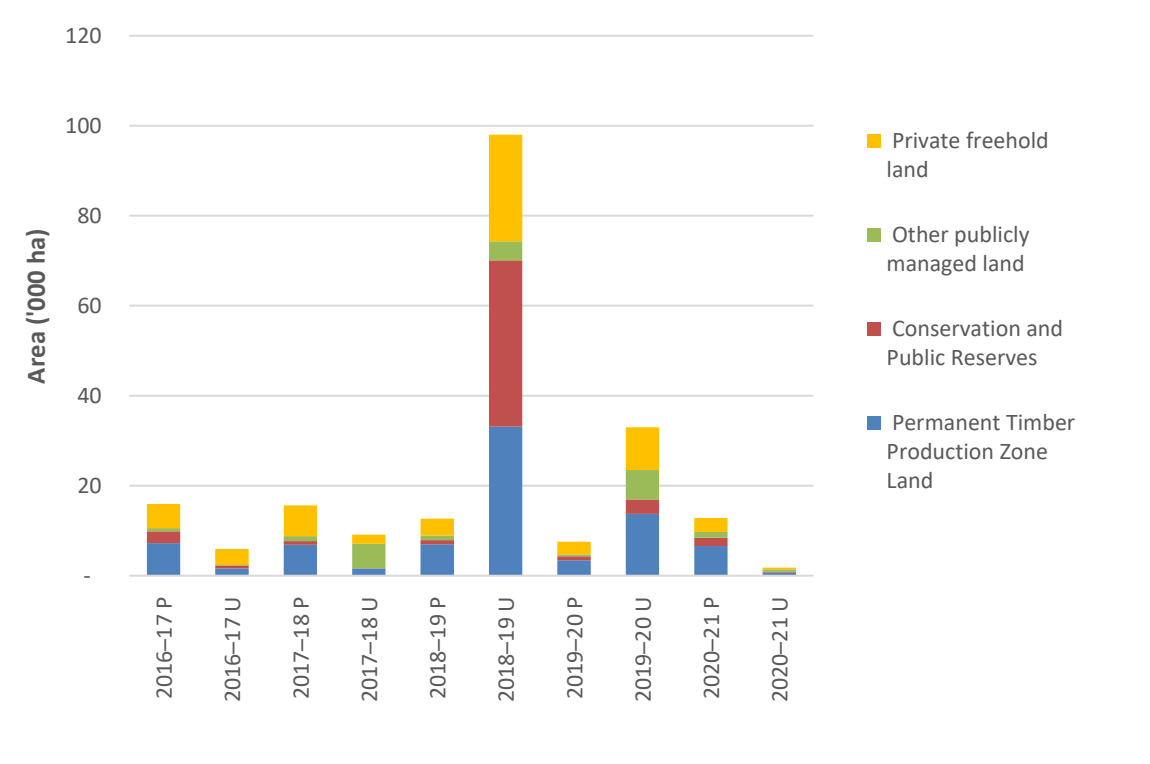

Figure 3.1.b.2 Area of forest by tenure, burnt by planned (P) and unplanned (U) fire

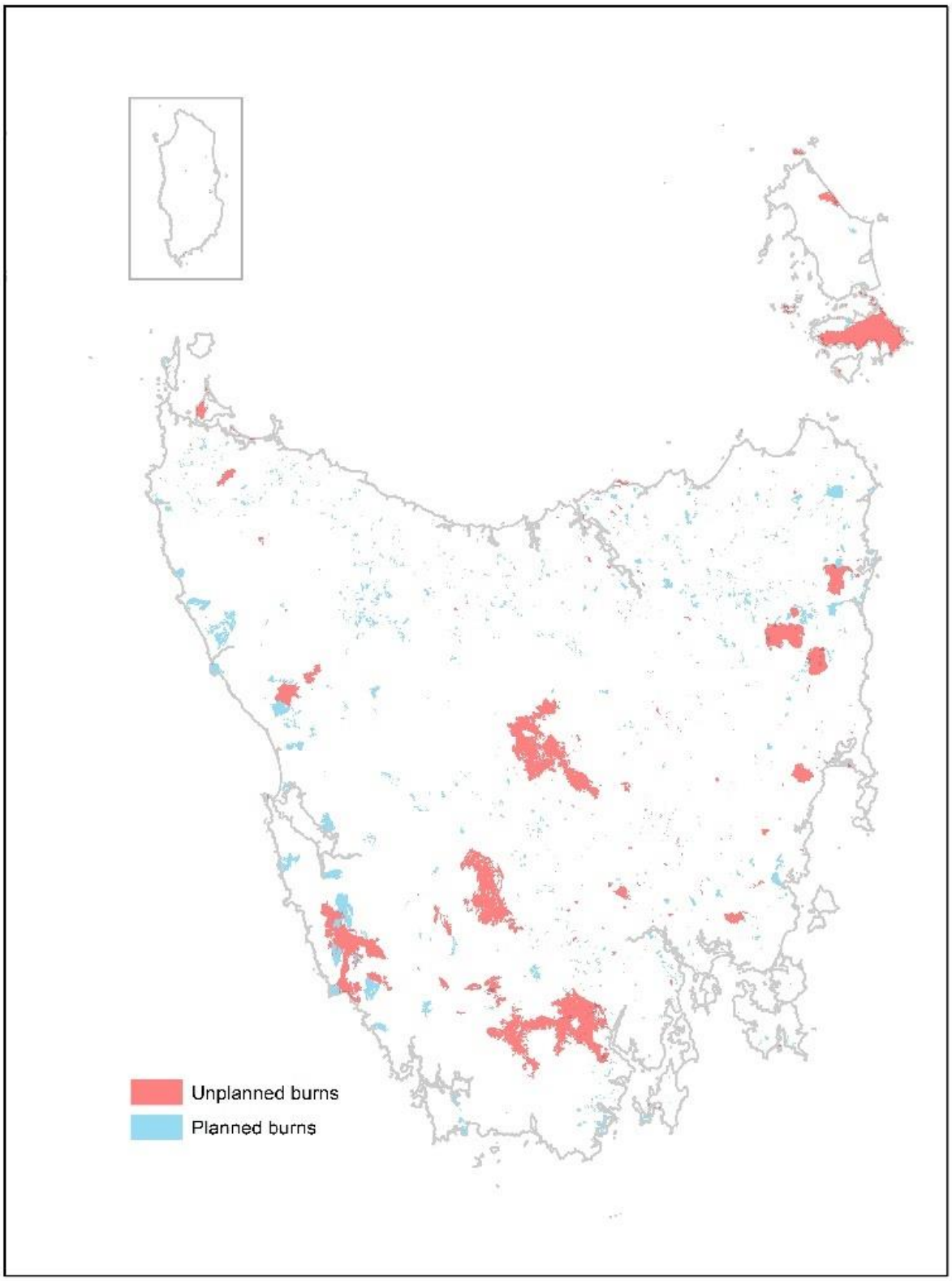

Figure 3.1.b.3 Distribution of area of forest burnt by planned and unplanned fire between June 2017-June 2021

CRITERION 4: CONSERVATION AND MAINTENANCE OF SOIL AND WATER RESOURCES

This criterion monitors the area of forest across Tasmania managed primarily for catchment protection values. This section also reports management procedures, and their implementation, put in place to mitigate against the risk of soil erosion and minimise the risk to soil physical properties, water quality and water quantity.

Indicator 4.1.a Area of forest managed primarily for protective functions

Soil and water values are managed by several legislative instruments in protected forests in Tasmania and in informally reserved forest areas within commercial forests, including:

- *State Policy on Water Quality and Management 1997*
- *Water Management Act 1999*
- *Tasmanian Reserve Management Code of Practice 2003*, which applies to all terrestrial reserves managed under the *National Parks and Reserves Management Act 2002*
- *Forest Practices Act 1985*
- Forest Practices Regulations 2017
- *Forest Practices Code 2020*.

The last three instruments are chiefly concerned with management of commercial forests, but have relevance to informally reserved areas. The *Tasmanian Reserve Management Code of Practice 2003* aims to maintain or restore the natural quality of water and soil processes and avoid soil degradation within reserved lands.

Area of forest in which disturbance impacting on soil and water values is excluded

Roading, timber harvesting, mining and mineral exploration, burning and recreation are activities that can directly affect soil and water values in forested areas. Of these activities, only timber harvesting is excluded from protected land in Tasmania, except in some circumstances where it is for special species timber.

The regulatory framework covering mining and mineral exploration allows for leases and licences to be granted over some protected land where the controlled use of natural resources is permitted under the *National Parks and Reserves Management Act* 2002. Any potential for impact to soil and water is managed under the *Mineral Resources Development Act 1995* and associated Mineral Exploration Code of Practice, and if mining, the *Environmental Management and Pollution Control Act 1994* provides the regulatory framework for the protection of these (and other) environmental values.

Roading and recreational pursuits are rarely fully excluded, but the potential impacts of these activities are managed through codes of practice, such as those listed above. Planning records for recreational facilities on reserves managed under the *National Parks and Reserves Management Act 2002* show that the proportion of land used for roads and tracks in reserves and visitor infrastructure is very small and direct effects on soil and water values in the reporting period have not been noted.

The total area of land excluded from timber harvesting across all categories of land in 2021 is 2.052 million ha (Table 4.1.a). During the reporting period 2016–2021 the main trends evident from the data are:

- There has been a net increase of 10,000 ha, or 3%, in the total area of native forest not available for harvest on permanent timber production zone (PTPZ) land.
- There has been a net increase of 7,000 ha in the total area of native forest excluded from timber harvesting on private land. The ongoing increase is due to the expanding area of forest protected within conservation covenants or other private reserves over the last five years through a range of private land conservation programs.

Table 4.1.a.1 Area (k ha) of native forest where timber harvesting is excluded, by tenure

	Land classification (tenure)				
Year[a]	Multiple use forest or PTPZ land[b]	Nature Conservation reserve[c]	Other publicly managed land[d]	Private freehold land[e]	Total
2001	368	1,104	80	3	1,556
2006	419	1,121	85	48	1,673
2011	582	1,172	73	83	1,910
2016	327	1,255	358	96	2,037
2021	337	1,255	357	103	2,052

a) Reporting dates are June of each year
b) The figures provided in this column include only those areas of native forest on PTPZ land from 2016 that are not available for timber harvesting, including areas in informal reserves and areas excluded by the provisions of the Forest Practices Code
c) The nature conservation reserve category includes all formal reserve categories within the CAR reserve system
d) This category of tenure broadly includes native forest on Commonwealth land, unallocated Crown land and FPPF land
e) Only those areas of native forest on private land that are within the CAR reserve system (e.g. conservation covenants, private naturereserves)

Area of forest in catchments managed primarily to provide water for human or industrial use

Tasmania has large areas of forested catchments within the CAR reserve system. Many of these catchments are used for water harvest for domestic or industrial use, although the majority of these are not explicitly reserved as water catchment areas. However, under the *National Parks and Reserves Management Act 2002*, all reserve classes have as one of the statutory management objectives the requirement 'to preserve the quality of water and protect catchments'.

Two reserves explicitly recognised as containing drinking water catchments are Wellington Park and Mt Field National Park. The slopes of Mount Wellington are specifically set aside and managed for town water supply to Hobart and adjacent localities. The Wellington Park Management Plan 2005, developed under the *Wellington Park Act 1993,* includes the requirement to manage water catchments in the park as sources of clean water.

The Lake Fenton/Lady Barron Creek drinking water catchment covers 1,530 ha of the Mt Field National Park and supplies 20% of drinking water for Hobart and environs. The Mt Field National Park Management Plan 2002 identifies the importance of the catchment for drinking water and specifies controls to protect water quality.

There is no statewide area figure available for forest in catchments explicitly managed for water harvest. The total area of forested catchment (i.e., forest land) in the CAR reserve system is provided in Indicator 1.1.c.

Area of environmental plantings of trees on previously degraded or cleared sites, to improve the protective function for soil and water values

During the reporting period, environmental plantings have been initiated by several private forest companies. The plantings are being made in second rotation sites, in areas which are now subject to

the *Forest Practices Code 2020* and on pasture sites where there are constraints on establishing plantations adjoining streams. These areas are increasingly being established with native species. For the reporting period 2016–2021, approximately 843 ha have been reforested in this way (see Table 2.1.e.2). For example, areas originally planted with *P. radiata* in the previous rotation are replanted with native seedlings grown from local seed and planted at a stocking of 660 stems per hectare.

Indicator 4.1.b Management of the risks of soil erosion and the risks to soil physical properties, water quantity and water quality in forests

This indicator reports the extent to which the risks to the physical properties and distribution of soils, and the risks to water quality and quantity in Tasmanian forests have been explicitly assessed and addressed in forest management.

Maintaining soil and water values in forests is critical to sustainable forest management because:

- soil erosion results in a permanent loss of resource. Topsoils are the most prone to erosion and loss of the organic topsoil means loss of nutrients and, on average, about half the soil's carbon content
- soil erosion results in contamination of streams with soil and silt and may also contribute to high levels of nutrients in streams
- physical degradation of soils, including compaction, mixing and loss of soil structure, can affect seed germination, growth and survival of trees and can also lead to increased water runoff
- users of stream water (including the natural ecosystem and commercial and domestic users) depend on natural flows being maintained in streams; however, most natural stream flows are variable and are affected by wildfires and forest age as well as short- and medium-term rainfall variation.

Water quality monitoring

NRE Tas maintains an extensive stream gauging and river health monitoring network in Tasmania's major rural catchments. Water quality is routinely monitored at 81 stream gauging sites, by spot sampling turbidity, dissolved oxygen, pH, electrical conductivity and water temperature. Continuous water quality equipment monitors turbidity, water temperature and electrical conductivity parameters at 13 of the 81 stream gauge sites.

Following a review of the River Health Monitoring Program (RHMP), a revised selection of 53 sites (43 test sites and 10 reference sites) will be monitored in the RHMP, whereas 60 sites (29 test sites and 31 reference sites) have been monitored historically (1994–2016). This monitoring is undertaken in autumn and spring every two years.

In addition to the collection of macroinvertebrate samples, the RHMP includes the collection of algal cover, algal biomass, and fine deposited sediment information to improve the understanding of overall nutrient and sediment status at a site.

Assessment of risk

The effects of current forest practices on soil and stream condition are not routinely monitored at the coupe or catchment scale because of the difficulty of obtaining meaningful results over short time periods and the practical difficulties of monitoring in remote areas, e.g. damage to equipment by floods or animals, or vandalism. However, an effective alternative to long-term monitoring of soil and water quality is to check whether management provisions for limiting deleterious effects are included in forest practices plans (FPPs) and applied during operations.

Meaningful indicators of effective management of soil erosion risk are whether:

- preventative measures designed to limit soil and water damage are included in FPPs
- management guidelines are implemented during harvest operations, rehabilitation, and reforestation

- operations comply with codes of practices, other regulatory instruments and associated guidelines.

Benchmarks against which the management of soil and water values can be assessed are contained in the *Forest Practices Code 2020;* supporting manuals and guidelines (FPA, 2022a) other regulatory instruments (listed in Indicator 7.1.a and applying to public and private lands at different scales); environmental certification schemes (such as the Australian Standard® for Sustainable Forest Management (AS 4708)); ISO 14001; and internal agency or company operational guidelines.

Irrespective of land tenure or forest type, assessments for soil and water risks are made for all forest activities covered by *Forest Practices Act 1985* during planning for forest operations. Risk assessments may also be undertaken in public forest (including those reserved for conservation) and large industrially managed private forest in relation to road and other site developments that do not fall under the jurisdiction of the *Forest Practices Act 1985* (e.g. major recreation facilities or new infrastructure such as pipelines and transmission lines). Risk assessments are not made for forest activities such as small-scale firewood harvesting that are not specified under the *Forest Practices Act 1985.*

Management of risks

The primary instrument for managing soil erosion risks, risks to soil physical properties and the associated risks to water quality and quantity in forested ecosystems is the *Forest Practices Code 2020* in which 54 pages describe how forest practices must be tailored to address risks to soil and water values. Further information on managing risks is contained in advisory documents, as well as in information sheets and booklets, e.g. *Forest Soils of Tasmania* (Grant et al., 1995) and 35 Soil Fact Sheets.

Prescriptions derived from the Code, the advisory documents mentioned above, field observations by foresters, and consultations with earth science specialists of the FPA are incorporated by Forest Practices Officers into legally binding FPPs, which are then implemented by contractors, who are required to have a copy of the FPP on site when conducting forest operations. The paper *Taking Account of Special Values in the Coupe Planning Process* (McIntosh and Ware, 2008) describes how a forest practices plan to address risks is put together using field observation combined with Code requirements and is still relevant. Compliance checks by foresters supervising operations is the means of ensuring that prescriptions in the FPP are followed. Independent checks by FPA are also made on selected coupes.

Past studies (eg.,Hairsine and Bren, 1997, Croke et al., 1999, Laffan et al., 2001, Pennington et al., 2001, McIntosh, 2007, McIntosh, 2008, Davies et al., 2016) have shown that the forestry operations that most increase the risk to soil and water values are:

- road and track construction and drainage
- lack of dispersion of timber harvesting operations in catchments
- harvest of pre-Code plantations established without streamside reserves
- long-term change of land use.

Such issues have generally been addressed by prescriptions in the *Forest Practices Code 2020*, advisory documents and 'agreed procedures' with forestry companies and these prescriptions are routinely applied during forest operations. Consequently, these issues are no longer of widespread concern. However, instances of erosion still occur due to unexpected combinations of events (see Boxes 4.1.b.1, 4.1.b.2 and 4.1.b.3).

Box 4.1.b.1 Erosion following exceptional rainfall

In early June 2016, north-western Tasmania experienced exceptionally high rainfall when over 300 mm of rain fell over two days. The rain caused landslides which were particularly extensive in a recently harvested pine plantation coupe near Oldina (Slee and McIntosh, 2022). An estimated 48,400–72,310 t of soil, sediment and woody debris was carried downslope by the major landslides and retained within the plantation area. Soil and sediment was also washed out of the plantation by runoff, so the total sediment moved was greater than this estimate.

Examination of soil scars produced by the landslides revealed charcoal in colluvial sediment, which was radiocarbon dated to determine whether the area had experienced similar landslide swarms in the past, thus being more prone to mass movement than previously thought. The ages obtained did not support this theory. The radiocarbon dating of charcoal indicated that the soils were last unstable during the Last Glacial Maximum period around 20,000 years ago, under a very different climate to that presently prevailing, and only three of the nine dates obtained indicated instability in the last 2,000 years.

It was concluded that regular erosion by mass movement in this area has not occurred under the present climate and recent erosion resulted from the unfortunate coincidence of intense rainfall and recent forest harvest (Slee and McIntosh, 2022). However, as this coincidence of circumstances may become more frequent with changing climate, prescriptions have been recommended to revegetate all areas affected by landslides and all riparian zones in this plantation area with native trees. Similar prescriptions will also be applicable to similar soils and landforms elsewhere in the plantation estate.

Box 4.1.b.2 Erosion following wildfire

Nine photo-monitoring sites were established in the Miami Creek catchment in north-eastern Tasmania on 1 April 2020, to serve as baseline sites against which to measure any stream erosion resulting from the extensive Mangana fires of December 2019 – January 2020, lit by an arsonist, which burnt 13,911 ha.

On 2–3 April 2020, 128 mm of rain fell in the catchment resulting in significant erosion in Class 4 stream channels on steep lands and corresponding sedimentation in the Class 2 stream, Miami Creek, in the major valley. Subsequent monitoring has not detected further significant changes of stream morphology (FPA, 2021). As in the Oldina example above, the combination of forest removal (in this case by fire followed by salvage harvest) and high rainfall has induced erosion.

Standard catchment management prescriptions for these steep land plantations (FPA, 2019) prescribe seeding or planting of native species in all stream riparian zones after harvest. Although this prescription was followed, germination was poor. Further photo-monitoring will continue with a view to modifying the catchment management procedures (FPA, 2019) if required.

Box 4.1.b.3 Rapid erosion associated with water-table lowering

Sinkholes were noticed in an unharvested Railton *Pinus radiata* plantation in 2011. Development of sinkholes (including streamsinks) was monitored between 2012 and 2014 using hand-held GPS and interpretation of photographic images. In five surveys (in July 2015, October 2015, April 2017, October 2017 and January 2018) the forest owner mapped the increasing extent of sinkholes using digital elevation models derived from high resolution drone imagery. Flow paths of streams entering sinkholes (including a streamsink on a Class 2 stream) were established by dye-tracing (Burke et al. 2020).

By June 2018, about 16,000 m^3 of soil and underlying sediment had been lost by sinkhole erosion. Based on observations of erosion since this date, the total sediment loss has probably exceeded 50,000 m^3, a figure comparable with the volume of soil and sediment displaced by the Oldina landslides (see Box 4.1.b.1). However, at Railton the sediment has not accumulated on site or been washed into surface streams (Caroline Creek and the Mersey River) but has disappeared into subsurface caves in the underlying limestone, from which a proportion of the sediment has probably reached the Railton limestone quarry to the south.

Research and monitoring undertaken by Burke et al. (2020) established that the severe plantation erosion at Railton is unrelated to forest management – it was caused by lowering of the regional water table by deep quarrying (to below sea level). Water table lowering has not only reduced hydraulic support for the overlying sediments but has also reactivated an ancient cave system in the underlying karst, which has been inactive for 240,000 years (Slee et al., 2022). The study undertaken, and similar studies overseas, demonstrate that sinkhole formation and severe loss of sediment and soils, is likely to continue unless water table levels are restored.

Knowledge base

In accordance with the objective of the *Forest Practices Act 1985*, the *Forest Practices Code 2020* provides a set of practical guidelines and standards for the protection of environmental values, including soil, and water quality and flow, across all land tenures during forest planning and operation. The relevant sections are:

- Section D1 which details principles and prescriptions to apply during operations to protect soils. The section refers to Appendix 3 of the Code which outlines how to identify a soil's erodibility class. Erodibility class then influences operational prescriptions and limitations (as specified in Tables 2, 4, 5, 6 and 8 and Appendix 5 of the Code) designed to mitigate the impact of forest activities on soils.
- Sections B3, C3 and C6 specify how to consider soil erodibility when using machines during forest operations.
- Section D2 about water quality and flow focuses on prescriptions and principles which protect water catchments and watercourses identified during planning and operational activities within forests. Specific guidelines in the *Forest Practices Code 2020* include culvert spacing along roads (Table 2), wet weather harvesting criteria (Table 4, Section C5) and the establishment of streamside reserves and machinery exclusion zones (Table 7).

The FPA website includes publicly available keys to soils and information on soil and water issues (including soil erodibility) that support the *Forest Practices Code 2020*. During training, foresters are encouraged to use this website information, as well as non-FPA resources such as geological maps, digital landscape information on LISTmap, non-digital information such as the book 'Forest Soils of Tasmania', and their own observations, to assess risks associated with soil and water during operations. Prescriptions are included in FPPs either to mitigate identified risks or, if risks are

considered high, to exclude areas from harvest. FPA earth sciences specialists are available to provide advice when required.

Assessment of practices

All of the major professional forest management organisations in Tasmania participate in one or more independently assessed environmental management and/or forest certification schemes tied to standards such as ISO14001, the Australian Forestry Standard, or the Forest Stewardship Council (see Indicator 7.1.b).

Assessment of forest practices which have been carried out under a FPP are also undertaken by the FPA on all tenure classes. This assessment takes two forms: compliance reporting on discrete operational phases performed on every certified FPP, and the FPA's annual compliance assessment program (see Indicator 7.1.b). Conservation forest, other Crown land and private forest are not externally audited unless subject to an FPP or forest certification audit.

The FPA's independent assessment process assesses specific aspects of selected operations to determine a performance rating against identified standards. Full details of assessments and methods, including questions addressed, are given in FPA annual reports, available on the FPA website. Up to 2016–2017, questions were answered using a scoring system ranging from 1 (unacceptable) to 3 (fully compliant) to rate performance, and compliance in the last year of use was very high (Table 4.1.b.1). In 2017–2018 and 2018–2019, only aggregated ratings were reported, as a percentage. These indicate the high level of compliance was being maintained. A new assessment framework was developed in 2019–2020 which focuses on a specific area of risk and incorporates a random, base line selection. This new framework does not support continued reporting of individual elements of the audit as risk approaches often exclude certain types of operations and so are not statistically valid.

The results in Table 4.1.b.1 indicate that consistently high scores were achieved for compliance inspections concerning soil and water issues on all tenures, demonstrating that operations are generally carried out to a very high standard and that only locally and sporadically do issues require attention.

Table 4.1.b.1 Compliance assessments of soil and water issues on recently active forestry operations.

Year	Independent private	Industrial freehold	PTPZ land	Total
Roading (15 questions)				
2016–2017[a]	2.8	3.0	3.0	2.9
2017–2018[b]				95.6%
2018–2019				99.1%
Harvesting (18 questions)				
2016–2017	2.9	3.0	3.0	2.9
2017–2018				95.6%
2018–2019				95%
Reforestation (13 questions)				
2016–2017	2.8	2.8	2.9	2.9
2017–2018				95.6%
2018–2019				93.1%
Soil erosion and watercourse classification (7 questions)				
2016–2017	2.9	3.0	3.0	3.0
2017–2018				98%
2018–2019				97.8%

a) 2016–2017 assessments were out of a maximum score of 3

b) Tenure breakdown data is not available for 2017–2019. The compliance assessment protocol changed significantly in 2019 and this information is no longer collected

CRITERION 5: MAINTENANCE OF FOREST CONTRIBUTIONS TO GLOBAL CARBON CYCLES

This criterion reports on parameters that relate to the role of Tasmania's forests in the carbon cycle.

Indicator 5.1.a Total forest ecosystem biomass and carbon pool

Forests are large natural pools of carbon; estimates of their biomass are a measure of their contribution to global carbon cycles. The Tasmanian *Forest Practices Code 2020* requires that '*Forest practices should be conducted in a manner that maintains the sequestration and storage of carbon...*'. Many provisions of the Code are designed to ensure that organic-rich topsoils are protected from excessive disturbance during forest operations and that soil erosion above natural levels is minimised.

Australia's National Greenhouse Gas Inventory is a system that estimates annual national greenhouse gas emissions, including emissions and sinks in the land sector, which is largely made up of forest and agricultural activities. Data presented in this report focuses on total biomass carbon and living biomass carbon, which are the units of the National Greenhouse Gas Inventory. Comparisons to previous *State of the forests Tasmania* (TasSOFR) reports should be made with caution, as significant improvements to sources and methods have been applied to the series by the Australian Government Department of Climate Change, Energy, the Environment and Water (DCCEEW).

Estimates of carbon in forest biomass for 2006, 2010, 2015 and 2020 are presented in Table 5.1.a.1. These estimates have been produced using spatial simulations of land use changes detected by satellite imagery, in conjunction with the Full Carbon Accounting Model (FullCAM). The National Inventory System operates in time-series and all methodological changes are reflected in retrospective updates to the entire time-series. Therefore, estimates can be compared over time, and carbon change trends can be assessed. Further information on the sources and methods used in these simulations are available in volume 2 of the DCCEEW's National Inventory Report (2020) (DISER, 2022a). This modelling method is consistent with international requirements. It is an ecosystem model that uses a mass balance approach to carbon cycling for each of the following carbon pools (Montreal Process Implementation Group for Australia and National Forest Inventory Steering Committee, 2018, DISER, 2022a):

- living biomass
  - above-ground biomass (stem or bole, branches, bark, leaves)
  - below-ground biomass (roots)
- dead organic matter
  - dead wood
  - litter
- soil organic matter.

Differences in the estimates presented here (Table 5.1.a.1) compared those provided in the Tas SOFR 2017 report (FPA, 2017b) are attributable to updates which incorporate spatial modelling of native forestry timber harvesting, wildfire, prescribed burning, and growth calibration updates for plantation forest species. A significant revision of the 'maximum biomass' layer underpinning site productivity occurred in 2019. These changes have been applied to the full time series. The carbon content within and across major vegetation groups has remained relatively constant over the four reporting periods because the relative and absolute abundance of Tasmania's forest types have remained largely unchanged.

Table 5.1.a.1 Estimated ecosystem carbon in Tasmania by vegetation type[a]

	Mean biocarbon[b] (t/ha)[c]				Area (k ha)[d]				Above-ground living biomass[e] (Mt C)[f]				Total biocarbon (Mt C)[f]			
Major vegetation group	**2006**	**2010**	**2015**	**2020**	**2006**	**2010**	**2015**	**2020**	**2006**	**2010**	**2015**	**2020**	**2006**	**2010**	**2015**	**2020**
Acacia forest and woodland	373	378	371	372	13	13	13	13	1.7	1.7	1.7	1.7	4.9	4.9	4.9	5.0
Acacia shrubland	255	260	256	252	1	1	1	1	0.1	0.1	0.1	0.1	0.3	0.3	0.3	0.3
Callitris forest and woodland	178	179	175	174	-	-	-	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Casuarina forest and woodland	205	206	198	193	14	14	14	15	0.8	0.8	0.8	0.8	2.8	2.8	2.8	2.9
***Eucalyptus* low open forest**	246	251	240	235	17	16	17	17	1.3	1.3	1.3	1.3	4.1	4.0	4.0	4.1
***Eucalyptus* open forest**	347	349	344	342	1,921	1,902	1,924	1,939	229.0	228.2	229.2	229.6	666.2	663.1	662.8	663.0
***Eucalyptus* open woodland**	232	237	232	231	74	71	73	74	4.7	4.7	4.6	4.7	17.1	16.9	17.0	17.2
***Eucalyptus* tall open forest**	373	375	372	372	697	694	700	702	95.1	95.0	95.7	96.2	260.2	260.0	260.5	261.4
***Eucalyptus* woodland**	286	289	285	284	533	528	536	542	44.8	44.7	44.8	44.9	152.3	152.3	152.9	153.8
Heath	336	335	329	324	148	146	149	151	15.2	15.0	15.1	15.1	49.6	49.0	49.0	49.0
Low closed forest and closed shrubland	515	516	512	510	250	249	251	253	48.0	48.0	48.3	48.4	128.5	128.6	128.7	129.0
Other forests and woodland	647	653	651	655	34	34	34	34	8.4	8.4	8.5	8.5	22.1	22.2	22.2	22.3
Other shrubland	337	338	327	322	63	63	65	67	6.9	6.9	7.0	7.0	21.3	21.1	21.3	21.5
Rainforest and vine thicket	602	605	604	605	841	840	845	847	206.1	206.9	208.6	209.7	506.1	507.9	509.9	511.9
Total natives[g]	399	401	397	396	4,605	4,571	4,623	4,655	662.2	661.7	665.6	667.9	1,835.5	1,833.2	1,836.3	1,841.0
Softwood plantations	179	185	193	194	73	73	72	71	1.7	1.8	2.3	1.9	13.0	13.4	13.9	13.8
Hardwood plantations	158	163	173	178	96	95	92	90	1.4	1.6	2.3	2.0	15.1	15.4	16.0	15.9
Post-1990 environmental plantings	149	151	167	194	34	33	31	28	0.4	0.4	0.7	0.9	5.1	4.9	5.2	5.4
Total plantations[g]	164	169	180	186	203	200	195	189	3.5	3.8	5.3	4.8	33.3	33.8	35.1	35.2
Total forests[g]	**389**	**391**	**388**	**387**	**4,808**	**4,771**	**4,818**	**4,844**	**665.7**	**665.5**	**670.9**	**672.7**	**1,868.8**	**1,867.0**	**1,871.4**	**1,876.2**

a) Differences when compared to TasSOFR 2017 are attributable to updates to incorporate spatial modelling of native forestry timber harvesting, wildfire, prescribed burning, and to growth calibration updates for plantation species. A significant revision of the 'maximum biomass' layer underpinning site productivity occurred in 2019. These changes apply to the full time series

b) 'Biocarbon' is all matter within an ecosystem that stems from biological sources whether living or dead (includes soil carbon to 30 cm depth). It is distinct from 'geocarbon' which is associated with geological strata

c) t/ha: tonnes of carbon per ha

d) k ha: thousands of ha

e) Includes all above-ground carbon but not litter or deadwood. I.e., above-ground tree components, standing deadwood and standing litter. Does not include soil carbon

f) Mt C: millions of tonnes of carbon

g) Totals are sum of actual ha or t, not sum of rounded ha or t

Source: Land Sector Carbon Modelling Section, DCEEW

Values for biomass carbon in Tasmanian forests have been updated by Moroni et al. (2010, 2017) and values for soil carbon have been reviewed and measured under Tasmanian tall wet 'mixed' forest and under Tasmanian rainforest by McIntosh et al. (2020). They found that the transition from tall wet 'mixed' forest to rainforest results in biomass carbon declining from 473 t/ha to 214 t/ha, but this was not accompanied by an increase in soil carbon, which remained at about 200 t/ha under the two ecosystems. Therefore, ecosystem carbon declines by a total of about 260 t/ha as mature eucalypt forest transitions to rainforest.

Mean values of total soil carbon (to 100 cm depth or to a rock contact within 100 cm depth) have been calculated by the FPA from published data from several sources (FPA, unpublished data). Highest soil carbon stocks occur in swamp forest (461 t/ha; *n*=2). Wet eucalypt forest contains 168 t/ha of soil carbon (*n*=26), dry eucalypt forest contains 84 t/ha of soil carbon (n=14), and rainforest contains 218 t/ha of soil carbon (*n*=10). In eucalypt forest and rainforest about half the soil carbon is held at 0–30 cm depth. These are considerably lower than several published estimates soil carbon stocks in Tasmanian forests (e.g., stocks estimated by Dean and Wardell-Johnson, 2010, Viscarra Rossel et al., 2014) which were reviewed by McIntosh et al. (2020). Plantation soil carbon has not been systematically measured, but a statistically robust study on the highly productive Ferrosols of north-western Tasmania (McIntosh et al., 2022) established that soils at 0–30 cm depth under plantations contain 120 t/ha of soil carbon, a figure statistically indistinguishable from the carbon (122 t/ha) under adjacent mixed eucalypt/rainforest. Most plantation soils are likely to contain less carbon.

The results of these Tasmania-focused studies suggest that the National Carbon Accounting estimates published in previous SOFRs have overestimated mean carbon for all Tasmanian soils at 0–30 cm depth and that figures for biomass carbon for several Tasmanian forest types have also been overestimated. Further cooperative work is planned with Federal agencies to improve the applicability of the FullCAM model to Tasmanian forests.

Threats to the carbon dynamics of Tasmanian forests

Tasmania's forests are exposed to risks from climate change. Recent published work (Wardlaw, 2022b) highlights the threat to carbon dynamics of Tasmania's tall wet forest from warming temperatures and has implications for the accuracy of carbon accounting (Box 5.1.a.1).

Box 5.1.a.1 The effect of the November 2017 heatwave on carbon uptake by the *Eucalyptus obliqua* tall forest at Warra, Southern Tasmania

Tasmania experienced persistent warm temperatures and heatwaves over three weeks in November 2017 (Bureau of Meteorology, 2017). Measurements of carbon, water and energy exchanges between the forest and atmosphere were made in *Eucalyptus obliqua* tall forest at Warra (Figure 1) during that warm period. Sharp and unexpected changes in the carbon dynamics of the forest were observed. Under normal conditions at that time of the year the forest is a carbon sink, expected to remove about 3 t/ha of CO_2 from the atmosphere over the three week period (Wardlaw, 2022a). In the 2017 warm spell, however, the forest became a carbon source, releasing about 10 t/ha of CO_2 over the three weeks. Despite this, no visible symptoms were seen, or measured, in the forest.

The switch from a carbon sink to a carbon source happened for two reasons. Firstly, the warmer temperatures increased respiration which released more CO_2 into the atmosphere. Secondly, the gross primary productivity (GPP) of the forest declined, so much less CO_2 was captured through photosynthesis (Wardlaw, 2022b). The reduction in GPP happened during the middle part of the day when there was plenty of light but temperatures were much higher than normal. Surprisingly, the conductance of the canopy to water loss remained close to normal during this middle-of-the-day decline in GPP. This response by a tall eucalypt forest to a heatwave (Figure 1) is a new observation.

We now know the optimum temperature for GPP in the tall eucalypt forest at Warra is 17°C (Bennett et al., 2021). We also know that when the temperature rises above that optimum, the GPP of the tall eucalypt forest at Warra declines rapidly, and much more, than in other temperate eucalypt forests in Australia (Bennett et al., 2021)..

As temperatures continue to rise, the amount of CO_2 that existing tall eucalypt forests in Tasmania can remove from the atmosphere will decline. Because these forests are very productive, that decline in CO_2 uptake by the forest could markedly reduce the buffering that the LULUCF sector provides in offsetting CO_2 emissions from other sectors in Tasmania's greenhouse gas accounts (Tasmanian Climate Change Office, 2021). More significantly, the progressive rise in temperatures being experienced in Tasmania over the past two decades could push the current generation of tall eucalypt forest in Tasmania past a tipping point. If this happens these forests will no longer be able to remove CO_2 from the atmosphere and the trees will begin to die (Wardlaw, 2022a).

This means that the cool, moist conditions in which Tasmania's tall eucalypt forests grow offer no buffer to the warmer temperatures being experienced as the result of climate change.

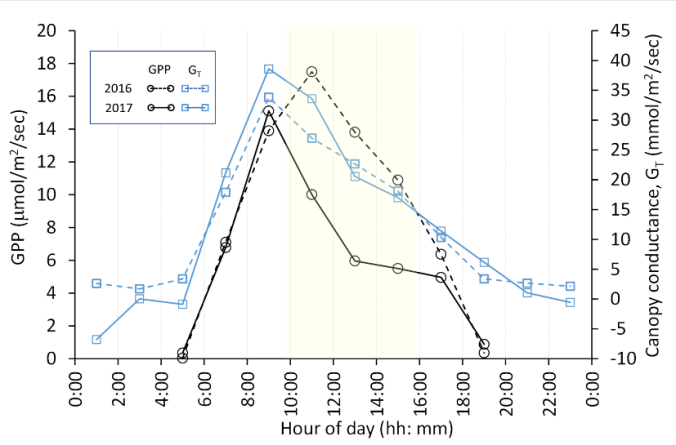

Figure 1 Diurnal pattern of average gross primary productivity (GPP) and canopy conductance (G_T) in *Eucalyptus obliqua* tall forest at Warra for the period 10–30 November 2016 (near-average conditions, dotted lines) and 2017 (heatwave conditions, solid lines). Yellow-shaded area shows the period in the middle of the day when GPP during the 2017 heatwave was significantly lower than the comparison period in 2016.

Forest management and carbon accounting

There is a range of opportunities for Tasmania's forests and forest industry in the context of climate change, as forests are the most cost-effective carbon-capture technology available (Box 5.1.a.2). Tasmania's forest industry has increased capacity in carbon accounting. In 2021, Forico become the first forest company in Australia to publicly release natural capital accounts. Tasmania's public forest manager, STT, is also actively engaged in carbon accounting (Box 5.1.a.3).

Box 5.1.a.2 Unpacking the drivers of Tasmania's land use, land use change and forestry carbon emission figures

Land use, land-use change, and forestry (LULUCF) is defined as a 'a greenhouse gas inventory sector that covers emissions and removals of greenhouse gases resulting from direct human-induced land use, land-use change and forestry activities' (UNFCCC, 2022). This includes settlements and commercial uses, land-use change, and forestry activities such as new forests planted on previously unforested land, and forest management practices that change emissions and sequestration.

LULUCF has impacts on the global carbon cycle and as such, these activities can add or remove carbon dioxide (or, more generally, carbon) from the atmosphere, influencing climate (Brown, 2013). LULUCF is a key driver behind Tasmania's carbon emissions profile (DCCEEW, 2022). According to the Australian Government National Greenhouse Gas Accounts 2020 (DISER, 2022b), carbon emissions from Tasmania's LULUCF went from net positive to net negative in 2011, meaning that the sector was sequestering more carbon than it was emitting.

Figure 1 shows that the key drivers within the LULUCF sector for this change from 1990 to 2020 were:

- the change in annual emissions from the private native forest estate from as much as to 15,000 kilotonnes (kt) of carbon dioxide equivalents ($CO_{2\text{-}e}$) to around –5,000 kt $CO_{2\text{-}e}$
- a reduction in emissions from deforestation activities from as much as 9,000 kt $CO_{2\text{-}e}$ to 1,000 kt $CO_{2\text{-}e}$
- an increase in sequestration from Tasmania's plantation estate.

Emissions from other land uses (settlements, wetlands and grasslands), harvested wood products and land converted to native forest, have largely been static for the reporting period. Emissions from public native forest or forests managed by STT (approximately 1.3 million ha) ranged from –7,000 kt of $CO_{2\text{-}e}$ to –2,000 kt $CO_{2\text{-}e}$ for the reporting period.

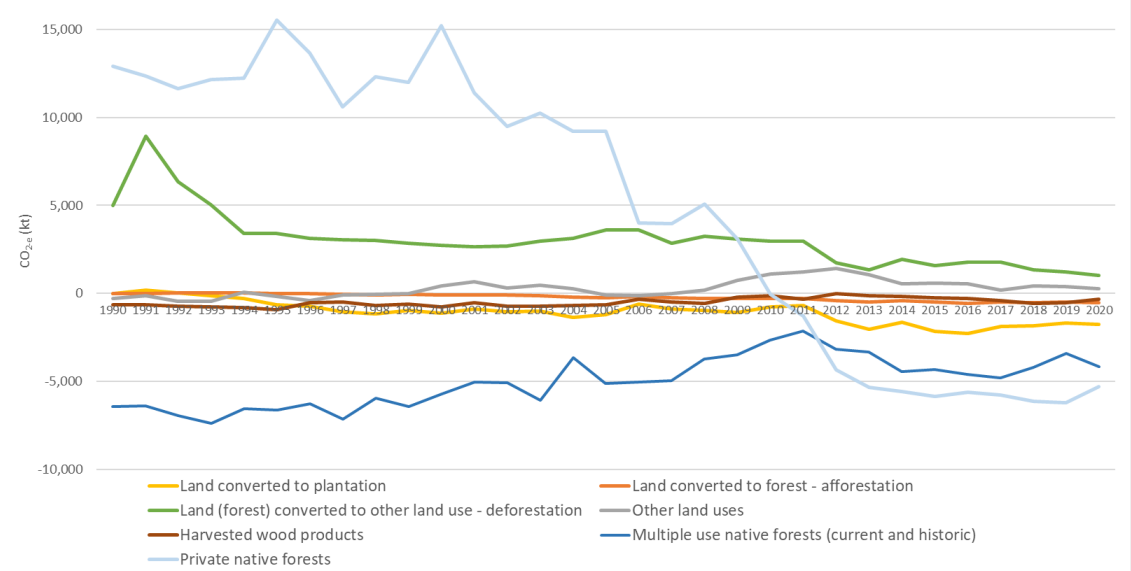

Figure 1 LULUCF emissions in Tasmania by sub-sector with harvested native forest split between private and public (current and historic) native forest (DISER, 2022b). Negative values represent carbon sequestered

Note: data relates to only native forest and vegetation on PTPZ land, not to plantations. (Drivers of change are not available for plantations)

Box 5.1.a.3 Sustainable Timber Tasmania carbon accounts

Sustainable Timber Tasmania (STT) is a government business enterprise with responsibility for managing approximately 812,000 hectares of Tasmanian land, designated as permanent timber production zone land (PTPZ land). In addition to this, STT manages some forest on Australian Defence Force land which is included in this analysis. For the purposes of brevity all land is referred to as PTPZ land. This land comprises native forest (including non-forest vegetation) and hardwood and softwood plantations. For the plantations, STT either owns, has various forms of joint ventures, or has sold the forestry right to third parties. They are all included in this analysis.

This case study provides an estimate of STT's carbon accounts, with the assistance of the Australian Government's Department of Climate Change, Energy, the Environment and Water National Greenhouse Accounts 2020 (DCCEEW, 2022). Both the stocks and flows (change) of carbon on PTPZ land, and an estimate of carbon put into harvested wood products are included. The flows are considered in terms of emissions for this case study, meaning that negative emissions represent carbon sequestered and positive emissions represent carbon released to another carbon pool, either the atmosphere or various harvested wood product pools.

Figures 1, 2, and 3 show the annual stocks, flows, and flows by mode of carbon on PTPZ land from 1984–1985 to 2019–2020. Figure 1 shows the annual stocks of carbon on PTPZ land, increasing from 651,100 kilotonnes (kt) of CO_2 equivalents ($CO_{2\text{-}e}$) in 1984–1985 to 671,800 kt $CO_{2\text{-}e}$ in 2019–2020 for native forest and from 48,000 kt $CO_{2\text{-}e}$ to 59,700 kt $CO_{2\text{-}e}$ for plantation. Figures 2 and 3 show the annual change in stocks (flows) of carbon on PTPZ land; and annual flows by mode (growth, timber harvesting, wildfire or planned burning), respectively. Annual flows for the reporting period oscillated between net sequestration of +1,500 kt $CO_{2\text{-}e}$ to emissions of –3,400 kt $CO_{2\text{-}e}$.

The amount of carbon in the harvested wood product[a] pool from STT's native forest and plantation harvesting ranged between –1,500 kt $CO_{2\text{-}e}$ to –1750 kt $CO_{2\text{-}e}$ each year between 2017–2018 and 2021–2022 (Sustainable Timber Tasmania, 2016-2022). Of this, between –80 kt $CO_{2\text{-}e}$ and –310 kt $CO_{2\text{-}e}$ emissions went into the long-lived solid wood product pool annually, with the remainder going into the shorter-lived paper and packaging pool or waste pools.

The data include carbon in tree, debris and soil pools, calculated and provided by DCCEEW (2022). Note that the results in this case study are not directly comparable to the National Greenhouse Accounts emissions estimates for public native forest. This is because the area for which carbon emissions were calculated for public native forest in Box 5.1.a.2 was all current and past multiple use forests (1.3 million ha). Whereas in this case study, the area modelled for carbon stocks and flows is STT's current estate. For native forest this was 706,021 ha and the area of plantation modelled was 116,499 ha. The carbon stocks presented here also differ from the National Greenhouse Accounts regarding the treatment of bushfires and subsequent recovery – this case study shows the annual impacts of natural disturbances whereas the National Greenhouse Accounts focus on the long-run trend in carbon lost during fires and that re-absorbed by regrowth (DCCEEW, 2022).

[a] calculated with TimberCam (Ximenes, 2004) using STT annual report data (Sustainable Timber Tasmania, 2016-2022)

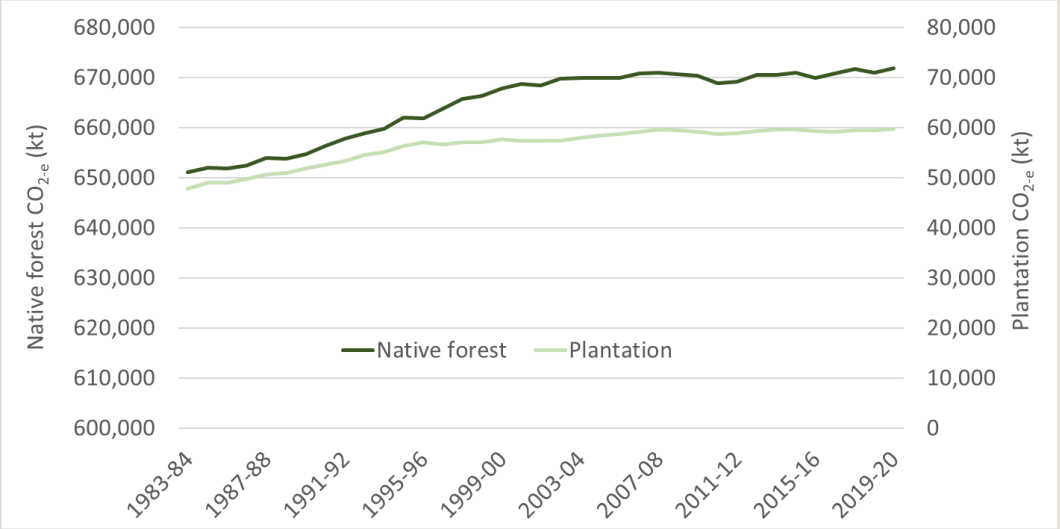

Figure 1 Annual estimated carbon stock on native forest and plantation on PTPZ land

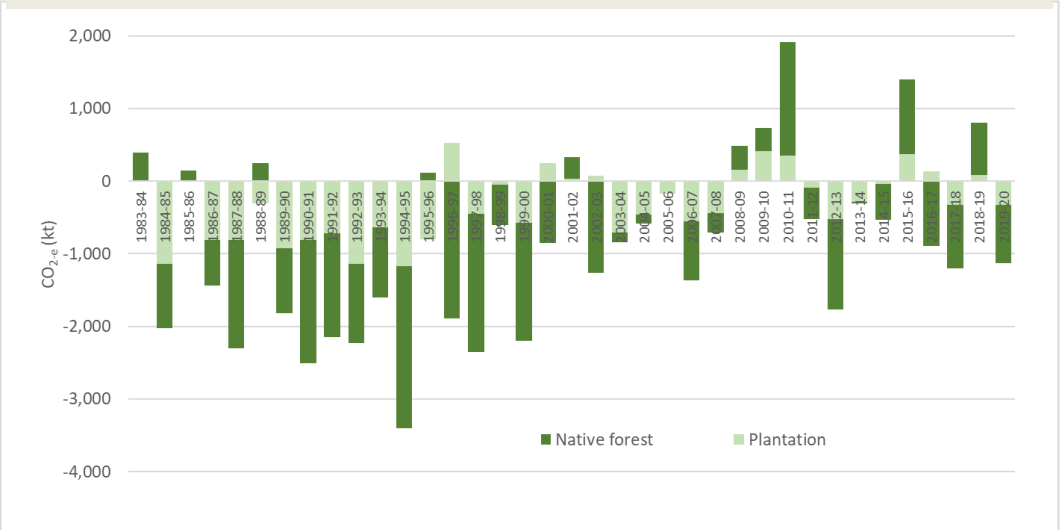

Figure 2 Annual net flow expressed as emissions of carbon on PTPZ land (plantation and native forest). Negative values represent carbon sequestered

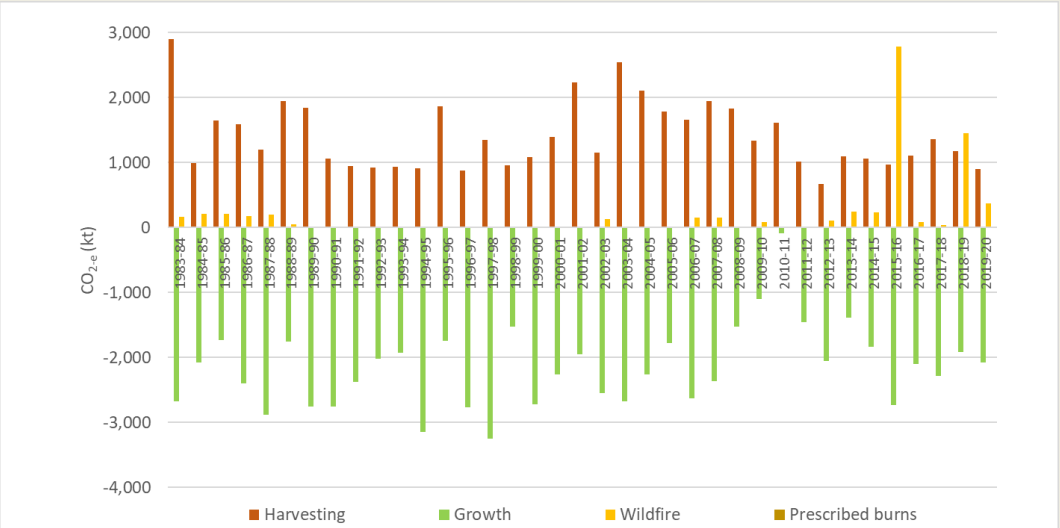

Figure 3 Annual carbon flow by mode expressed as emissions of carbon on PTPZ land. Negative values represent carbon sequestered

CRITERION 6: MAINTENANCE AND ENHANCEMENT OF LONG-TERM MULTIPLE SOCIOECONOMIC BENEFITS TO MEET THE NEEDS OF SOCIETY

This criterion, and associated indicators, is intended to show the extent to which forests contribute to national and regional economies, benefit personal and community wellbeing, and support cultural values. Socio-economic data provide important measures of the monetary and non-monetary value and benefits of forests to society. In addition, Tasmanian communities have strong social and cultural connections to the forests, including for provision of wood and non-wood forest products, direct and indirect employment, and nature-based recreation.

The forestry industry in Tasmania has been recovering strongly over the last five years with increased production of hardwood plantation fibre, robust demand for timber construction materials and heightened interest in the carbon capture market associated with forests – both native and plantation. The indicators in this criterion are considered in five sub-criteria.

6.1 PRODUCTION AND CONSUMPTION

This sub-criterion provides data and analysis on the socio-economic benefits to the Tasmanian economy of both value and quantities of both timber and non-wood products.

Indicator 6.1.a. Value and volume of wood products

This indicator enables socio-economic benefits to be monitored by ascertaining trends in value and volume of wood production.

Volume

Table 6.1.a.1 and Figure 6.1.a.1 shows the reported volumes of wood harvested for the reporting period from Tasmanian forests. The wood production and volume data for this report has been sourced from the annual reports of STT and Private Forests Tasmania (PFT). These reports provide comprehensive data on harvest of wood from both plantations and native forest. The PFT reports compile data from all companies sourcing significant volumes of wood from private forest (Figure 6.1.a.2).

While the volume of timber produced from the public forest estate has increased steadily since 2011 it has been relatively consistent over the past five years (Figure 6.1.a.3).

Table 6.1.a.1 Quantity[(a)] of wood produced from public and private forest in Tasmania (2016–2017 to 2020–2021)

Product	2016–2017	2017–2018	2018–2019	2019–2020	2020–2021
Hardwood – native forest: high quality sawlog or veneer (m^3)	117,529	129,403	116,025	118,893	115,375
Hardwood – native forest: other sawlog, veneer, peeler, special timbers (t)	212,471	229,035	229,706	207,484	215,790
Hardwood – native forest pulpwood (t)	744,423	811,223	802,087	756,463	1,119,828
Hardwood – plantation sawlogs (m^3)	363,834	644,154	622,831	324,755	503,695
Hardwood – plantation pulpwood (t)	2,292,301	2,370,964	2,489,570	2,343,845	1,720,004
Softwood – sawlog (m^3)	698,076	688,636	649,761	736,432	644,195
Softwood – pulpwood (t)	576,226	568,389	594,146	676,427	722,718
Total production[(b)]	**5,330,665**	**5,771,093**	**5,825,049**	**5,646,249**	**5,049,067**

a) Not all wood products and volumes are included and therefore the numbers in the table do not equal the true total production numbers

b) Assumes 1 m^3 = 1 tonne

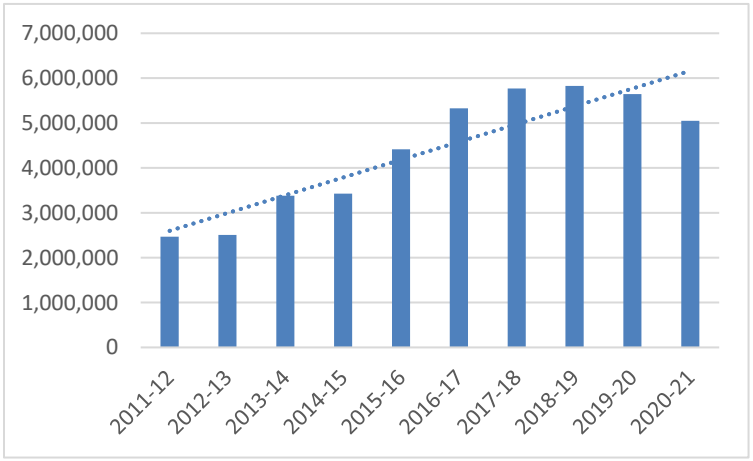

Figure 6.1.a.1 **Trends in total wood production (t) from private and public native and plantation forest (2011–2012 to 2020–2021)**

Source: STT annual reports (2016–2017 to 2020–2021) and PFT annual reports (2016–2017 to 2020–2021)

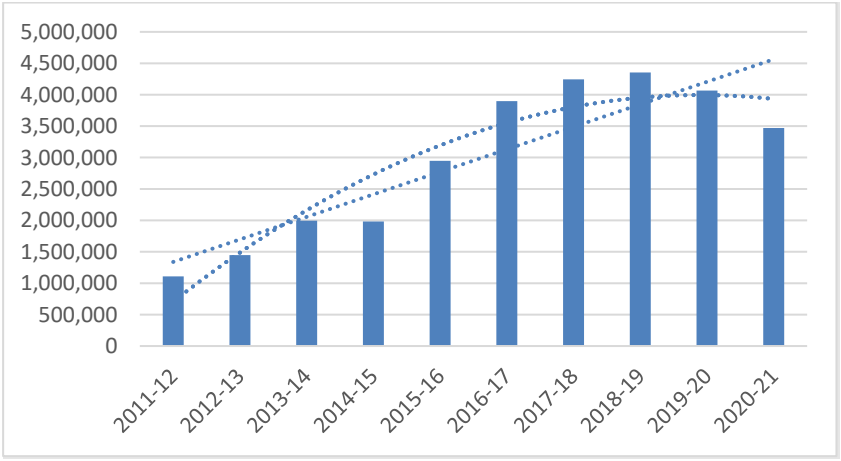

Figure 6.1.a.2 **Trends in total private native and plantation forest production (t) (2011–2012 to 2020–2021)**

Note: A second polynomial trendline has been fitted to highlight that in the last two years the volumes have retreated from the peak achieved in 2018-19.

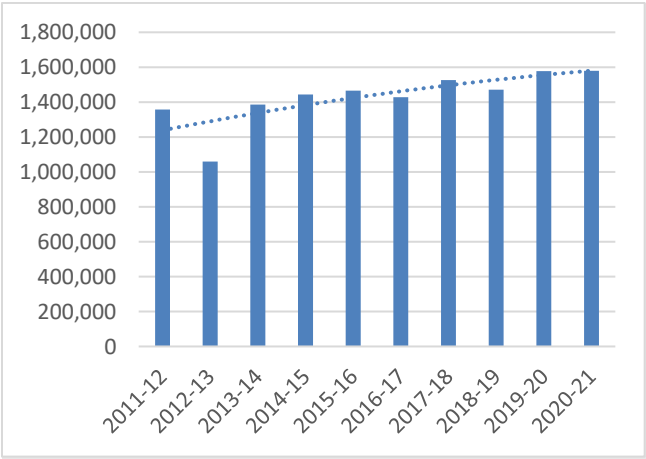

Figure 6.1.a.3 **Trends in total public native and plantation forest production (t) (2011–2012 to 2020–2021)**

Value

The forest industry in Tasmania is composed of many different sectors. Deriving a complete and accurate picture of the entire industry is complex. However, there are various sources of information, included below, that will help in providing a guide to the size and scale of the Tasmanian industry.

ABARES publishes quarterly data in the Australian Forests and Wood Products Statistics (AFWPS) as shown in Table 6.1.a.2. Over the last five years, the total value of logs harvested has increased by 10.7%. There was, however, a significant decrease in the value of hardwood native and softwood logs harvested in 2020–2021.

Table 6.1.a.2 Value ($m) of logs harvested in Tasmania (millions of dollars) (2016–2017 to 2020–2021)

Source	2016–2017	2017–2018	2018–2019	2019–2020	2020–2021
Hardwood native	85.0	87.9	68.4	93.9	73.4
Hardwood plantation	166.5	210.2	229.3	209.9	226.2
Softwood	105.7	128.6	126.7	145.0	95.9
Total	**357.2**	**426.7**	**424.5**	**448.8**	**395.5**

Source: AFWPS Datasets (ABARES, 2022)

The data in Table 6.1.a.3 shows the output (gross sales of an industry, which includes the cost of inputs to that industry) each financial year for the reporting period. The data highlights the volatility in these markets with it showing an 8.8% decrease in output value over the 5-year reporting period, but a 11.8% increase in 2020–2021 from 2019–2020.

Table 6.1.a.3 Value ($ m) of output of the Tasmanian wood and paper product manufacturing sectors by (2016–2017 to 2020–2021)

Wood and paper product sector	2016–2017	2017–2018	2018–2019	2019–2020	2020–2021
Forestry & logging	409.6	341.7	386.8	360.4	455.2
Forestry support services[a]	35.1	26.5	29.0	32.8	24.4
Wood product manufacturing	455.7	406.6	386.2	344.2	395.7
Pulp, paper and converted paper product manufacturing	226.5	222.2	229.8	182.0	152.8
Total	**1,126.9**	**997.0**	**1031.8**	**919.4**	**1,028.1**

a) The support services output value is a simple percentage of the forestry sector within the larger agriculture sector from the analysis developed by id.community

Source: id.community website (https://economy.id.com.au/tasmania)

Indicator 6.1.b Values, quantities and use of non-wood forest products

This indicator enabled socio-economic benefits to be monitored by ascertaining trends in quantities, values and usage of non-wood products against management objectives.

Previous TasSOFRs (2012 and 2017) provided some data and analysis on various other non-wood forest products produced from the forests. Changes in the types of data collected, and the levels of monitoring by government and industry bodies, means that some data relied upon in 2012 and 2017 is not available. This report has relied on those data sources that remain available, together with other research and industry observations.

Apiary industry

The apiary industry is regulated by the NRE Tas (AgriGrowth Tasmania, 2019). Honey is the major commercial output of this industry. There are several other products which also add to the income of bee businesses, and include paid pollination services, beeswax production, queen bee and packaged bee sales.

Leatherwood honey is the most distinctive Tasmanian honey, and accounts for a significant proportion of sales, particularly outside of the state. Leatherwood (*Eucryphia lucida*) trees predominantly occur in mature wet eucalypt forest and rainforest. It is estimated that the total accessible leatherwood resource across Tasmania is about 705,000 ha, including 136,000 ha on permanent timber production zone (PTPZ) land.

NRE Tas conducted the Tasmanian Beekeeping Survey 2019 and produced a report highlighting the significance of the industry in Tasmania (AgriGrowth Tasmania, 2019). Some of the key findings were:

- 257 registered beekeepers
- 22,092 registered hives
- 70% of hives reported in the survey are owned by 2% of beekeepers
- 403 t of honey was produced in the 2018–2019 financial year
- honey has a farm gate value of $7.4 million
- leatherwood accounted for 43% of all honey production
- manuka accounted for 42% of honey value.

Beekeeping is not only reliant on honey to produce income. Beekeepers generated farm gate value of $468,658 in 2019 for other bee products including wax, nucleus hives, honeycomb, queens and package bees. The survey also estimated that 9,147 hives supplied pollination services that produced $1.8 million in revenue for those services.

Treeferns

There are five species of treefern that occur naturally within Tasmania, *Dicksonia antarctica, Cyathea australis, C. cunninghamii, C. xmarcescens* and *Todea barbara*. *Cyathea cunninghamii* and *C. marcescens* are listed as threatened species on the Tasmanian *Threatened Species Protection Act* 1995. D. antarctica (manfern or soft treefern) is the only species of treefern that can be harvested and traded (Indicator 2.1d, (Donoghue and Turner, 2022) Species distribution models have been developed for all five Tasmanian treefern species (FPA, 2022).

The harvesting of treeferns in Tasmania is regulated under the *Forest Practices Act 1985*, through the FPA. The guidelines for the harvesting of *D. antarctica* that applied during the reporting period were outlined in Indicator 2.1d. Failure to comply can result in substantial penalties.

Treeferns are sourced from native forest operations as well as harvesting within existing plantations, treefern plantations or nursery sites. All harvested treeferns must have a Tasmanian treefern tag issued by the FPA securely attached at the point of harvest. Tree ferns cannot be sold on a wholesale or retail basis without a tag.

The Forest Practices Regulations 2007 were amended in July 2011 to allow for two categories of treefern stem lengths: below 30cm (small) and above 30 cm (large). The tag cost of a large fern was set at one fee unit, and the tag cost of a small fern set at 0.5 of a fee unit in a given financial year. Table 6.1.b.1 shows the number of treefern tags issued annually by the FPA for the most reporting period.

Table 6.1.b.1 Number and value ($) of large and small treefern tags issued (2016–2017 to 2020–2021)

Year	Tree fern size	Number of tags issued	Tag cost ($)	Value of tags issued ($)
2016–2017	large	6,095	1.53	9,325
	small	8,295	0.76	6,304
Total		14,390		15,629
2017–2018	large	157,000	1.55	24,335
	small	9,600	0.77	6,387
Total		25,300		30,722
2018–2019	large	12,239	1.58	19,338
	small	2,417	0.79	1,909
Total		14,656		21,247
2019–2020	large	13,380	1.62	21,676
	small	7,040	0.81	5,702
Total		20,420		27,378
2020–2021	large	28,273	1.62	46,802
	small	8,014	0.81	6,491
Total		36,287		53,293

Source: FPA annual reports (2016–2021)

Wallaby

Two wallaby species (Bennetts and rufous) are permitted to be hunted across Tasmania for sport and recreation, to protect crops and pastures, and for the commercial trade in meat and skins. Landholders are also able to procure a Crop Protection Permit for wallaby management as browsing causes significant crop loss, and commercial hunting is permitted under a Commercial Purposes licence (previously Commercial Wallaby Hunter's licence). Figure 6.1.b.1 shows the number of wallaby licences issues annually over the last ten years. As of late August 2021, a total of 2,852 Crop Protection Permits authorising the take of Bennetts and rufous wallaby were active. NRE Tas conducts annual spotlight surveys of wallabies between November and February to monitor population trends to ensure sustainability of the take. Recent surveys indicate that wallaby numbers are not in decline (Indicator 2.1d) (NRE, 2022).

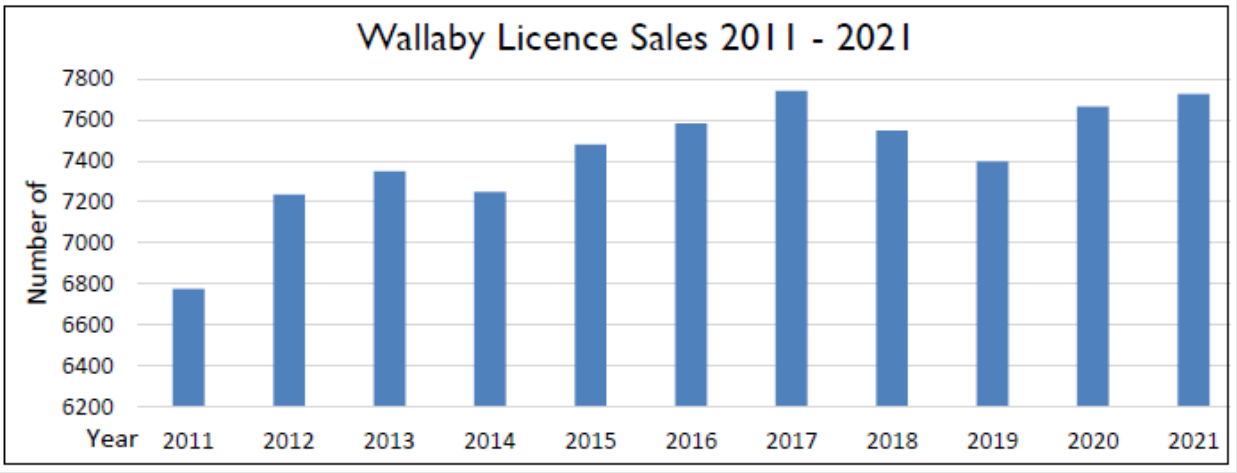

Figure 6.1.b.1 Wallaby licence (crop protection and commercial purpose) sales 2011–2021 (to August 2021)

Source: DPIPWE Game Tracks Publication (NRE, 2022)

Hunting and fishing

Forests are home to many different species of native and introduced animals. Maintaining forestry access roads (almost 3,000 km in total) assists hunting and fishing on PTPZ land.

Fallow deer

Fallow deer (*Dama dama*) is an introduced species principally inhabiting central and north-eastern Tasmania, but increasingly being found in north-western and south-eastern Tasmania (see also Indicator 2.1d). Deer can be hunted under a recreational hunting licence or crop protection permit issued by NRE Tas.

During the reporting period there were changes in management of antlerless deer (including no bag limits, extended hunting season and introduction of five-year Property Protection Permits). Reporting of harvest data by NRE Tas has therefore changed. Since the issuing of antlerless permit tags ceased in 2019, these numbers can no longer be reported. Also, harvest data is two years behind due to returns being received after statistics are prepared. During most of the reporting period, the number of recreational hunting licences and number of male deer taken was fairly stable (Figure 6.1.b.2) but the number of deer taken under crop protection permits has increased (Figure 6.1.b.3). Based on preliminary data to the end of August 2021, the new deer management regime has allowed licenced hunters to harvest a total of 27,221 antlerless deer under hunting licences and Crop Protection Permits, an overall increase of 22% compared to 2020.

Table 6.1.b.2 Fallow deer hunting (licence sales and reported take) and crop protection (tags issued) statistics 2016–2020

	2016	2017	2018	2019	2020
Hunting licences sold	5,114	5,171	5,067	5,162	5,894
Reported take	6,445	6,721	6,587	6,890	16,469[a]
Protection tags issued	18,000	24,000	23,000	14,836	15,343[b]

a) Preliminary data only
b) Male deer only, due to changes in management of antlerless deer

Source: DPIPWE Game Tracks Publication (NRE, 2022)

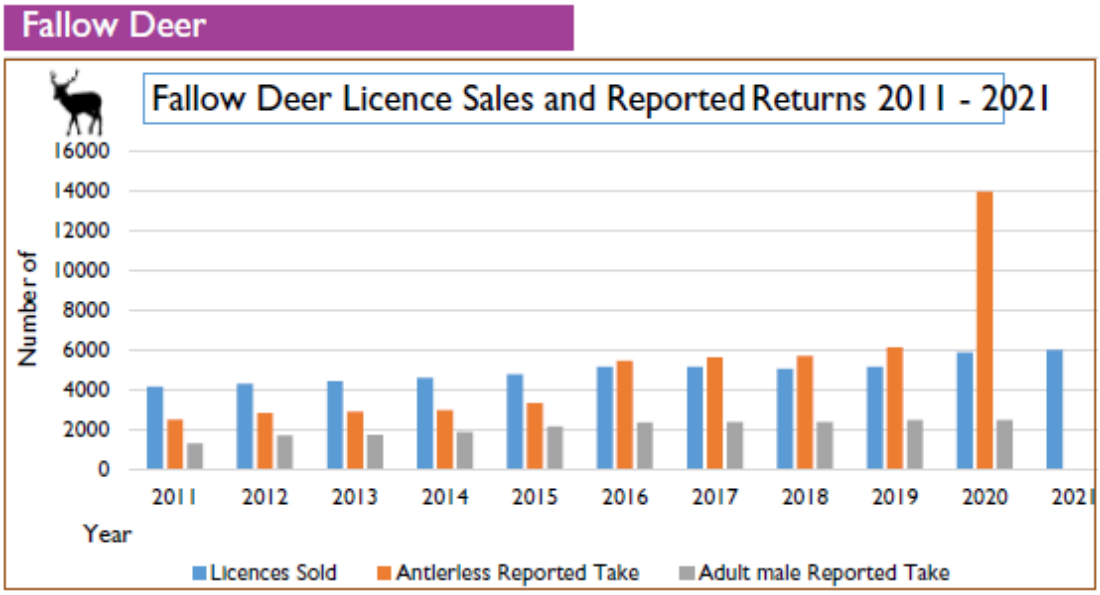

Figure 6.1.b.2 Fallow deer licence sales and reported returns 2011–2021

Source: DPIPWE Game Tracks Publication (NRE, 2022)

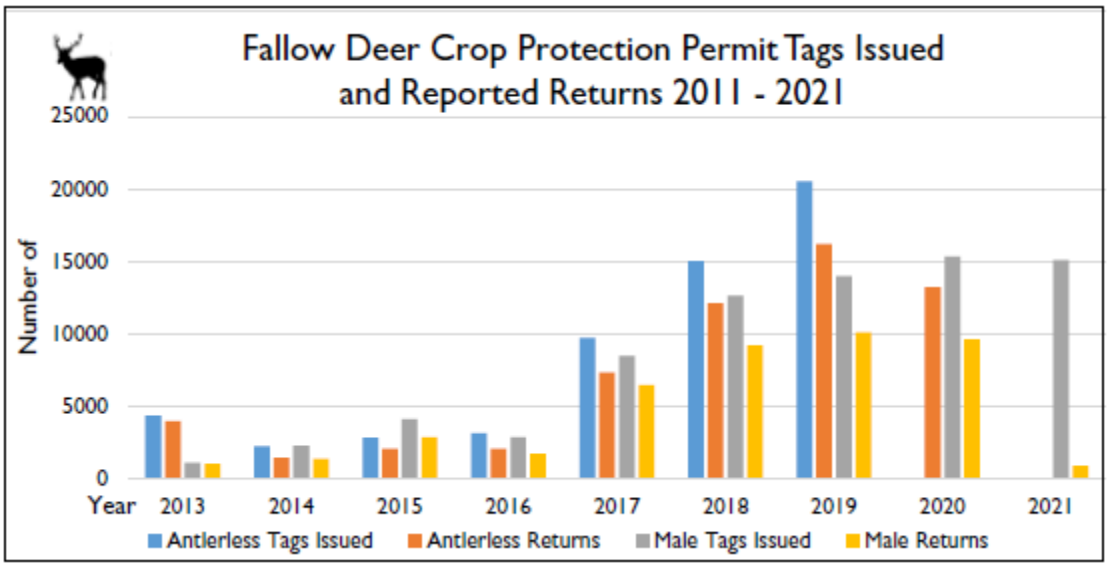

Figure 6.1.b.3 Fallow deer crop protection permit tags issued reported returns 2011–2021

Source: DPIPWE Game Tracks Publication (NRE, 2022)

Indicator 6.1.c Value of forest-based services

Mountain biking and bushwalking

Tasmania offers over 2,800 km of walking tracks, and over 880 different walks in its national parks, conservations areas, and reserves. Not all tourists to Tasmania visit to enjoy the walks and forested areas, but many do. There are no direct numbers associated with the socio-economic benefits that are derived from people visiting Tasmania's forests and walking through the many national parks.

Tasmania has experienced significant growth in visitation to its globally popular mountain bike tracks over the last five years and there have been significant economic benefits from the establishment of mountain bike trails in Tasmanian forests. Indicator 6.3 also summarises the contribution of forests to recreation and tourism in Tasmania.

Mountain bike trails have been developed across Tasmania, including in:

- North-west and west coast
  - Penguin Mountain Bike Park and Dial Range
  - Wild Mersey
  - West Coast Mountain Bike Trails
- North and north-east
  - Blue Derby Network
  - St Helens Mountain Bike Trails
  - Hollybank Bike Park
  - George Town
  - Launceston Mountain Bike Trails
- South
  - Maydena Bike Park
  - Hobart Mountain Bike Trails (Wellington Park)
  - Clarence Mountain Bike Trails (Meehan Range).

COVID-19 severely impacted Tasmania's visitor economy throughout 2020, with border restrictions in place for all nonessential travellers from March 2020 with interstate travel restrictions remaining until November 2020 and limited international visitation resuming in April 2021. However, there was an increase in local and, once interstate travel resumed, Australian visitors during this period.

The Tasmanian Visitors Survey (TVS) collects data for Tourism Tasmania from interstate and international visitors regarding visitor behaviour, including engagement with outdoor activities and specific natural attractions (but does not capture the location a visitor participated in an activity such as mountain biking). TVS surveys showed that during COVID-19 the appeal of the state's wilderness, wildlife and natural scenery grew.

For the twelve-month period ending September 2021, TVS data indicated:

- around 19,300 interstate and international visitors to Tasmania reported participating in mountain biking at some point during their trip
- an estimated 316,400 visitors reported bushwalking at some point (any duration and location) during their trip.

These data highlight that many interstate and international visitors to Tasmania seek to enjoy its natural environment at some point during their visit to Tasmania, and this has important economic opportunities for local communities and the broader Tasmanian economy and diversifying the income related from the Tasmanian forest estate.

Indicator 6.1.d Production and consumption and import/export of wood, wood products and non-wood products

This indicator provides a measure of the trends in the production and consumption of wood and wood related products in Tasmania, and the export of those products from Tasmania. Ongoing access to interstate and international markets is fundamental in ensuring the viability of the forestry sector, as Tasmania is an export focused economy.

Data is limited on the value of the timber products imported and exported to and from Tasmania. The information on prices achieved for various products are averages over the financial year to provide some form of indication as to the revenue these products generate.

Wood products exported from Tasmania

Table 6.1.d.1 provides data on the export of wood products from Tasmania obtained from TasPorts. However, it does not record the destination, with some of the goods consumed in international markets, and some consumed in domestic markets.

Table 6.1.d.1 Wood and wood products (t) exported from Tasmania (2016–2017 to 2020–2021)

Product	2016–2017	2017–2018	2018–2019	2019–2020	2020–2021
Whole Logs	623,876	706,091	825,286	649,363	604,310
Woodchips	2,987,676	3,193,803	3,324,042	3,030,920	2,936,698
Paper-newsprint	264,324	265,231	199,266	185,258	90,250
Total	**3,875,876**	**4,165,125**	**4,348,594**	**3,865,541**	**3,631,258**

Source: TasPorts

Export woodchips have been consistent over the previous five financial years. The bulk of this product is from the private hardwood plantation estate.

Whole log exports have declined since the 2018–2019 financial year to be almost 27% lower in the 2020–2021 financial year. The primary reason for this decline in export volumes has been the continuing trade issue with China and their continuing refusal to accept whole logs from Australia due to suspected detection of insect pests in shipments from Australia. This has created supply chain issues and surplus whole logs in Australia. Tasmanian businesses have been able to pivot some of the volumes traditionally bound for China to the Malaysian timber processing sector. This market, however, is much smaller than the Chinese market which explains the noticeable decline in volumes over the last two years.

The trade issues currently being experienced with China highlight the need for market diversification for Tasmanian businesses. The Tasmanian Government is financially supporting the timber processing sector by providing grants to businesses seeking to process, value-add and produce timber products on-island. This in-turn generates employment opportunities for Tasmanians and supports businesses in diversifying the potential end market for their products.

There are several businesses in Tasmania seeking to develop new timber products that will add significant value to the raw input material, especially targeting the construction sector. Timber is gaining a lot of traction as a replacement product in the construction sector for steel, a high carbon product. With the global shift to low carbon economies, the sustainable nature of timber highlights the positive contribution the industry can play in abating global warming. Further strengthening the timber industry, the World Bank are forecasting that global timber demand is set to quadruple by 2050 (World Bank, 2016). This is an enormous opportunity for Tasmanian timber businesses over the long-term.

Over the previous five years, the volumes of woodchips exported from Tasmania to international markets has been consistently around the 3 million t annually.

The export of paper-newsprint has seen a dramatic decrease over the last five financial years from almost 265,000 t in 2016–2017 to just over 90,000 t in 2020–2021; an almost 66% decline in volumes over that period. This is not just an Australian phenomenon, it is being experienced in virtually all modern economies across the globe, as more and more information is consumed and shared digitally.

The indication of exported sawn timber from Tasmania can provide an insight into the volumes for the calendar year 2021, but not the destinations, as virtually all the sawn timber is exported in twenty-foot containers, which are then trans-shipped and consolidated with other types of cargo at either Melbourne or Sydney ports. Tasmania exported through its various ports a total of 138,160 t of sawn timber products in 2021. It is assumed that most of this trade is for the domestic housing construction markets on mainland Australia, with some smaller volumes being sent offshore to international markets.

Wood products imported to Tasmania

There are limited data recorded in the public domain that provides a complete detailed overview of the volumes and values of the timber related products and services imported into Tasmania. Table 6.1.d.2 lists three forestry and timber related imports to Tasmania for the 2020–2021 financial year, compared to the 2015–2016 financial year. Wood product manufacturing is mostly related to furniture importation, and overall, these forestry and timber related products and services represent a small fraction of Tasmania's total imports each year.

Table 6.1.d.2 Value ($) of wood and wood products imported to Tasmania, and percentage change

Product	2015–2016 value ($m)	2020–2021 value ($m)	Change (%)
Forestry and logging	26.8	29.8	3
Wood product manufacturing	113.3	113.1	-0.2
Pulp, paper and converted paper	186.7	196.5	9.8

Source: National Institute of Economic and Industry Research (NIEIR), 2021. Compiled and presented in economy.id by.id (informed decisions)

Tasmania does have to import some construction material and small amounts of timber not grown in Tasmania from mainland Australia and overseas.

Non-wood products

Data and statistics on the volumes and values of non-wood forest products exported from Tasmania are not available as the data is no longer collected by the relevant agencies.

Indicator 6.1.e Degree of recycling of forest products

This indicator aims to provide information on the extent to which recycling and reuse of forest products occurs in Tasmania. There is very limited data about recycling of forest products in Tasmania. This has resulted in a serious data gap for this indicator, with no central database where this information is stored and can be easily accessed.

The major products derived from timber fibre that are recycled are cardboard products and paper products. Increased volumes of paper and cardboard recycling reduces the demand for new raw timber fibre direct from the forest. Tasmania had been reliant on exporting its 'waste' materials (paper, cardboard, plastic etc) to China up until recently. This is now no longer possible, with China unable to process the large volumes of recyclable material it was receiving from all over the world. This has forced Tasmania and other Australian jurisdictions to pursue moving to a circular economy and developing new industries and businesses that benefit from processing this material into new reusable products. Moving to a circular economy in Tasmania is intended to be system-wide and economy-wide, and likely to require a range of policy interventions across sectors, industries and communities.

A strategic approach is being pursued with the 2019 release of the draft Tasmanian Waste Action Plan (Department of Natural Resources and Environment Tasmania). This draft plan focuses on all types of waste resource and the recycling problems encountered. It provides a framework for discussion with local government, business and the community on the best way to address the waste and resource recovery challenges in Tasmania. The draft plan includes actions to improve waste data collection and reporting to facilitate waste policy and resource recovery planning as well as resource recovery targets for all waste types.

There is a small demonstration plant at Boyer using sawdust to create Cyrene, a non- toxic solvent which will potentially replace petrochemical solvents. This FC5 plant operating in Tasmania is being upscaled in France from the learnings made at the Boyer plant since 2019.

A recent example of the potential for wood fibre to be used in combination with a waste product is the announcement that Timberlink is building Tasmania's first biocomposite plant, following the awarding of a grant from the Tasmanian Recycling Modernisation Fund (Plastics) Grants Program (Tasmanian Forests and Forest Products Network, 2022). The biocomposite plant will produce wood plastic composite products that will upcycle plastic waste and plantation timber mill residues, producing decking and screening for commercial and residential applications.

Timberlink intends to source the recycled high-density polyethylene (a type of plastic) for the core of the product from Tasmania, ensuring that the feedstock for this plant where possible is sourced within Tasmania. This will enhance the circular economy in Tasmania and generate economic value to Tasmania as these products are produced and sold both in Tasmania and mainland Australia.

The Timberlink example illustrates that well-funded and resourced research and development can deliver new and innovative products. There are potential opportunities for Tasmania to deliver new versatile products using waste as a key ingredient as shown by this example.

6.2 INVESTMENT IN THE FOREST SECTOR

This sub-criterion reports on investment and expenditure in forest management, and the development and implementation of new technologies.

Indicator 6.2.a Investment and expenditure in forest management

This indicator aims to monitor the investment in managing all forests and plantations, and expenditure on developing, maintaining, and obtaining goods and services from them. Investment in active forest management is undertaken by a wide range of government agencies, private companies, community groups and associations, and individuals. The level of management ranges from specific projects to integrated approaches that are funded by grants, budgetary appropriation, commercial operations and private donations. The complexity of organisations and funding models means that comprehensive data on the level of this investment in forest management are not readily available. Sources of information used for this indicator include the annual reports from Sustainable Timber Tasmania (2016-2022) and DPIPWE (2016-21), NIFPI project information (NIFPI, 2022), and University of Tasmania media announcements (University of Tasmania, 2022b).

Forest management investments include, but are not necessarily restricted to:

- establishing, maintaining, conserving and re-establishing native forest and plantations for commercial and non-commercial uses, including wood and non-wood products
- identifying, maintaining and managing of biodiversity values
- monitoring, maintaining and enhancing water quality and production capacity
- establishing, maintaining and enhancing recreational and tourism facilities and opportunities, including access
- constructing, maintaining and decommissioning infrastructure such as roads, bridges, walking tracks and fire breaks
- identifying, developing and providing contemporary education, information and training, and opportunities for individuals, groups and organisations involved in forest management
- establishing processing facilities for both wood and non-wood forest products.

There are numerous private and government owned businesses and statutory enterprises that operate in this space in Tasmania. The annual reports for many of the private businesses in the forestry sector are not readily available, making it difficult to get a detailed insight into their investment profile in Tasmania. Midway Limited is the exception, with this large wood fibre business listed on the Australian Stock Exchange (ASX). Midway has a facility at Bell Bay in northern Tasmania that processes wood fibre and exports predominately to the Asian market. The business also has operations across Australia, notably in Queensland, Western Australia, Victoria and the Northern Territory. In an announcement to the ASX on 17 May 2021, Midway is planning to invest between $12–14 million in capital expenditure on port storage, processing and loading facilities in several stages over the next two financial years, subject to regulatory approvals. The facility at Bell Bay, once completed, will have the capacity to process up to 600,000 t of wood fibre annually.

Also contained in this statement to the ASX, was the announcement that Midway is partnering with Climate Friendly, a leading carbon advisory firm, to help develop farm forestry on privately-owned farmland in Tasmania.

Pacific Forest Products Australia (PFP) is a subsidiary of its New Zealand based parent, but actively operates in Tasmania from the Port of Burnie, Bell Bay and Port of Hobart, buying both softwood and hardwood (native and plantation) logs for export, predominately to the Asian market.

Over the last five-year period, the Hermal Group has developed a pilot plant in the Wynyard region of Tasmania investigating the production of Cross-Laminated Timber Panel (CLTP) and structural Glue Laminated Timber (GLT) beams from plantation hardwood timber. They have announced they will construct Australia's largest plantation hardwood mill at Burnie in north-west Tasmania. Once fully developed it will have required $190 million of total investment, will employ around 200 staff and will process more than 300,000 m^3 of sustainable plantation hardwood logs each year. The Tasmanian Government has committed to provide $13 million in grant funding for the project, and provided guaranteed loans at very competitive rates to ensure the full $190 million is invested in this facility. It is expected that the plantation hardwood logs will be sourced from Tasmania's largest hardwood plantation estate manager, Forico, with a large proportion of its plantation hardwood estate in the north-west region.

The Tasmanian Government also announced in 2021 that it was providing $10 million in grants over a five-year period to further develop the state's on-island processing capabilities. This aims to ensure that Tasmanian timber businesses are in the strongest possible position to benefit from the expected increase in demand for timber products in an ever-increasing range of industries, as there is a global transition to a net-zero economy.

Carbon farming/natural capital accounting

Forests and carbon farming in Tasmania (and globally) have been attracting a lot of interest in the last four to five years. The global push to reach net zero greenhouse gas emissions by 2050 are highlighting the strategic benefits native and plantation forests can provide to society and assist in achieving the goal of net zero emissions. Forests provide much more than just timber and wood fibre products, and these 'other' values are sought to be captured through natural capital accounting (see Criterion 5).

Another emerging trend with regards to funds management and investing is Environmental, Social and Governance (ESG) criteria. ESG criteria are used to evaluate companies and countries on how far advanced they are with sustainability. Carbon farming and forest management has a strong correlation with the environmental factor of ESG. 'Environmental' in the ESG criteria includes: carbon emissions, air and water pollution, deforestation, green energy initiatives, waste management, and water usage. The 'Social' component of ESG criteria encompasses: employee gender diversity, data security, customer satisfaction, company sexual harassment policies, human rights at home and abroad, and fair labour practices. The 'Governance' in ESG relates to internal practices and policies that lead to effective decision making and legal compliance.

There is empirical evidence that businesses that achieve a high rating against ESG criteria produce better financial returns to their owners. There is also an increasing number of Australian superannuation funds that are allocating their funds against businesses ESG ratings.

Natural capital accounting enables businesses to assign a value to the natural assets they own and manage and to highlight the wider benefits to society that these assets provide. These may include carbon sequestration from plantation and natural forests, water provisioning services, water regulating services, sediment control, and conservation of vegetation and habitat of the natural forests. For forestry businesses highlighting the values of their natural assets and the services these provide to the broader environment and society, through ESG rating agencies, should be able to attract capital to help them to expand their business.

Tasmania's largest privately owned forestry business, Forico, released its inaugural Natural Capital Report in 2020 and has since released an updated 2021 Natural Capital Report. Forico manage both a hardwood plantation estate for producing timber products and a significant native forest estate for conservation and biodiversity values. Natural capital accounting can help businesses to measure and report on their environmental performance and track it against their economic information,

improving their decision making and justifying investments in nature. For example, in the Forico 2021 Natural Capital Accounting Report, they reported their net natural capital value as $3.39 billion. This comprised of $463 million in value to the business plus $2.92 billion in value to society.

Australian Carbon Credit Units

The Australian Government, through the Clean Energy Regulator, provides opportunities for various projects to be eligible for Australian Carbon Credit Units (ACCUs). Each ACCU represents one tonne of carbon dioxide equivalent (t CO_2-$_e$) stored or avoided by a project, for example a plantation conversion project. Plantation conversion projects sequester carbon by converting an existing short rotation plantation forest to a long rotation forest for commercial harvesting of wood products. ACCUs are issued as either Kyoto ACCUs or non-Kyoto ACCUs which then are either sold to the Australian Government under a carbon abatement contract, relinquished (mandatory or voluntary), cancelled, transferred, and/or traded (Australian Government, 2022).

Tasmania currently has twelve vegetation carbon abatement projects registered with the Clean Energy Regulator under the Emissions Reduction Fund, with a total of 729,606 ACCUs issued up to April 2022. The two most common project areas registered in Tasmania under the vegetation method are:

- converting an existing short rotation plantation forest to a long rotation forest for commercial harvesting of wood products
- protecting native forest on private land from harvesting.

The projects will have a duration of a minimum of 25 years and sometimes up to 100 years. ACCUs are issued to the project holder each financial year for the volume of carbon sequestered from the atmosphere. There has been increased interest in the trading of ACCUs as Australian businesses seek to offset their carbon footprint, with ACCUs a cheaper alternative to businesses changing their respective operations to minimse the carbon they emit into the atmosphere. Figure 6.2.a.1 highlights the rapid increase in the value of ACCUs value during the second half of 2021, with the price reaching over $55 per ACCU. The dramatic fall in March 2022 was due to amendments made by the Australian Government to the Emissions Reduction Fund (ERF). These amendments allowed holders of ACCUs to opt out of their fixed-delivery carbon credit contracts with the federal government and enter the open market, where prices are much higher.

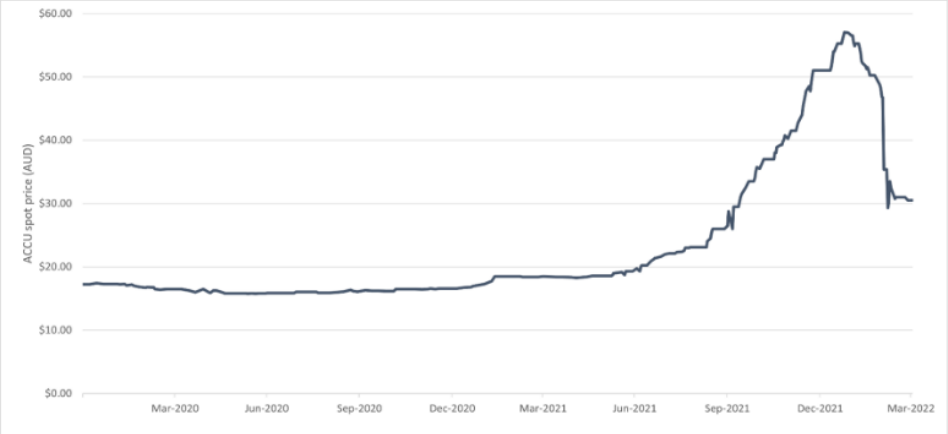

Figure 6.2.a.1 Spot price for ACCUs from January 2020 to March 2022

Source: Australian Government Clean Energy Regulator.

Voluntary certification

Ongoing commitment to the Tasmanian RFA supports a culture of continuous improvement and adaptive management which is embraced and driven by forest managers. STT employs stringent forestry management systems that underpin their compliance with various forest standards, and most industrial forest areas are accredited under the Responsible Wood Forest Management (AS4708:2013) and other independently audited environmental management systems such as ISO 14001.

A large area of Tasmania's production forest is now also Forest Stewardship Council (FSC) certified (see Indicator 7.1.b, Table 7.1.b.9). Almost all forest managers have Responsible Wood certification (authorised under the PEFC scheme) whilst many (who are largely plantation-based) are dual certified to the FSC standard. All the large processors in Tasmania are also chain of custody certified.

Organisations investing in forest management in Tasmania

Table 6.2.a.1 lists the main public and private forest organisations that invest and expend monies in forest management in Tasmania. In addition to those listed in Table 6.2.a.1, there are other organisations involved in the promotion of improved approaches to the management of forests. These include the recently formed Tasmanian Forest Products Association, the Tasmanian Timber Promotion Board, the Forest Education Foundation, Timber Communities Australia, Forestry Australia, local governments and volunteer organisations including Landcare.

Table 6.2.a.1 Major organisations investing in forest management in Tasmania

Organisation[(a)]	Function
AKS Forest Solutions	A forest management and wood broking company operating in the private and public forest sectors in Tasmania.
ARC Centre for Forest Value (UTAS)	Provides research solutions to industry driven problems in the forest and wood products sector. Tree genetics, growing climate ready forests, forest silviculture, forest socio-economics, forest restoration and conservation
Department of Natural Resources and Environment (NRE Tas), including the Tasmanian Parks and Wildlife Service (PWS)	Tasmanian government agency – monitoring and research into natural forest values including land, biodiversity and water. The PWS is responsible for the management of large areas of forested reserved lands for conservation and recreation.
Forest Practices Authority (FPA)	Tasmanian statutory authority – forest practices regulator.
Forico Pty Ltd	Tasmania's largest private forest company – responsible for New Forests' hardwood plantation assets. Business concentrates on the managementand harvesting of hardwood plantations.
Global Forest Partners LP (GFP)	Manages investment funds for institutional investors that invest in forestry assets. Recently purchased 21,000 ha from RMS of hardwood plantations on 36,500 ha of freehold land.
Hydro Tasmania	Tasmanian government owned business – responsible for use and management of water resources to produce power and manages forestedland that surrounds dam infrastructure.
Midway Tasmania	Involved in forest management and all stages of the wood production process from plantation and native forest.

Organisation[(a)]	Function
National Institute for Forest Products Innovation (NIFPI) (Launceston)	Funding by the Australian and Tasmanian Government's to provide research grants for a range of activities associated with value adding to the forest estate.
Natural Resource Management (NRM) Groups (NRM South, NRM North and NRM Cradle Coast)	A government funded network of three regional bodies working with local communities to co-ordinate improve management of natural resources, including forests.
New Forests	International funds management business based in Sydney that owns and manages a range of forestry assets in Tasmania.
Norske Skog (Owner Oceanworld Capital)	Paper manufacturing business based in Southern Tasmania.
Pentarch	Directly involved in the procurement, development and sale of timber products to export markets in Asia
PF Olsen Australia	Managing hardwood and softwood plantations across Tasmania
Private Forest Owners	There are over 5,000 private landowners inTasmania whose property incorporates native and-orplantation forest.
Private Forest Reserve Owners	A wide range of owners and organisations, hundreds of conservation covenants in place. Funding is typically through governments, donations and the sale of covenanted lands for the purchase, management, and conservation of lands that include forests.
Private Forests Tasmania	Tasmanian statutory authority – with a legislated role to facilitate and expand the development of the private forest resource which is consistent with sound forest and land management practices.
Reliance Forest Fibre	Directly involved in forest management, port operations and the procurement, development and sale of timber products to export markets
SFM Environmental Solutions	A provider of independent plantation management services across Tasmania. Management of commercial plantation estates, carbon projects and independent advice to natural resource and renewables-based businesses.
Sustainable Timber Tasmania (STT)	Tasmanian government business enterprise – manages native and plantation forests, recreation and tourism facilities, roads and infrastructure, and carries out forest research and analysis either directlyor in collaboration.
Tasmanian Land Conservancy	A private fund which aims to protect areas with high conservation values for species which are not adequately protected on private land.
Timberlands Pacific	Provides expertise to manage large plantation forestsin Australia, and market forest products both domestically and internationally.
Wildcare Inc	Tasmania's largest environmental volunteer group supporting heritage conservation and reserve management, including many forested areas.

a) Listed in alphabetical order

Box 6.2.a. Case Study – landscape-scale integrated farm forestry demonstration sites program

In 2020 Private Forests Tasmania (PFT) provided more than $600,000 in grant funding to help establish a program to demonstrate landscape-scale integrated farm forestry. The program is intended to integrate commercial trees into productive farming properties that will complement and add to the landowners existing agribusiness activities.

The sites will form demonstrations of best practice establishment and management of shelterbelts and woodlots where the landowner will continue to have access to agroforestry information from PFT, and PFT will continue to have access to the planted trees and sheltered paddocks to showcase on field days and use for instrumentation and data collection.

After an open competitive process, seven Tasmanian farmers established more than 210,000 seedlings across a total of nearly 200 ha in the form of shelterbelts and woodlots. In many cases, the new plantings augmented or complemented existing native forest and/or plantations on the property or adjacent properties. Sites were prepared and planted in winter 2021. Mostly, *Pinus radiata* was planted, but there were smaller plantings of *Eucalyptus globulus*, *E. nitens*, *Acacia melanoxolyn* and other mixed species.

The project's strategic value includes the demonstration of best practice commercial tree plantings that are integrated on-farm and visible at a landscape-scale. This will help farm forestry to be better recognised by farmers as a legitimate farm enterprise alongside other traditional farm activities and be similarly recognised for its non-wood benefits to agricultural production systems and the environment.

The benefits of integrating trees on farms include improved soil, water and biodiversity, provision of shelter for livestock, rehabilitation of unproductive land and improved amenity aspects of the landscape whilst at the same time creating high-value timber products.

Case studies conducted by PFT, UTAS and CSIRO on selected Tasmanian farms demonstrated that farm systems which included trees were more productive and profitable. For example, at a farm in Epping Forest there was a 300% increase in lucerne hay yield which increased income by $1133 across a sheltered 7.7 ha paddock. At a farm near Cressy, the sheltered half of a paddock had 30% more biomass than the unsheltered half and on farms in York Plains, Carrick, Cressy and Jericho, shelter for livestock provided by tree shelterbelts increased lambing and fattening significantly.

Trees can also prepare farmers to be investment-ready for a carbon-neutral economy, as well as having the potential to earn additional income. Planting trees is one of the most effective methods of sequestering carbon and the Australian Government's Emission Reduction Fund provides opportunities to earn carbon credits through growing trees. Two of the seven properties planted in 2021 as part of the program have registered their new plantations with the fund to earn carbon credits. The success of the program has resulted in PFT announcing a second round of grants to the value of $600,000 to establish more trees on farms. The second round is being rolled out through 2022.

A PFT demonstration site located at Montumana Tasmania. Mounded soil in the foreground is ready to be planted in a shelterbelt configuration. In the background is a recently harvested area about to be planted into its second rotation. Both areas were planted with *P. radiata* (Image by Liam Beattie, Technical Forest Services)

Indicator 6.2.b Investment in research, development, extension and use of new and improved technologies

This indicator reports the level of investment and investment trends in research, development, extension and use of technologies to improve forest management for economic, social or environmental purposes.

Research and development are key drivers of innovation and are vital to ongoing industry competitiveness, sustainability and investment for economic, social and environmental values.

Tasmania's forests provide a wide range of services to the broader environment and provide valuable socio-economic opportunities to the communities that work in forest management and the businesses dependent on forest products.

Tasmania has developed strong expertise in forest sector research. Significant research has been undertaken during the reporting period 2016–2021 by a wide range of public and private organisations including:

- CSIRO
- STT
- UTAS (and other universities)
- National Institute for Forest Products Innovation (NIFPI)
- Tasmania's Regional Forestry Hub (the Hub)
- FPA
- Private Forests Tasmania
- ARC Centre for Forest Value
- Forico
- CLTP Tasmania (CUSP).

Many of the research institutions involved in forest sector research provide valuable training opportunities and their continued funding is essential if the forest industry is to realise its full potential. Research over the last five years has focused on areas that assist forest managers and businesses to ensure that the forests can continue to provide a wide range of benefits to society. Below is a sample of some projects exploring the use of new technologies to answer key questions.

Eagle Eye Project

This project, led by STT in collaboration with NRE Tas, Forico, FPA, Indicium, Midway Tasmania, Newood, Private Forests Tasmania, TasNetworks, Timberland Pacific, Reliance Forest Fibre, Resource Management Service, examined the application of the Internet of Things (IoT) to the management of the endangered Tasmanian wedge tailed eagle (WTE) in a landscape shared with industrial forestry operations and electricity transmission infrastructure.

Broadly, the IoT utilises sensors, communication networks and human interface systems to support efficient decision making. An IoT approach to monitoring WTE nest activity has the potential to increase economic activity and animal welfare outcomes whilst reducing the worker safety concerns and costs that are associated with the current helicopter-based nest activity checking practices. Passive infrared and ultrasonic sensors were tested to identify which was the most effective, efficient, reliable and robust to detect nesting activity by WTEs. Data from these sensors was collected via a network of wireless gateways (or portals) using industry standard long range radio

protocols, processed and stored in a cloud-based repository then reported through a web-browser based dashboard and corporate information systems (Microsoft's Power BI).

Success in this project would lead to information collected by an IoT solution that would enable forest and electricity network managers to make more timely and objectively informed management decisions around operations that may interact with WTEs, with improved productivity, reduced costs, increased safety and positive animal welfare outcomes, compared to the current regime.

The initial findings in this project indicated that the method has negligible impact on eagles, but further data collection on nest activity from nest trees with and without sensors is needed to confidently determine if this is indeed the case. An economic analysis comparing the costs of the current nest activity checking method (aerial surveys by an ecologist) with the Eagle Eye IoT method found a strong financial case in favour of the Eagle Eye IoT approach.

Opportunities for natural capital financing in the forestry sector

This report (Smith et al., 2020b), prepared by staff at the CSIRO, assessed the opportunities for natural capital financing as a source of funding for managing non-timber natural capital and the goods and services that flow (as ecosystem services) from forests to the economy and society. The report used the Tasmanian forest industry as a case study. The report defined 'natural capital finance' as the sub-set of sustainable finance that is directed specifically towards conservation, enhancement or maintenance of natural capital.

Forest operational decisions can have significant impacts – either positive or negative – on greenhouse gas emissions/carbon sequestration, nutrient cycling, water quality, air quality, and biodiversity, as well as timber production. The report highlighted that only some forestry natural capital stocks and flows – principally standing timber and harvested wood products – are measured and explicitly valued by forest managers and investors.

This report identified opportunities that apply to different types of forest and/or forest owners. The largest-scale opportunities relate to the growth in demand for responsible investment in new privately-owned sustainable forestry assets, which could be combined with a sustainability-linked loan scheme, and the potential to issue a green bond for improved natural capital management of publicly owned native forest. However, interventions aimed at small-scale private native forest owners could also have a large cumulative impact, due to the size of this sector in Tasmania. Typically, such interventions would require some degree of government or philanthropic support, possibly combined with new revenue streams from environmental markets. The report highlighted some examples that could be explored, including: working forest conservation covenants; developing an Australian Forest Resilience Bond; increased public funding for forest natural capital management; collaborative funding approaches to achieve landscape-level outcomes; blended finance; and new environmental markets.

Although each opportunity tends to have its own specific barriers, the report identified a number of generic actions that the forest industry could take to translate opportunities into reality. These include:

- identify the natural capital benefits provided by forest estates
- implement natural capital accounting and/or risk assessment, where appropriate
- engage with researchers and government-provided tools and data
- communicate natural capital benefits to stakeholders
- understand current and future financial opportunities

- identify new investable projects, activities and assets with the potential to improve natural capital benefits
- develop an impact theory
- map to sustainable development goals
- engage with policy makers and regulators
- consider natural capital risk.

The report highlighted that governments can play an important role in coordinating action at the landscape level. Suggested actions from the report include:

- understand landscape scale responses to natural capital risk, such as bushfire management
- implement landscape scale natural capital accounting
- consider scale and connectivity benefits
- consider innovative ways of meeting scaling requirements, for example a cross-sectoral or even multi-sectoral approach.

There is still a lot of work required in this field for both governments and private forest and landowners, but this initial report from the CSIRO provides useful indicators to where environmental finance is heading, and the potential opportunities for Tasmania to be at the forefront of this evolving structural change.

Nonparametric machine learning for mapping forest cover and exploring influential factors

The contribution of forest ecosystem services to human well-being varies across space following the dynamics of forest cover. Use of machine learning models is increasing in projecting forest cover changes and investigating the drivers, yet references are still lacking for selecting machine learning models for spatial projection of forest cover patterns.

This project (Liu et al., 2020) assessed the ability of nonparametric machine learning techniques to project the spatial distribution of forest cover and identify its drivers using a case study of Tasmania. The proponents developed, evaluated, and compared the performance of four nonparametric machine learning models: support vector regression (SVR), artificial neural networks (ANN), random forest (RF), and gradient boosted regression trees (GBRT).

The results of testing the four different models demonstrated the RF outperformed the other three models in both fitting and projection accuracy and required less computational costs. The project and the practitioners were encouraged by the nonparametric machine learning methods and promoted its use when facing problems of complex environmental data modelling.

Access to land and land use policy for plantation forest investment

The objective of this report (Greenwood Strategy, September 2020) was to undertake a strategic assessment of the factors affecting the forest growing and processing sectors in the context of land access and land use policy for north-north-western Tasmania. The broader context for the report was consideration of ways in which the total available future plantation timber resources in the region can be maintained and augmented, underpinning the long-term viability and sustainability of the region's forestry and forest products sectors.

The spatial analysis contained within the report determined that 37,000 ha of current agricultural land is (i) suitable and available, (ii) able to support plantations in competition with other land uses, and (iii) grow commercially viable plantations. This suggests that plantation forestry is close to capacity for the region, at least based on traditional industrial-scale forestry.

The report anecdotally estimated that the future reduction in the decline in plantation area planted in the region to be between 10,000 and 25,000 ha over the next five to ten years. The report highlighted there is neither the commercial will nor social licence to support industrial scale expansion into higher productivity agricultural areas and it is currently not possible under the State Policy on the Protection of Agricultural Land 2009.

The opportunities for maintaining and expanding plantation forestry in the region will rely on the ability to develop models for integrating forestry into the farming landscape in ways which recognise that smaller, independent landowners have a range of motivations for considering tree plantation and the policy and commercial solutions will need to be both innovative and flexible. The report found that a key ingredient for success is likely to be improving the forestry and forest products supply chain and market knowledge for smaller growers, to the extent that they feel confident and secure in making decisions about what to plant, how it will get to market and how the market will respond with respect to price. The report also highlighted the need to improve knowledge about and acceptance of the integrated benefits of trees on farms – not simply commercial timber production but broader agricultural productivity benefits and environmental services.

Climate change and carbon policy assessment report

The School of Ecosystem and Forest Sciences at the University of Melbourne was commissioned by the Tasmanian Regional Forestry Hub to provide a strategic assessment of how climate change and Australia's carbon policy impacts upon the current state of Tasmania's forestry sector, and to identify opportunities for growth and barriers to expansion of the sector.

The report looked at numerous aspects of the forestry sector in Tasmania and the various barriers and opportunities each area presented to the sector as a whole. The three areas of focus in the report were: carbon policy and Tasmania's forest, bioenergy and Tasmania's forest, and natural capital accounting. The report highlighted that the price for carbon needs to increase from the $15 to $20 per t range to provide encouragement to plant more plantation forests and that the numerous rules and restriction on the Emissions Reduction Fund being altered would also provide an incentive. This has, to some degree, occurred since the completion of this report.

Australian Research Council Centre for Forest Value projects

The ARC Centre for Forest Value (ARC CFV) provides research solutions to industry driven problems in the forest and wood products sector. The ARC CFV has undertaken a range of research projects spanning the vast forest and forest products value chain, including tree genetics, growing climate ready forests, forest silviculture, forest socio-economics, forest restoration and conservation, and wood and bio-products. The research produced by the ARC CFV at UTAS for the forestry sector highlights some of the key challenges and opportunites that are currently relevant to the plantation and native forestry sectors in Tasmania.

Over the past five years, the ARC CFV has published numerous journal articles and completed many research projects. The ARC CFV has many current projects still underway and they are built around various themes within the forestry sector. Projects completed during the reporting period include:

Measuring and assessing structural complexity in restoration plantings – Nicolo Camaretta

This project aims to establish and test a methodology to measure and assess forest structural complexity using a combination of remote sensing technologies and field surveyed data in Tasmanian Midlands, one of Australia's 15 biodiversity hotspot regions. Forest structure is commonly recognised to be a good indicator of biodiversity complexity, following the concept that ecosystems containing different stands with a broad variety of structural attributes are more likely to provide resources for a variety of species utilising them.

Recent literature on structural complexity indices and ways to measure and assess its main attributes using remote sensing technology has been reviewed. The project will investigate ecological questions in restoration planting a very complex area of forest research.

The business case for trees on farms – Zara Marais, PhD project

This project looks at the use of natural capital accounting as a way of measuring the varied benefits of trees on farms. This work will involve collating known benefits such as timber production and shelter benefits as well as calculating the potential economic value of other ecosystem services such as impacts of pests and predators.

Using developed models, this project will also assess how the benefits of trees on farms varies between planting timber production and native forest established for restoration/ecosystem services.

Silvicultural options to optimise the productivity of Eucalyptus nitens – Vilius Gendvilas

This project aims to enhance plantation productivity by understanding the effects of silvicultural management on growth and wood characteristics. In particular, this project will examine the effects of tree spacing and thinning on critical wood properties such as basic density, tension wood and modules of elasticity.

Non-destructive evaluation of plantation logs for segregation into different product types – Michelle Balasso

This project seeks to understand the opportunities to extend the use of the hardwood plantation estate in Tasmania for higher-value products such as sawn material, veneers and engineered wood products. To maximise these opportunities, it is important to understand the wood quality traits of the current resource.

The project aims to investigate wood quality traits of standing eucalypt trees, logs and boards using non-destructive techniques. The project works across the full value chain of growers, harvesters and processors to:

- investigate and map environmental effects on wood quality traits in fibre grown in *Eucalyptus nitens* plantations
- examine the capacity to sort and segregate trees and logs on a harvesting landing using non-destructive techniques to predict wood properties
- investigate the perceived and effective characteristics of the raw material impacting different products
- assess the volumes and value recovery of eucalypt sawn material for structural production
- investigate in-forest segregation systems to sort logs into different quality classes at harvest.

The outcomes of this research will enable a greater understanding of the characteristics of the fibre-managed eucalypt plantation resource, its suitability for different product types and its potential uses, while validating the use of readily available and novel technologies to test wood quality.

Ongoing ARC CFV projects include:

- Climate adaption capacity in Australia's declining woodlands – Meridy Price
- The impacts of assisted migration and translocation on community genetics in restoration ecology – Alice Grieve
- Forty spotted pardalote and manna gum: joining the spots to save an Australian endangered bird species – Erin Bok

- The determinants of optimal leaf area in eucalypt plantations – Rose Brinkhoff
- Development of an autonomous unmanned aerial system for below-canopy laser scanning of forests – Sean Krisanski
- Scaling up adoption of co-operative agroforestry among smallholders in Tasmania – Zoya Cheraghi
- Deer in forestry landscapes: Autonomous detection and deterrent devices for browsing management in forested landscapes – Alison Hayman
- Preferences for sustainable utilisation of forest residues – Bassie Yizengaw Limenih
- Applications for natural capital accounting in forestry – Isobella Grover
- Public perceptions of 'Off-Reserves' in Tasmanian production forests – Hasanthee Ampe Mohottige.

National Institute for Forest Products Innovation (NIFPI) projects

The National Institute for Forest Products Innovation (NIFPI) was co-funded by the Tasmanian and Australian Governments for a centre to be established in Launceston (other Centres were created in other jurisdictions with co-funding from the relevant state government). The initial funding from both governments was $2 million each and in-kind contributions from industry and research agencies brought the total to over $5.5 million.

As of June 2020, the projects supported by the Launceston NIFPI include:

Solutions for the optimal use of dense, remotely acquired data by forest growers (Jointly with Mount Gambier NIFPI Centre)

Rapidly advancing remote sensors on Unmanned Aerial Vehicle (UAV), airborne and satellite platforms are providing high fidelity spatial, spectral and temporal data. A trans-Tasman team of remote sensing specialists, data scientists and forest industry service providers will ensure the project delivery of multiple task specifications and procedures for the operational implementation of these technologies by the forestry sector.

Optimising machinery configurations for profitable harvesting operations of small-scale plantations

This project will provide guidelines and a web-based decision support system (DSS) to effectively select harvesting equipment configurations for smaller, more dispersed woodlots. This may improve profitability for landowners, contractors, consultants, forest companies and potential machinery co-operatives.

Conceptualise and develop a functioning model for collaborative integrated pest management within the Tasmanian forest industry

The project will develop an innovative, integrated pest management model to provide prompt information to stakeholders on pest and disease status across all land tenures, enabling timely and co-operative management activities.

Sensing technology and digital tools to support decision-making in hardwood timber drying

This project aims to develop and validate a timber drying technology suite with an accompanying decision support tool 'app' for higher value product recovery across the wider timber industry in Australia and overseas.

Increasing the durability and other material characteristics of Tasmanian hardwoods

This project focuses on increasing the desirable material characteristics of Tasmanian hardwood species, Tasmanian oak and plantation hardwoods, for use in several product groups: sawn

appearance board; cladding; veneer-based products and glue assembled products; glulam and cross laminated timber (CLT).

Developing a new generation of Tasmanian appearance hardwood products for in-State design and manufacturing

The project will develop a new generation of hardwood appearance products for manufacture in-state using current and new technologies from available native, reclaimed, and plantation resources.

Developing laminated structural elements from fibre-managed plantation hardwood

This project will develop the grading, jointing and gluing expertise and results necessary for producing structurally reliable glue laminated elements from a fibre-managed plantation hardwood resource.

A forest resource characterisation of Tasmania

This study assessed the feasibility of developing models to characterise the wood volume and wood quality of the Tasmanian hardwood estate. Better ability to model characteristics of the Tasmanian hardwood estate would provide valuable information to the forestry sector for both forest growers, timber producers, and end users.

The feasibility of developing statewide characterisation models was determined by reviewing the current, available data and methods used for collecting information on wood properties and volume. The availability of information on key drivers of variation in wood characteristics such as climate and environment was assessed. Key gaps in the capacity to create a complete forest characterisation of the Tasmanian hardwood estate and potential projects to address these gaps were identified.

Assessing the economic impact of damage to Eucalyptus nitens logs during mechanised harvesting operations

This project will deliver improvements to practices and equipment to reduce log damage to *Eucalyptus nitens* logs during mechanised harvesting, improving profitability for landowners, forest growers, contractors and machine manufacturers.

Managing timber's moisture content in the supply chain, construction and in service

This project aims to understand the moisture content of wood products and timber in the Australian timber supply chain and develop guidelines that allow industry to limit unacceptable moisture content variation and improve customer confidence.

Minimising market-limiting discolouration in appearance of Tasmanian hardwood

This project will investigate the cause of market-limiting, grey discolouration and 'tyre track' of plantation species *Eucalyptus nitens*, a future resource, as well as process-induced discolouration of appearance Tasmanian hardwood boards, particularly 'sticker mark' in Tasmanian Blackwood and Oak.

New methods of reliably demonstrating species durability in commercially relevant timeframes

This project will explore ways to demonstrate acceptable durability of natural and modified Tasmanian hardwood species in commercially relevant timeframes. The project will test material not covered by current durability standards and establish longer duration comparative trials of testing processes and material performance.

6.3 RECREATION AND TOURISM

This sub-criterion reports on the area of forest available for recreation and tourism, the range of uses and facilities available and the intensity of usage.

This indicator complements Indicators 6.1.a and 6.1.b and recognises that forests have diverse non-consumptive uses that are commercially, socially and culturally important. It is therefore important to monitor whether access is provided to forests for recreation or tourism.

Indicator 6.3.a Area of forest available for general recreation and tourism

Indicator 6.3.a reports the extent and proportion of forests available for recreation or tourism. For the purpose of this indicator, an area of forest is considered to be available for recreation and tourism if there is no legal or other form of prohibition of access for recreation and tourism activities. This includes areas where patrons may have to pay for public access to private land, such as a privately run wildlife park.

There has been little change in the availability of public forest for recreation and tourism in the reporting period.

The overwhelming majority of forested land managed under the *National Parks and Reserves Management Act 2002* is available for recreation and tourism. Recreation and tourism are statutory management objectives for most reserve classes 'to encourage tourism, recreational use and enjoyment consistent with the conservation of the reserve's natural and cultural values.' Recreation and tourism activities are not specifically excluded from nature reserves; rather they are not encouraged, as they are not within the management objectives for that reserve class.

In the case of the two private land reserve types – private sanctuaries and private nature reserves – the Director of National Parks and Wildlife is not the managing authority for these two reserve classes, and public access is a matter of the owner's discretion.

The total combined area of forest within nature reserves, private sanctuaries and private nature reserves is approximately 14,000 ha, which is just over 1% of the area of reserved forests.

Public access to a reserve can be restricted by the Director of National Parks and Wildlife through the declaration of a 'restricted area' in a statutory management plan. Access to these areas may be restricted year-round or on a seasonal basis. If there are year-round restrictions, access may be possible under a permit from the Director of National Parks and Wildlife. No further 'restricted areas' have been declared in the reporting period. As required, roads and tracks may be closed for safety reasons as well as environmental protection. Similarly, all reserves were closed to the public for six weeks from late March to May 2020 in response to the COVID-19 pandemic.

In private forest, some recreation such as camping, hunting and fishing does occur at the owner's discretion and there are also some small commercial tourism ventures on forested land.

The area of forested land available for general recreation has not changed significantly since the previous reporting period, when 1.244 million ha of conservation reserves and 359,000 ha of other publicly managed land was available. Some small areas (less than 1,000 ha) of the private reserve estate also remain available, including some commercial ventures.

Indicator 6.3.b Range and use of recreation and tourism activities available

This indicator reports the range of recreation and tourism facilities available in forests and how much the facilities are used. Some of these facilities are usually provided solely for recreation or tourism. These might include walking or riding tracks, picnic sites and campgrounds. Other facilities, such as roads and vehicular tracks are provided for a range of management purposes and are also available for use for recreation and tourism. Sources of information include Tourism Research Australia (2015), (2016) and Tourism Tasmania (2019), (2021).

Recreation facilities and activities available

Table 6.3.b.1 lists the recreation facilities and activities available on PTPZ land and reserves managed by the Parks and Wildlife Service (PWS). With the transfer of forest reserves to the PWS in 2013, many facilities previously recorded on PTPZ land are now reported under PWS management. Facilities managed by Sustainable Timber Tasmania on PTPZ land are listed in Table 6.3.b.2.

In addition to the activities listed, climbing, abseiling, caving, nature observation, photography and swimming are all further activities that occur in PTPZ land and parks and reserves. Hunting continues to be allowed on PTPZ land and on some reserve classes: game reserves, conservation areas and regional reserves. There have been few significant observed changes in the nature or level of these types of activities over the past five years.

Major investment in mountain bike facilities in forested environments were a feature of the past five years (Indicator 6.1c).

New mountain bike trail networks

In addition to the major mountain bike trail network developed in north-eastern Tasmania (Blue Derby), additional trail networks have also been developed in forested areas:

- A significant network of mountain bike trails has been completed at St Helens in the north-east of the state. This network features a series of eight interconnected trail loops totalling 70 km in the dry eucalypt forest inland of St Helens, as well as the longer 42 km Bay of Fires trail linking the Blue Tier to the Bay of Fires Conservation Area on the east coast.
- In 2019, $4.4 million was awarded from the Australian Government's Community Development Grant Programme to construct 80 km of network mountain bike trails across two sites. The Mount George network opened in late 2020, with the Tippogoree Hills component currently under construction.
- The Wild Mersey trails feature individual networks at Latrobe (Stage 1), Railton (Stage 2) and Sheffield (Stage 3), all linked via exiting and new purpose-built tracks. At the time of writing, the Latrobe and Railton networks were largely complete, with work continuing on the Sheffield trails and their connection to Railton.

The opportunities for recreation on PTPZ land are manifold. Sightseeing, walking, picnicking, fishing and camping remain the more popular recreational activities. Facilities for these, and other activities, are maintained wherever feasible.

Table 6.3.b.1 Type and number of facilities available for recreation and tourism in national parks and reserves – February 2022

Facility/activity	Data source/notes	Number in national parks and reserves
Disabled access	AMS[(a)] – 'walking track-PWS W1' asset type This is PWS W1 'wheel chair accessible' tracks. Other DDA compliant facilities (e.g. parking spaces, toilets) are not separately recorded).	32
Information/visitor centre	RSF[(b)] 'Day Use Comfort – Visitor Centre' classification	18
Toilets	AMS 'amenity building' asset group	128
Gas barbecue	AMS 'bbq' asset type (includes wood, gas and electric)	207
Wood barbecue		NSR[(c)]
Picnic shelter	AMS 'shelter basic' and 'shelter complex' asset types	198
Picnic area	RSF 'day use comfort – visitor centre' and 'day use comfort – mid' sites	216
Fireplace		NSR
Boat ramp	AMS 'boat ramp/slip' asset group	49
Lookout (platform)	AMS 'viewing area/platform'	190
Overnight walking tracks	Sum of length for W1 to T4 class from PWS walking tracks within RSF Bushcamping Backcountry and NMVS Some overlap with Day Walk and Short Walk categories	1,235km
Daywalk tracks	Sum of length for W1 to T4 class from PWS walking tracks within RSF Easy Access Camping and Day Use Get Away Some overlap with Overnight Walk and Short Walk categories	825km
'Short Walk' tracks	Sum of length for W1 to T4 class from PWS walking tracks within RSF Day Use Comfort Some overlap with Day Walk and Overnight Walk categories	130km
Camping area (vehicle access)	AMS 'campsite front country' asset group	249
Camping area (foot access)	AMS 'campsite backcountry' asset group	273
Caravan site	(included in Camping area – vehicle access)	NSR
Accommodation (walkers' huts)	AMS 'walkers hut' asset group	71
Accommodation cabins	AMS 'PA-accomm shared' asset type	30
Self-guided interpretation		NSR
Guided interpretation		NSR
Interpretation booths	AMS 'booth-information/rego' asset type	87
Wildlife observation hides	AMS 'hide-viewing' asset type	5
Education		NSR
Cultural heritage	PWS manages 37 Historic Site reserve types under the Nature Conservation Act, as well as many historic and Aboriginal heritage values and sites throughout reserves in Tasmania.	NSR
Mountain bike riding	AMS number of PWS sites containing 'mountain bike trail' asset group. In addition to specific mountain bike trails, mountain biking is authorised on many fire trails and roads within reserves, however this is not separately recorded.	108 trails
Trail bike riding	Registered trail bike riding is authorised on some tracks in some reserves but due to tenure changes this data is not available for all PWS-managed land. Public roads on PWS land are available to licensed drivers or registered vehicles.	NSR

Facility/activity	Data source/notes	Number in national parks and reserves
Recreational vehicle driving	Four-wheel driving is promoted on some tracks in some reserves (e.g. Arthur-Pieman Conservation Area, Mount Heemskirk Regional Reserve, St Helens Conservation Area, Southport Lagoon Conservation Area), however due to tenure changes, this data is not available for all PWS managed land.	NSR
Horse riding	AMS 'trail – horse riding' asset type. In addition to specific trails, horse riding is authorised on some fire trails within some reserve types, however this is not separately recorded.	8 trails
Boating	AMS 'boat ramp/slip' and 'jetty' asset groups	49 boat ramps/slip 64 jetties
Canoeing	Canoeing and kayaking is allowed on nearly all water bodies in most reserve types. However only specific infrastructure is provided (e.g. portage ropes on Franklin River, Slalom Gates and visitor facilities at Mersey White Water Regional Reserve) or is not recorded as being specifically for canoeing, kayaking or rafting (e.g. 4WD tracks providing access to river 'put-ins').	NSR
Fishing	Fishing is allowed on nearly all water bodies in most reserve types, however little specific infrastructure is provided or is not recorded as being specifically for fishing (i.e., walking tracks providing access to fishing areas)	NSR
Hang gliding	Known sites licensed for paragliding/hangliding, but not separately recorded in AMS	2
Playground equipment	AMS number of PWS sites containing 'playground equipment' asset type	8
Skiing (ski Fields with facilities)	Mount Field, Ben Lomond	2
Special events	PWS managed land is used for a large variety of recreational and cultural events, however centralised data on the number of these events is not recorded.	NSR
Licensed Tourism Businesses	Nature based tourism agreements over reserved Crown land	356

a) *AMS = PWS Asset Management System*
b) *RSF = PWS Reserve Standards Framework*
c) *NSR = data not separately recorded*

Table 6.3.b.2 Type and number and of facilities available for recreation and tourism on PTPZ land

Facility/activity	Number	Facility/activity	Number
Disabled access	3	**Self-guided interpretation**	0
Information/visitor Centre	2	**Guided interpretation**	1
Toilets	34	**Interpretation booths**	3
Gas barbecue	4	**Wildlife observation hides**	0
Wood barbecue	20	**Education[(a)]**	1
Picnic shelter	12	**Mountain bike riding[(b)]**	10
Picnic area	9	**Trail bike riding[(c)]**	-
Boat ramp	42	**Recreational vehicle driving[(d)]**	6
Lookout (platform)	3	**Horse riding**	7
Short walk	7	**Boating**	0
Day walk	2	**Canoeing**	0
Overnight walk	0	**Fishing**	0
Camping area (vehicle access)	3	**Hang gliding**	1
Caravan site	1	**Playground equipment**	0
Accommodation (walkers' huts)	0	**Skiing (ski fields with facilities)**	0
Accommodation cabins	1	**Licensed tourism businesses**	2

a) Areas where educational material is available
b) All public roads are available, STT figure includes areas where mountain bikes are commonly directed
c) FT/PWS all public roads are available for licensed riders and registered vehicles – figures represent tracks published in the Ride Around Tasmania booklet
d) All public roads are available for licensed drivers and registered vehicles

During the reporting period, the following major visitor services were undertaken by PWS in forested reserves:

- significant work replacing recreational assets (walking tracks, camping areas, signage) and roads that were damaged or destroyed in the 2018–2019 bushfires, particularly in the Tasmanian Wilderness World Heritage Area
- Cradle Mountain Lake St Clair National Park
  - completion of new entrance facilities and day use area at Cradle Valley
  - replacement of Waterfall Valley Hut on the Overland Track
  - planning for the replacement of Kia Ora and Windemere Huts on the Overland Track
- replaced Tahune Hut at Frenchmans Cap
- upgraded the Crescent Bay, Cape Raoul and Shipstern Bluff walking tracks, Tasman National Park
- South Coast Track – two years into the 4-year $2 million upgrade. Priority erosion control works were done on natural surface track, existing walking track infrastructure was repaired and new track infrastructure built.

Number of visits to recreational sites

The PWS manages over 800 parks and reserves in Tasmania. The PWS does not monitor visitors to all sites. Rather, the PWS maintain counts of visitors at 11 selected parks and reserves (called 'reference sites') across the state. Information from the reference sites gives a general idea of visitor trends generally (Table 6.3.b.3).

Over the long-term, visitor numbers have been increasing, until 2019 when COVID-19 reduced visitation. However, there have been periods of growth and decline in visitor numbers:

- visitor numbers generally rebounded from 2012 and increased steadily at most sites and peaked by 2019
- visitor numbers declined at nearly all reference sites from 2018 to 2020 due to COVID-19 and the closure of reserves
- visitor numbers were down around 16% across the state in the 2020–2021 compared to 2019–2020, and down 30% compared to 2018–2019, which was the last fiscal year before COVID-19.

Over the 23-year period since the RFA was signed, the tourism industry grew substantially in Tasmania. This growth is demonstrated by an increase in visitors to Tasmania, who are often the major source of activity at most of the reference sites monitored by the PWS (Table 6.3.b.3).

Table 6.3.b.3 Visitors to reference sites, visitors to Tasmania, and change in Tasmanian resident population, over the life of the RFA (1997–98, 2015–2016 and 2020–2021)

	Number of visitors (thousands)				Change in residential visitors since 1997–1998 (%)
Reference site	1997–1998	2015–2016	2020–2021	Change since 1997–1998	
Freycinet	146	272	265	119	82
Cradle Mountain	135	228[a]	170	35	26
Mount Field	134	189	170	36	27
Tasman Arch (Tasman Peninsula)	nc[b]	164	97	NA[c]	NA
Lake St Clair	83	94	72	-9	-13
Mole Creek Karst	52	55	25	-27	-52
Narawntapu (Western entrance)	31	46	61	30	96
Hastings Caves and Thermal Pool	25	46	25	0	0
Tamar Island Wetlands	nc	30	42	NA	–
Maria Island	13	23	33	20	154
Overland Track	7	9	8	1	14
Tasmania	485	1,168	574	111	18

a) Cradle Mountain – the estimate of 228,000 is for the 12 months ending March 2016
b) nc – data not collected in that year
c) NA – not available

Source: Tasmanian Visitor Survey, Tourism Tasmania

6.4 CULTURAL, SOCIAL AND SPIRITUAL NEEDS AND VALUES

This sub-criterion reports on the area of forest to which Indigenous people have use and rights to protect their special values and the extent to which these values are protected by Indigenous participation in forest management. It also reports on the protection of non-Indigenous cultural values and the importance of forests to people.

Indicator 6.4.a Area of forest to which Indigenous people have use and rights that protect their special values and are recognised through formal and informal management regimes

This indicator monitors the degree to which land is placed under appropriate tenure classifications or management regimes to protect Indigenous peoples' values in forests. An acceptable level of accountability for the protection of Indigenous peoples' cultural, religious, social and spiritual needs and values is an essential part of forest management.

Tenure

Aboriginal and Torres Strait Islander people have three main forms of rights and/or tenure over lands and waters in Australia, by which they can potentially derive some economic benefit. These are direct control or ownership, native title or Indigenous Land Use Agreements (ILUA). There have been no native title determinations within Tasmania and there are no registered ILUAs.

Currently, the only mechanisms for permanently returning substantial parcels of land to Tasmanian Aboriginal people are either land purchases by the Indigenous Land and Sea Corporation (ILSC) or the transfer of Crown land under the Tasmanian *Aboriginal Lands Act 1995*.

The ILSC is a corporate Commonwealth entity established under the *Aboriginal and Torres Strait Islander Act 2005* with the long-term vision of enabling Aboriginal and Torres Strait Islander people to enjoy the rightful entitlements, opportunities and benefits that the return of country and its management brings. The ILSC provides assistance for acquiring and managing rights and interests in land, salt water and fresh water country in order to achieve this vision. The ILC acquires and grants properties to Indigenous organisations and assists them to sustainably manage land and develop viable and sustainable land uses

The Tasmanian Government introduced the *Aboriginal Lands Act 1995* to grant certain parcels of land of historical or cultural significance 'for the benefit of all Aboriginal persons and in the interests of reconciliation with the broader Tasmanian community'. This Act established the Aboriginal Land Council of Tasmania (ALCT) as a statutory body to hold and manage land on behalf of the Aboriginal community in perpetuity. The ALCT promotes and supports the cultural aspirations of Aboriginal people and negotiates with the Tasmanian Government for the return of land, and for funding support to manage Aboriginal lands.

Under these arrangements more than 70,000 ha of land (Table 6.4.a.1) has been returned to Aboriginal people in Tasmania, with the majority of this land returned in 1995 and 2005. One of these areas, truwana/Cape Barren Island, contains large areas of forest. A number of these areas have been declared Indigenous Protected Areas (IPA). This is a voluntary agreement between the Indigenous owners and the Australian Government to promote biodiversity and cultural resource conservation. An IPA is declared in perpetuity by the Indigenous landowners on behalf of their community members, but does not affect land tenure. There are currently 8 recognised IPAs in Tasmania.

No areas of Crown land were transferred in the reporting period. Approximately 110 ha of private forest (gifted by the owners) on Tasmania's East Coast and 335 ha of coastal vegetation (including

dry forest) in the far north-west (purchased by the ALCT through a collaborative funding arrangement) was returned to Aboriginal ownership in 2019.

Table 6.4.a.1 Land owned or held by the ALCT, or by other Aboriginal community organisations, including land owned or subsequently transferred by the ILSC and private landowners

Mechanism	Total area (number of locations)
Land returned by the Crown under the ALA	55,597 (15)
Land returned by the Crown under the *Crown Lands Act 1976*	9 (2)
Land held by ALCT under lease from Crown	10 (1)
Land owned by ALCT following transfer from ILSC3 or non-Crown owners	8,702 (5)
Land transferred by ILSC to other Aboriginal communities	6,353 (5)
Land leased by ILSC to Aboriginal community organisation	235 (1)
Total	70,721

Source: *An improved model for returning land to Tasmania's Aboriginal people Consultation Paper on proposals for change.* NRE Tas 2022

Towards the end of the reporting period, the Tasmanian Government announced a review of the Act, which identified several potential improvements, including:

- extending the scope and intent of the Act to meet community expectations
- enabling broader and more inclusive representation on the ALCT electoral roll
- simplifying the process for land return by creating a new instrument of transfer for significant parcels of Crown land (see Indicator 6.5d)
- expanding provisions for local or regional Aboriginal community organisations to play a role in land management
- creating transparent processes and clear criteria for proposing and assessing land for return
- clarifying the role of the ALCT and requiring reporting of administrative and land management activity.

Management to protect Indigenous values

Formal and informal management regimes that recognise Aboriginal values have been established under legislation including, the *Aboriginal Heritage Act 1975*, the *National Parks and Reserves Management Act 2002* and the *Forest Practices Code 2020*. There are provisions in other Acts that also consider Aboriginal heritage.

Aboriginal Heritage Act 1975

All forest land on all tenures is subject to the *Aboriginal Heritage Act 1975* (formerly the *Aboriginal Relics Act 1975*) which is the main piece of state legislation affecting Aboriginal heritage. It is intended to provide protection for all Aboriginal cultural heritage as defined in the Act. The Act was amended in 2017, with six key changes:

- The name of the *Aboriginal Relics Act 1975* was changed to the *Aboriginal Heritage Act 1975*
- The 1876 cut-off date for what is considered Aboriginal heritage was removed, and the definitions were significantly updated

- The penalties for damage to Aboriginal heritage were sharply increased to be both in line with penalties related to non-Aboriginal heritage in Tasmania, and on par with the highest penalties in other states
- Scaled offences were introduced, including distinguishing between deliberate acts and 'reckless or negligent' acts. The ignorance defence was removed and the time available to commence prosecutions was increased from six months to two years
- A statutory Aboriginal Heritage Council was established to advise the Minister
- A statutory timeline was set for a full review of the Act, with a full review of the Act announced in 2021.

The statutory Aboriginal Heritage Council was established in August 2017, replacing the non-statutory Aboriginal Heritage Council that had been advising Ministers since 2012.

All members of the Council are from the Tasmanian Aboriginal community and have knowledge and experience in Aboriginal heritage management.

The Aboriginal Heritage Council provides advice and recommendations to the Minister for Aboriginal Affairs, the Director of National Parks and Wildlife, and stakeholders on the protection and management of Aboriginal heritage in Tasmania.

The Council takes a partnership approach in developing measures to promote community understanding and awareness of Aboriginal heritage in Tasmania, and its views are increasingly sought on a broad range of Aboriginal heritage matters including land and coastal management, academic research projects and legislative changes.

The *Aboriginal Heritage Act 1975* is intended to ensure that any action that affects Aboriginal cultural heritage (called 'relics' in the Act) is subject to strict investigatory, scientific and administrative controls. Under the legislation, all people have a duty to report finding Aboriginal heritage, and to deal with Aboriginal heritage only through the mechanism of a permit issued by the Minister, or recognised procedures approved by the Minister. Aboriginal Heritage Tasmania (AHT), within NRE Tas, administers the *Aboriginal Heritage Act 1975*. The part of the legislation relating to Ministerial permits has not been used in relation to forest practices during the reporting period, as forest practices are covered by an agreement ('agreed procedures') between FPA and NRE Tas, formulated after discussion between the FPA, AHT, forest industry representatives and other stakeholders (FPA, 2015).

It should be noted that the current *Aboriginal Heritage Act* 1975 does not regulate the full range of Aboriginal values identified under this indicator, nor does it include requirements for Aboriginal participation in forest management identified under Indicator 6.4.c. The *Environmental Management and Pollution Control Act 1994*, the *Land Use Planning and Approvals Act 1993*, the *National Parks and Reserves Management Act 2002*, the *Nature Conservation Act 2002*, and the *Forest Practices Act 1985* complement the *Aboriginal Heritage Act 1975*. The *Coroners Act 1995* also has specific provisions relevant to Aboriginal heritage, as do a number of other state Acts, including the *Aboriginal Lands Act 1995*, and the *Museums (Aboriginal Remains) Act 1984*. The Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* and the *Aboriginal and Torres Strait Islander Heritage Protection Act 1984* also affect how Aboriginal heritage should be dealt with in the state. All legislation relevant to the environment is likely to have some relevance to Aboriginal heritage protection.

National Parks and Reserves Management Act 2002

For all public reserve categories listed in Schedule 1 of the *National Parks and Reserves Management Act 2002*, the objective is 'to encourage cooperative management programs with Aboriginal people in areas of significance to them in a manner consistent with the purposes of

reservation and the other management objectives'. The management objectives for all reserves under the Act provide for the conservation of Aboriginal heritage values. The *National Parks and Reserves Management Act 2002* does not preclude Aboriginal cultural activities on reserved land.

Under the *National Parks and Reserves Management Regulations 2019* it is an offence to remove, damage, deface or disturb any Aboriginal relic. Informal arrangements are in place to facilitate Aboriginal cultural activities in some reserves.

The Tasmanian Wilderness World Heritage Area (TWWHA) Management Plan was completed and approved in 2016. The Management Plan gives increased recognition of Aboriginal cultural heritage and a greater emphasis on involving Tasmanian Aboriginal people in management of the TWWHA by investigating joint management arrangements. New activities proposed in reserves are assessed for impacts on Aboriginal sites and the Aboriginal community is consulted where there are known interests, in accordance with the *Tasmanian Reserve Management Code of Practice 2003*, under the PWS Reserve Activity Assessment system.

Forest practices system

The *Forest Practices Code 2020* provides for the assessment, planning, management and protection of Aboriginal heritage within production forests. In practice, Aboriginal cultural heritage found in forest coupes is protected or managed according to the prescriptions contained in the document *Procedures for managing Aboriginal Cultural Heritage when preparing Forest Practices Plans*, an 'agreed procedure' between the FPA and NRE Tas, developed through extensive discussions with representatives from the Aboriginal Heritage Council, Aboriginal Heritage Tasmania, the forest industry, the FPA and the Tasmanian Farmers and Graziers Association.

Forty new Aboriginal heritage sites were identified in forested land in the reporting period. Most of these were single stone artefacts or small scatters. Five were overhangs which may have served as Aboriginal shelters. Whilst no artefacts were found in these shelters, excavations might prove Aboriginal use. All sites were recorded on the Conserve Aboriginal database administered by STT and records were also sent to Aboriginal Heritage Tasmania (AHT) for recording on the Aboriginal Heritage Register.

Limited ground surface visibility in forested environments means that artefacts are almost impossible to detect before forest harvest. All artefact sites were located after harvest or during cultivation for plantations when mineral soil was visible. All newly found sites have been protected in informal reserves or machinery exclusion zones.

Given the difficulty of identifying Aboriginal heritage before forest harvesting, the level of disturbance to Aboriginal heritage during the reporting period is unknown, but is likely to be low as no public forest has been converted to plantations or agriculture over the reporting period, and only limited conversion of private native forest to other land use is permitted. Cultivation for plantations still occurs, generally for second and third rotations, but is generally by spot methods that expose less mineral soil than the mound ploughing that was widely used for initial establishment. Consequently, although surveys are specified for plantation land which meet the trigger criteria specified by the *Procedures for managing Aboriginal cultural heritage when preparing Forest Practices Plans* (FPA, 2015) few 'new' artefacts have been found because of these surveys.

As at 30 June 2021 about 20,200 ha of permanent timber production zone (PTPZ) land was allocated for Indigenous and non-Indigenous cultural heritage special management (of which about 5,900 ha was allocated for Indigenous cultural heritage value and the balance for other cultural heritage values). STT has two polices aimed at protecting Indigenous heritage and providing for access to PTPZ land for access to traditional materials (Sustainable Timber Tasmania, 2014b, Sustainable Timber Tasmania, 2018).

Indicator 6.4.b Registered places of non-indigenous cultural values in forests that are formally managed to protect these values

This indicator reports on the extent of public land that is specifically dedicated to the management of non-indigenous historic heritage values. These areas are managed for the heritage values that may relate to historic mining, timber-extraction or agricultural sites, as well as historic tracks, tramways, huts, fences and the like.

World Heritage

World Heritage listing identifies, protects and preserves sites of cultural and natural heritage considered to be of outstanding value to humanity.

Tasmania is home to five of the Australian Convict Sites placed on the World Heritage Property list in 2010, including three in forested reserves: the Coal Mines Historic Site (Tasman Peninsula), the Darlington Probation Site (Maria Island) and the Port Arthur Historic Site (which includes Garden Point and Point Puer).

No additional Tasmanian sites were added to the World Heritage Property list during the reporting period, nor any changes made to the boundaries of the Tasmanian Wilderness World Heritage Area.

Nationally listed places

Historic and natural places of national significance are listed on the National Heritage List, which prohibits any actions likely to have a significant impact on the heritage values of the places. This register comes under the provisions of the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*. In Tasmania there are six sites listed primarily for their historic values. Four of these sites are in forested areas or have forested components: the Recherche Bay (North East Peninsula) French exploration site; the Coal Mines Historic Site (Tasman Peninsula); the Darlington Probation Site on Maria Island and Port Arthur Historic Site (which includes Garden Point and Point Puer). There have been no Tasmanian additions to the National Heritage List in the reporting period.

State listed places

Historic places of state significance are listed on the Tasmanian Heritage Register (THR), which is managed by the Tasmanian Heritage Council with assistance from Heritage Tasmania in NRE Tas, through the *Historic Cultural Heritage Act 1995*. The Act prohibits any actions likely to have a significant impact on the heritage values of listed places.

There are over 5,000 places permanently entered in the THR. Of these, 150 are located on state reserves or Crown Land. A small number of places are also located on land identified as private timber reserve. The THR continues to assess significant places on both private and public land for inclusion on the THR.

Recognition of non-indigenous cultural heritage in Tasmanian forest areas has increased over the reporting period, with new and revised entries added to the Tasmanian Heritage Register that acknowledge an evolving relationship between people and the environment. Tasmania's rich mining history was recognised by the addition of the 53 km long Mount Cameron Water Race (THR6952), and the significance of the forestry industry has been acknowledged by the addition of the Kermandie Experimental Pulp and Paper Mill site (THR10123), the Crisp & Gunn offices and workshop, and the STT dome (THR12028). The use of public land for recreational purposes was recognised with a new entry for Halls Hut (THR10805), and the entry for Oura Oura (THR11875) acknowledges the growth of the conservation movement in Tasmania.

Under the *Nature Conservation Act 2002,* 29 places are designated Historic Sites, four of which are in forested areas. The forested sites cover approximately 7,870 ha. This remains unchanged from 2006 (although previous reports have under-reported the forested area).

Regulations governing the use of all reserved land under the *Historic Cultural Heritage Act 1995*. prohibit unauthorised removal, damage, defacement or disturbance of any object of archaeological, historical or scientific interest.

Historic heritage sites within formal reserves are managed in accordance with the *Tasmanian Reserve Management Code of Practice 2003*. Individual sites are identified and may be further protected by prescriptions contained within relevant reserve management plans. For example, the Macquarie Harbour Historic Site (15,300 ha, of which just over half is forested) is specifically protected by the Tasmanian Wilderness World Heritage Area Management Plan (DPIPWE, 2016). PWS has entered all known heritage places on parks and reserves in its Asset Management System.

On PTPZ land historic sites of significance are protected by informal reserves. Areas specifically zoned for the management of historic heritage are identified in the Management Decision Classification system as Special Management Zones for Cultural Heritage.

During the reporting period 2016–2021, foresters detected 140 new non-Indigenous cultural heritage sites. These have been recorded on the Historic Sites Register. There are now 5,018 sites recorded on the register, consisting of 4,528 point sites (e,g, huts, machinery, sawmill sites and caches of bottles) and 490 line sites (e.g. water races and tramways). The Register was previously curated by STT but is now in the process of being transferred to the FPA.

Individual historic sites on public and private land that are subject to FPPs are assessed and managed in accordance with the *Forest Practices Code 2020.* The Code requires that all sites found in the preparation of a FPP are recorded and protected. In practice, sites are managed according to the guidelines in the *Procedures for managing historic cultural heritage when preparing Forest Practices Plans* (FPA, 2017a), which constitutes an ‘agreed procedure’ between the FPA and NRE Tas.

Indicator 6.4.c The extent to which indigenous values are protected, maintained and enhanced through indigenous participation in forest management

This indicator reports the extent to which Indigenous people participate in forest management.

Aboriginal Heritage Tasmania (AHT), within NRE Tas, is responsible for maintaining the Aboriginal Heritage Register, recording newly found sites, and advising on 'permits to disturb' under sections 9 and 14 of the *Aboriginal Heritage Act 1975*. Permits are issued by the Director of National Parks and Wildlife or Minister for Environment, Parks and Heritage. AHT advises on survey and management of Aboriginal heritage sites and has been involved in site surveys and advising PWS in relation to Aboriginal site management in forests.

The document titled *Procedures for managing Aboriginal cultural heritage when preparing forest practices plans* was endorsed by the Aboriginal Heritage Council and recognised as an 'agreed procedure' between the FPA and NRE Tas in March 2016. It clarifies the responsibilities of FPOs and specifies procedures for managing and protecting Aboriginal cultural heritage in forests during coupe planning, harvest operations, and post-harvest operations such as cultivation.

Two courses have been run on Bruny Island to train FPOs in the identification and documentation of Aboriginal heritage. The courses were run on weetapoona Aboriginal Corporation land (Murrayfield Station) and the Chair of the Aboriginal Heritage Council was the main contributor to proceedings. FPOs who completed these courses qualified as FPA-endorsed Aboriginal heritage FPOs, allowing them to access Aboriginal information on the Conserve Aboriginal heritage database and to conduct surveys as specified in the *Procedures* document.

The Aboriginal Trainee Ranger Program that PWS commenced in 2010 has continued during the reporting period. Jointly funded by PWS and the Australian Government's Working on Country regional program, the program provides Indigenous people with training and competencies to enable them to move into ranger positions in PWS. Five trainees from one intake completed their traineeships in 2020–2021, and another two trainees have now commenced. The graduating trainees joined several other Aboriginal people employed in various roles in the PWS.

In 2018–2019, PWS initiated a cultural burning program employing two Aboriginal Fire Rangers and an Aboriginal Burning Project Officer. The program achieved cultural burns on the west coast of Tasmania and the development of a cultural burning policy and procedures to guide future cultural burning on PWS managed land.

PWS manages the Working on Country Aboriginal Ranger program, as a means of engaging Tasmanian Aboriginal people in the management of protected areas. Participants undertake a four-year development program, gaining dual qualifications in Conservation and Ecosystem Management, and Public Safety (Firefighting Operations), consistent with their major duties and projects. The Aboriginal rangers make a significant contribution to the PWS through cultural knowledge sharing, on country. Six rangers have now graduated the program and been made permanent employees of PWS.

All new PWS staff receive an introduction to Aboriginal values and heritage as part of induction programs. PWS staff also attend cultural awareness training programs to assist them in enhancing understanding of Aboriginal culture and developing good working relations with Aboriginal communities.

Within reserves established under the *Nature Conservation Act 2002*, sites of Aboriginal heritage importance are generally protected and interpreted, where appropriate and agreed by the Aboriginal community. Existing activities and new proposals in reserves that may impact on Aboriginal heritage values are assessed under the PWS Reserve Activity Assessment system and

managed according to guidelines in the *Tasmanian Reserve Management Code of Practice 2003*, including consultation with relevant Aboriginal groups.

During the reporting period, formal Aboriginal involvement in reserve management continued through dedicated Aboriginal community representation on reserve advisory committees, including the statutory National Parks and Wildlife Advisory Council and the Arthur-Pieman Conservation Area Management Advisory Committee.

Indicator 6.4.d The importance of forests to people

Forests are valued in the community for a range of attributes, from forests as a source of income and job security to broader values encompassing renewable resources, biodiversity, carbon capture and storage, clean air and water. From a socio-economic perspective, the forest industry remains a key component of regional communities in Tasmania. Tasmania has extensive areas of forested land within the formal reserve network. The total Tasmanian terrestrial reserved area was 3.428 million ha, or 50.3% of the area of Tasmania, as at 30 June 2021 (NRE Tas, 2021).

Tasmania has a total of 812,000 ha of PTPZ land managed to produce timber products. There are also over 100,000 ha of hardwood and softwood plantations, managed by STT and other forest managers. An additional land tenure was created to provide a 'wood bank' to provide for future sustainable forestry production under the *Forestry (Rebuilding the Forest Industry) Act 2014*. There are around 356,000 ha of Future Potential Production Forest (FPPF) land outside of the Tasmanian Wilderness World Heritage Area (TWWHA) (Tasmanian Government, 2020). Currently no FPPF land has been harvested. Harvesting timber would require a change from the classification of FPPF, by either exchanging FPPF land with PTPZ land such that the overall stock of FPPF land remains constant, or converting conversion (without replacement) of areas of FPPF land into PTPZ land.

STT released its updated Forest Management Plan (the Plan) in October 2019 (Sustainable Timber Tasmania, 2019a). The policy sets out how STT will manage the PTPZ land. STT will:

- operate in an environmentally, socially, and economically responsible manner
- actively engage with stakeholders
- strive to maximise recovery that minimises waste and prevents pollution
- undertake and support research so operational practices are underpinned by sound science
- meet or exceed relevant legislation and other requirements
- maintain a forest management system and conduct forest management in a manner that is certified to be compliant with ISO 14001, AS 4801 and the Australian Forestry Standard
- commit to actively work towards long-term incorporation of Forest Stewardship Council Principles and Criteria into the Forest Management System
- develop objectives and targets to achieve the strategic objectives in the Plan
- ensure that staff and contractors have the information, skills, training and resources to implement this policy
- regularly monitor, audit, review and publicly report on its performance
- commit to continual improvement in their sustainability performance
- communicate this policy and make it publicly available.

These policy statements reflect the changing community socio-economic expectations of forest management that STT are seeking to meet.

6.5 INDICATOR EMPLOYMENT AND COMMUNITY NEEDS

This sub-criterion reports on direct and indirect employment in the forest sectors and wage rates.The health and welfare of workers is critical to the forest industry and trends in work injury rates are also reported.

Indicator 6.5.a Direct and indirect employment in the forest sector

The forestry sector in Tasmania provides a range of employment opportunities across a range primary, secondary and services sectors. Employment and the forestry sector in Tasmania has remained steady over the last five years.

Forestry industry

During the reporting period, Dr Jacki Schirmer released the *Socio-economic impacts of the forest industry Tasmania, May 2018* (Schirmer et al., 2018). This report was based on Australian Bureau of Statistics (ABS) *Census of Population and Housing* from 2006, 2011 and 2016 and a survey conducted in 2017 and 2018. This data was then modelled by EconSearch using their RISE regional input-output model to provide estimates of direct and indirect employment in the forestry sector for Tasmania.

The Schirmer report estimated the direct employment associated with the Tasmanian timber industry as 2,714 people. A further estimated 362 direct jobs were generated by secondary processing activities as of August 2016. This means a total of 3,076 direct jobs were generated in the Tasmanian forest industry as of 2017–2018. The estimated flow-on employment generated by activities up to and including primary processing was an additional 2,651 jobs, which were generated in other industries as a result of demand generated from the forest industry. It is therefore estimated that 5,727 jobs were generated by the industry in 2017–2018.

The Schirmer report provides the most definitive data for employment in Tasmania for the forestry sector, albeit now over four years old. As a comparison, .idcommunity has developed a website that uses data from the ABS and regional econometric modelling developed by the National Institute of Economic and Industry Research (NIEIR). It should be noted that. idcommunity do not calculate indirect employment in their modelling, instead the Schirmer multiplier (1.98) from the May 2018 report is used to provide total employment comparison. The .idcommunity modelling is for the 2020–2021 financial year and provides an indicative insight into current employment in the forestry sector in Tasmania. Table 6.5.a.1 shows the modelled employment from .idcommunity for 2015–2016 and 2020–2021 and as a percentage of the total Tasmanian employed population. The model estimates were somewhat higher than those estimated by Schirmer, and indicated that employment increased slightly in the five years between the two estimates.

Table 6.5.a.1 Full-time equivalent employment in the forestry and timber sector, and change between 2015–2016 and 2020–2021

Full-time equivalent employment by sector	2015–2016	2020–2021	Change since 2015–2016 (%)
Forestry and logging	1047	932	–11%
Forestry support services	86	49	–43%
Wood product manufacturing	1195	1321	10%
Pulp, paper and converted paper product manufacturing	476	605	27%
Road transport – truck drivers	408	439	7%
Totals – direct	3,212	3,346	4%
– indirect employment (1.98 ratio)	3,148	3,279	4%
Total direct and indirect	6,360	6,625	4%
Total industries	189,261	202,394	7%
Percentage of total workforce (direct employment)	1.70%	1.65%	-0.05%

Source: .idcommunity

The release of key employment data from the 2021 ABS Census is scheduled for October 2022 and this will provide greater insight into employment across the forestry sector in Tasmania and its distribution across regional Tasmania.

The forestry industry supports a range of service providers to the industry, such as: suppliers, manufacturers, and maintenance providers of logging and wood processing equipment; fuel and fertiliser suppliers; financial and training service providers. Increased spending from wages earned also creates and supports jobs in other sectors, including in retail, hospitality, education, and health.

Apiary industry

There are no recent estimates of employment in the apiary industry. The *Tasmanian Beekeeping Survey: Fast Facts for 2018-19* quantified some key elements from the beekeeping industry in Tasmania, however, there was no data on the numbers employed within the industry (AgriGrowth Tasmania, 2019).

AgriGrowth Tasmania (part of NRE Tas) produced the *Bee Industry Futures Report, July 2019* (AgriGrowth Tasmania, 2019). The report noted that the Tasmanian Government has committed $750,000 over three years in its 2018–2019 Budget to 'Implement the Bee Industry Futures Report', including $500,000 for selected infrastructure upgrades to improve resource access. The report notes that the honey bee industry is not well understood in economic or statistical terms. Effective action by both government and industry will be greatly assisted by up-to-date information on current values for Tasmanian honey and wax products, and for pollination services.

The leatherwood resource that the honey bee industry has historically depended on has been under pressure for many years. The 2018–09 season further highlighted that the industry is vulnerable, particularly as climate trends produce warmer, drier summers and more dry lightning. The industry's dependence on a now precarious resource poses a fundamental challenge to the state's beekeepers. It requires a response including research into alternative business models and sources of bee sustenance.

These challenges will require consideration of opportunities for business diversification, identifying new markets, updating of current skills, and the training of a new workforce.

Research, development and innovation will also be needed as business models evolve and change.

Reserve management, tourism and recreation

The Parks and Wildlife Service (PWS) manages 49% of the land area of Tasmania which includes in excess of 2.9 million ha of land and water. In addition, PWS are also responsible for the Future Potential Production Forest (FPPF) lands. There were 373 full-time equivalent PWS employees at 30 June 2021. PWS work in partnership with the community, in particular with the Tasmanian Aboriginal community as the traditional and original owners, and continuing custodians of the land.

There are hundreds of businesses that operate within Tasmania's reserve area, providing employment opportunities across the state. Much of this employment is in rural and regional areas around the state. Previously highlighted in the report has been the enormous growth and interest in mountain biking in Tasmania and in the many reserve areas across the state. This type of tourism growth provides new business and employment opportunities to people in these areas.

Indicator 6.5.b Wage rates and injury rates in the forest sector

This indicator measures the level of wage and injury rates in the forest sector. A sustainable industry will ensure high levels of workforce health and welfare and wage rates comparable with national averages for equivalent occupations.

Wage rates

The Fair Work Ombudsman has developed the Timber Industry Award 2020 (Award) under which pay rates are updated from 1 July each year. The Award is the minimum rate that employees in the timber industry must be paid for undertaking a particular job (Table 6.5.b.1). It is not necessarily what employees are paid whilst working in those jobs as employers may pay above Award rates.

Table 6.5.b.1 Annual salary or wage rates in selected forestry occupations

Occupation category	Wage or salary June 2016 ($ per year)	Wage or salary July 2021 ($ per year)	Change (%)
Timber Industry Award 2020 – GeneralTimber Stream level 2	35,989	41,330	14.8
Timber Industry Award 2020 – GeneralTimber Stream level 3	37,367	42,910	14.8
Tasmanian State Service Band 6 Level 1 (General Stream, 2019 Tasmanian State Service Award)	86,230	98,358	14.1
Regional Manager (Parks and Wildlife) Band 8, Level 4 (2019 Tasmanian State Service Award)	117,979	135,790	15.1

Source: WorkSafe Tasmania

There is no data available that collates the total value of wages and salaries paid to Tasmanians working in the timber industry since the ABS ceased producing this type of data well over a decade ago.

The Tasmanian Department of Treasury and Finance summarises ABS catalogue number 6302.0 (average weekly earnings) when released. For the year ending May 2021, the average weekly ordinary time earnings (AWOTE) for a full-time person in Tasmania was $1,504. Over the previous 12 months AWOTE increased by 2.4%. Tasmania's AWOTE is 87.2% of the Australian average of $1,724. This has been consistent for well over a decade.

Injury rates

WorkSafe Tasmania reports injury frequency rates for Tasmanian industries against Australian and New Zealand Standard Industrial Classification (ANZSIC) industry codes. The injury frequency rate (also known as all claims frequency rate) is measured as the number of workers' compensation claims reported in any given year divided by the number of hours worked during the same year, multiplied by one million.

The injury frequency rate is calculated using data from WorkSafe Tasmania's statistical collections relating to workers' compensation. As the data covers only those injuries that result in a claim being lodged by a worker for compensation, the frequency rate of injuries may be underestimated.

Table 6.5.b.2 provides data on the injury frequency rate for selected forest industry sectors for the periods 2016–2017 to 2020–2021. The general trend for the previous five years for injury frequency rates in the timber industry is downward. An exception is the Log Sawmilling and Timber Dressing area of employment in the timber industry where the last three years have seen an increase in the injury frequency rates.

Table 6.5.b.2 Injury frequency rate (number of claims per million hours worked)

ANZSIC Code	Sector	2016–2017	2017–2018	2018–2019	2019–2020	2020–2021
152	**Converted paper product manufacturing**	6.5	42.0	23.5	12.8	24.8
30	**Forestry and logging**	36.0	40.8	25.4	27.7	27.1
141	**Log sawmilling and timber dressing**	35.0	25.2	43.6	62.1	39.1
149	**Other wood product manufacturing**	33.4	38.2	55.6	28.4	25.6
151	**Pulp, paper and paperboard manufacturing**	26.3	15.2	23.8	17.0	29.6

Source: WorkSafe Tasmania

Figure 6.5.b.1 shows the injury frequency rate over the past 15 years. Trendlines indicate the frequency rates have experienced a downward trend since the mid-2000s. Some sectors have, however, experienced more recent increases.

Fatality rates

This information for forestry and related timber sectors is not readily accessible, with WorkSafe Tasmania providing aggregated figures for the Agriculture, Forestry and Fishing industries when reported serious and fatal injuries from these industries and individual workplaces.

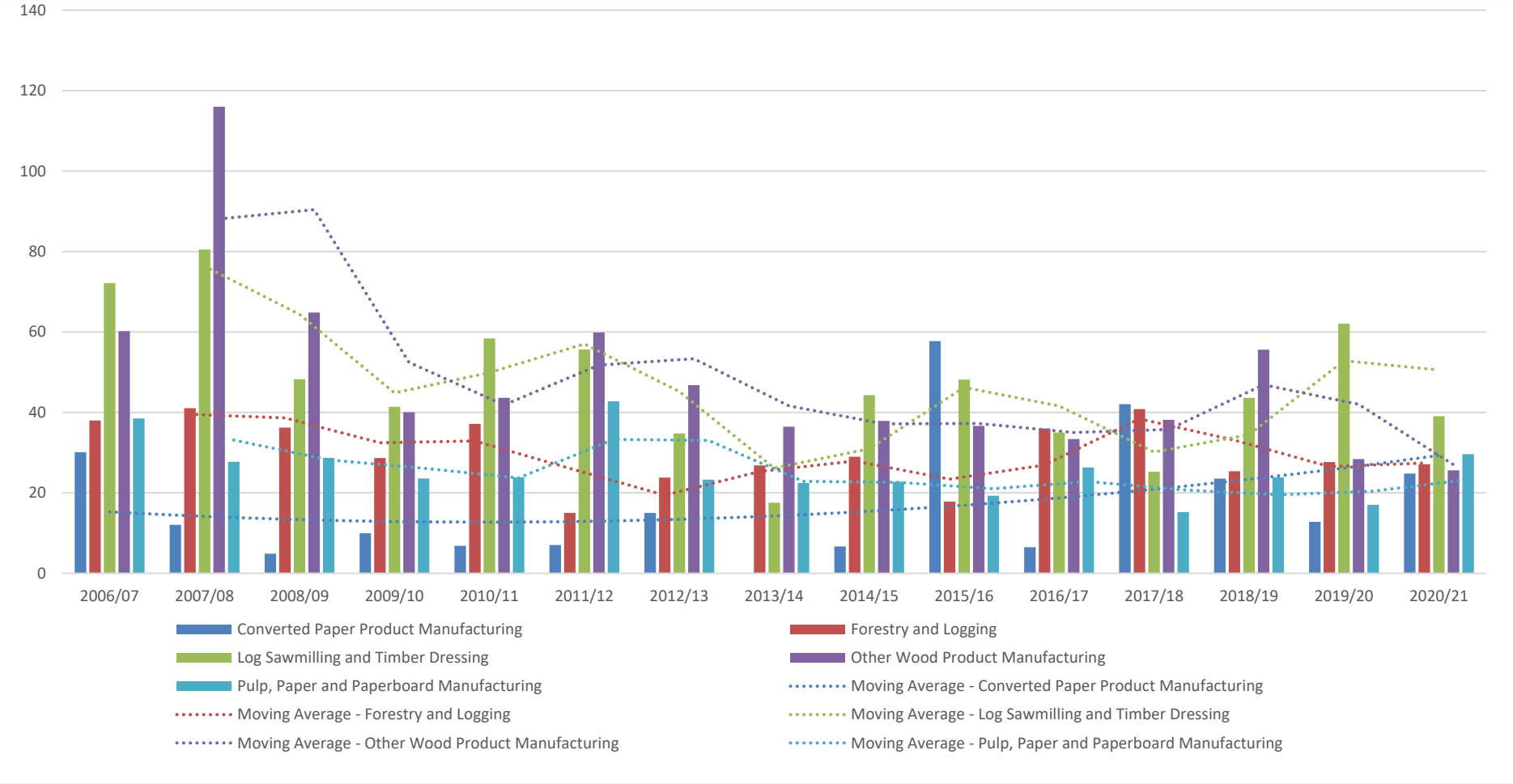

Figure 6.5.b.1 Injury frequency rate[(a)] trends, with moving trendline

a) Injury frequency rate = the number of workers' compensation claims reported in any given year divided by the number of hours worked during the same year, multiplied by one million.

Source: WorkSafe Tasmania

Forest Safety Code 2021

The *Forest Safety Code 2021* provides practical advice on how to manage workplace health and safety risks in the Tasmanian forest industry. This Code was first introduced in 2002, was updated in 2007 and reviewed in 2020. The review was a co-investment between the Tasmanian forestry industry and Private Forests Tasmania (PFT), overseen by a steering committee. The committee was chaired by PFT and comprised members from the TFFPN, STT, the Australian Forest Contractors Association, Lenah Estate and a representative of the Tasmanian Forest Industry Work Health and Safety Committee, with support from WorkSafe Tasmania. The review consisted of extensive consultation with stakeholders. The objectives of this review were:

- providing up-to-date guidance on high-risk activities and common hazards in current forestry operations
- updating Code references to the current Act and regulations
- eliminating inconsistencies with other legislation and Codes of Practice
- making the Code consistent with national guidance
- addressing the features of current Tasmanian forestry operations
- addressing emerging working patterns and technologies
- providing flexibility for different scales of forestry operations
- focusing on practical examples and advice to achieve safe and healthy outcomes.

Following this review, the updated *Forest Safety Code* was published in 2021 and came into effect on 2 March 2022. The new Code:

- is a Tasmania-only code of practice
- provides practical guidance on how to manage health and safety risks associated with forestry work; and how to achieve the standards required under the work health and safety laws
- applies to all workplaces where forestry work is carried out and anyone involved in these activities
- covers general safety principals for working alone, road access restrictions, operator competency, personal protective clothing, forest operations signage, onsite amenities, first aid, emergencies procedures, tools, work vehicles, tools, fire equipment and more
- covers chainsaws and brush cutters, manual tree felling, higher risk tree felling, mechanised felling, firewood cutting, log extraction. machinery, log landings, transportation, road construction and maintenance, silviculture, forest fire fighting
- covers human factors such as fatigue, dehydration, fitness for work, UV exposure, noise and more.

Indicator 6.5.c Resilience of forest dependent communities to changing social and economic conditions

This indicator provides a measure of the extent to which communities can respond and adapt to change successfully.

Forestry in Tasmania over the reporting period has seen generally consistent production volumes from both the native and private plantation estates. The continued harvesting and re-planting of these areas and the associated services required over the intervening years provide local employment opportunities to regional Tasmanian communities.

Tasmania has both softwood and hardwood plantations that when harvested provide materials for different markets both domestically and internationally. Softwood from pine plantations provides the timber for framing domestic housing construction. Recently, since the advent of COVID-19 and various policies introduced to stimulate the Australian economy, demand for timber for housing construction has been outstripping supply, causing price increases and delays in completing housing construction projects across Australia. This has not just been restricted to timber supply as many construction materials have also seen demand outpace supply.

Tasmania's largest softwood timber mill is in Bell Bay, located on the eastern shore of the Tamar River in northern Tasmania. The increased timber demand has been evident at the Bell Bay timber mill, highlighting the benefits that softwood plantation timber can provide to a local community. In December 2021, Timberlink announced a $63 million capital investment to expand the Bell Bay timber mill by more than 50% (https://www.timberlinkaustralia.com.au/), to support innovation and longevity in the softwood timber market. The project has been brought forward by two years to support additional supply into the Australian market. This announcement builds on the upgrades completed two years ago at Bell Bay on developing Tasmania's first Wood Plastic Composites manufacturing facility. These investments are expected to provide employment in the construction stage and, when completed, Timberlink expects that there will be an additional 18 permanent full-time jobs at the facility.

Tasmania also has a large estate of hardwood plantations both on private and public land. Investment and research into utilising this material in alternatives to export wood chips is underway.

Currently Tasmanian native forest timbers are utilised for high value appearance grade products used in the construction sector in Australia. The ability to supply this timber is becoming more difficult due to STT predominately harvesting re-growth native forest and not old-growth native forest where the large timber sawlogs used to come from.

Researchers are investigating using hardwood *Eucalyptus nitens* timber for appearance and structural grade timber products to offset the diminishing supply of high-quality sawlogs to the Tasmanian timber processing sector. CUSP have been developing a plantation structural timber product, the world's first certified plantation hardwood CLT (Cross Laminated Timber). This product uses *Eucalyptus nitens*, which is fast-growing, and harvestable in short 15-year rotations, compared to 25–30 years for softwood plantations. CUSP use *E. nitens* supplied from Tasmania's largest hardwood plantation estate manager Forico; an example of on-island processing of Tasmanian grown timber.

Forestry in Tasmania is continually evolving, providing opportunities and impacts on the predominately regional communities where most of this industry operates. As the timber sector has reduced over the last two decades from its peak, local communities have had to pivot to alternative industries for employment and social cohesion, notably tourism-based businesses that use the forests and co-exist within production forests.

The release of the 2021 ABS Census in late 2022 will provide detailed information on the key regions in Tasmania that have significant forestry businesses and employ local people. As previously alluded to in criteria 6.5.a, the ABS Census provides comprehensive detailed employment data by Local Government Area.

Indicator 6.5.d Resilience of forest dependent indigenous communities to changing social and economic conditions

This indicator considers the extent to which Indigenous communities are able to respond and adapt to changing social and economic conditions, ensuring they prosper into the future.

The Tasmanian Government is committed to resetting the relationship with Aboriginal communities. The reset agenda identifies five key priority areas which are informed by the themes of recognition, reconciliation and real outcomes. One of these priority areas that is relevant to this Indicator is to 'Explore joint land management arrangements and review the current land return model'.

There is widespread community and business recognition that managing land and forests by traditional Aboriginal methods can have long-term benefits for the environment and maintain the cultural heritage values that Tasmanian Aboriginal people have with particular places.

To date, over 70,000 ha of land in Tasmania has been returned to Aboriginal communities (Table 6.4.a.1). The *Aboriginal Lands Act 1995* (the Act) is the key Tasmanian legislation providing for the return of land and its management. Since the initial return of land in 1995, only a small number of additional land parcels have been returned to the ALCT under the Act. The Act is currently under review (see Indicator 6.4a) with one of the objectives being to improve the model for returning land to the Tasmanian Aboriginal people.

The Tasmanian Government is continuing to progress and support Aboriginal joint management of reserved lands in Tasmania by:

- funding of $200,000 per annum for joint management of reserved land, including a focus on the Aboriginal cultural values of the Tasmanian Wilderness World Heritage Area
- continued support for the Parks and Wildlife Service (PWS) Working on Country Aboriginal Trainee Ranger program, with an investment of $166,000 per annum towards funding of two trainee positions
- exploring options to develop a Cultural Burning Policy, the creation of new cultural burning positions in the PWS, and a trail grants program totalling $100,000.

An example of working towards joint land management was the first cultural burn at Dempster Pains on the west coast by PWS Aboriginal Fire Rangers. The Tasmanian Government continues to support Aboriginal cultural land management and burning practices, with the awarding of 10 grants to five Tasmanian Aboriginal community organisations as part of a $100,000 pilot Aboriginal Cultural Burning Program to help engage and build capacity in cultural burning practices.

STT recognises Tasmanian Aboriginal people as the traditional custodians of the land and the significance of heritage, including places, objects and stories, for maintaining continuous links with the land. STT acknowledges the historical, cultural and spiritual values of Aboriginal heritage in Tasmania's production forests and recognises its shared responsibility to conserve it (Sustainable Timber Tasmania, 2018).

STT's Aboriginal Heritage Policy objectives are to:

- foster positive and respectful relationships with local Aboriginal communities and relevant statutory bodies and agencies to inform and guide forest planning and management activities
- identify, protect and manage places of Aboriginal cultural significance in accordance with the *Forest Practices Code*, the Australian ICOMOS Burra Charter 2013 and the *Aboriginal Heritage Act 1975*

- explore and promote participation, economic and employment opportunities for Aboriginal communities to maintain the link with their heritage
- develop and implement appropriate training to assist staff gain an awareness of Aboriginal culture and allow for identification of Aboriginal heritage.

A review of the *Aboriginal Heritage Act 1975* by NRE Tas has been conducted and a review report released in March 2021 (DPIPWE, 2021). The feedback received and the Review Report is helping to inform the preparation of new Aboriginal cultural heritage legislation. The details of the new legislation are intended to be released for further consultation later in 2022. This will be in the form of a draft Exposure Bill. It is expected that this new legislation will have some similarities with legislation is other jurisdictions.

CRITERION 7: LEGAL, INSTITUTIONAL AND ECONOMIC FRAMEWORK FOR FOREST CONSERVATION AND SUSTAINABLE MANAGEMENT

This criterion and associated indicators relate to the overall policy framework that guides and directs the conservation and sustainable management of forests. It includes the broader societal conditions and processes which are often external to the forest, but which support efforts to conserve, maintain or enhance one or more of the conditions, attributes, functions and benefits captured in criteria 1–6.

Indicator 7.1.a Extent to which the legal framework supports the conservation and sustainable management of forests

This indicator reports on the evolution of the legal framework for management of forest on all land tenures in Tasmania, environmental management systems and community perspectives. It also addresses the extent to which transparency and public participation in policy and decision-making for the continuous improvement of forest management is ensured.

There are three primary elements to achieving ecologically sustainable forest management in Tasmania's approach:

- the *Forest Practices Code 2020* to ensure the achievement of sustainable forestry operations
- the development of a comprehensive, adequate and representative (CAR) forest reserve system to securely protect nature conservation values
- the maintenance of a permanent native forest estate to ensure that we maintain the resource base for all its various production, conservation and amenity values.

Production forest

The Tasmanian Regional Forest Agreement (RFA) is a 20-year bilateral agreement between the Tasmanian and Australian governments, signed on 8 November 1997. The Tasmanian RFA was varied on 18 August 2017 to extend its life to 8 November 2037 and to establish an automatic rolling life mechanism with subsequent five-yearly extensions contingent to satisfactory completion of five-yearly reviews. It is a framework document that underpins Tasmania’s forest management system. The RFA’s key principles are:

- ecologically sustainable forest management (the management of forest on all land tenures to maintain their overall capacity to provide goods; protect biodiversity; and protect the full suite of forest values at the regional level)
- certainty for conservation of the environment and heritage values (through the establishment and maintenance of a Comprehensive, Adequate and Representative reserve system)
- certainty of resource access for the forestry industry.

Under the Tasmanian RFA, the Tasmanian and Australian Governments agreed to establish a Comprehensive, Adequate and Representative (CAR) reserve system for forests, which meets the national agreed criteria to ensure long-term conservation and protection of Tasmania’s Forest biodiversity, old-growth forest and wilderness values (see Indicator 1.1c).

The *Environment Protection and Biodiversity Conservation Act 1999* (the EPBC Act) is Australia’s main federal environmental legislation. The EPBC Act is designed to protect and manage matters of national environmental significance. However, due to the comprehensive nature of the Tasmanian RFA and the Commonwealth fulfilling its duties in relation to the RFA for assessment of

environmental impacts prior to the RFA, virtually all forestry operations conducted in accordance with the RFA are exempt from the assessment and approval requirements of Part 3 of the EPBC Act.

The Policy for Maintaining a Permanent Native Forest Estate ensures (PNFE Policy) was first issued in 1997, in accordance with the Tasmanian RFA. The PNFE Policy ensures that Tasmania maintains a permanent forest estate that comprises areas of native forest managed on a sustainable basis both within formal reserves and within multiple-use forests across public and private land. The Policy enables the maintenance of the native forest resource base for all its various conservation, production, and amenity values by placing limits on broadscale clearance and conversion of native forest in Tasmania. The PNFE policy regulates how native forests are to be maintained as they are managed for a variety of uses. The maintenance of native forest refers to the limitations on clearance and conversion of native forest to other lands uses or non-native vegetation covers.

The Policy is implemented by the FPA through consideration of applications for approval of FPPs under the *Forest Practices Act 1985*. In the period 2009 to December 2015, the Policy was revised on several occasions to set a limit on the rate of clearing of native forest as the statewide level of retained forest approached the 95% level, to clarify terminology and implementation mechanisms, and to enable orderly completion of a comprehensive review. The Policy is reviewed in conjunction with the five-yearly review cycle of the Tasmanian Regional Forest Agreement.

To ensure the Policy and the RFA remain up to date, the Tasmanian and Australian Governments agreed that a full review of the Policy would be undertaken in 2015 as a related action to the RFA third five-yearly review and extension process. The review was extended in June 2016 leading to some minor amendments to the Policy to provide for the extension.

The review resulted in a simplification of the Policy in June 2017, moving from a threshold-based approach to a prohibition on broadscale clearing and conversion of native forest, other than in limited prescribed circumstances.

The *Forest Practices Act 1985* (the Act) is designed to ensure that forest operations are conducted in an environmentally acceptable manner on public and private forest. The Act forms part of a broader legislative and policy framework that provides a basis for sustainable forest management in Tasmania. The Act also includes the provision for private timber reserves (PTRs), which are a means by which private land holders can ensure the security of their forest resources without requiring permits under the *Land Use Planning and Approvals Act 1993.* At their peak in June 2012, there were 475,321 ha of private property dedicated as PTRs. This had decreased to 434,181 ha as of 30 June 2021. The gradual decline in area under PTRs since 2012 can be attributed to the harvesting of many managed investment scheme (MIS) plantations and subsequent conversion of the land away from forestry use and back into other agricultural uses.

The *Forest Practices Code* (the Code) was released in 1987 and has been updated in 1993, 2000, 2015 and 2020. The Code is a practical set of guidelines and standards for forest management, timber harvesting and other forest operations. It provides for the protection and management of environmental values and social values during forest operations, in particular: soils; geomorphology; visual landscape; water quality and flow; flora, fauna, genetic resources and cultural heritage.

The *Tasmanian Forests Agreement Act 2013* provided legislative backing to the 2012 Tasmanian Forest Agreement, negotiated by key forestry stakeholders, and created the concept of permanent timber production zone (PTPZ) land which replaced ‘multiple-use forest’, and which describes those areas of forest under the management of Forestry Tasmania (now STT). It also designated 500,000 ha of PTPZ land as Future Reserve Land and prohibited native forest timber harvesting from that land. Approximately 95,700 ha of Future Reserve Land has since been proclaimed as reserves

under the *Nature Conservation Act 2002*, 90% of which is coincident with the 2013 extensions to the Tasmanian Wilderness World Heritage Area.

The *Forestry (Rebuilding the Forest Industry) Act 2014* purpose was to repeal the *Tasmanian Forests Agreement Act 2013* and to provide for the invigoration of the forest industry. The main feature of the *Forestry (Rebuilding the Forest Industry) Act 2014* was the conversion of 399,000 ha of Future Reserve Land to Crown Land, to be known as Future Potential Production Forest (FPPF). The administration of the FPPF was transferred from STT to the Department of Primary Industries, Parks, Water and Environment (now NRE Tas).

The *Forest Management Act 2013* repealed the *Forestry Act 1920* and provides for the future management of the PTPZ land by STT as the Forest Manager. It reinforces that the Forest Manager must manage forestry operations within the PTPZ land consistent with the principles of forest management established under the *Forest Practices Code*. It also declared approximately 221,000 ha of forest reserves to be either regional reserves or conservation areas under the *Nature Conservation Act 2002*.

Private forest

A framework for ecologically sustainable forest management has been established at a high level for public land and adoption of the Montreal Process Criteria and Indicators provide a framework for assessment of current Tasmanian processes. The framework for private land is also comprehensive, but slightly less than for public land. Most commercial private forest managers and STT have established systems which ensure compliance with legislation as an integral management objective specified under independently certified ISO and environmental management systems standards. These organisations have also obtained or are seeking to obtain certification under the Australian Forestry Standard (AS4708, now AS/NZS 4708:2021) and/or the Forest Stewardship Council (FSC).

Reserved forest

The *National Parks and Reserves Management Act 2002* is the principal Act that sets out the management objectives for conservation reserves declared under the *Nature Conservation Act 2002*. The following mechanisms are in place for nature conservation reserves:

- legislated management objectives for reserve classes
- statutory management plans that require formal public consultation input from the statutory National Parks and Wildlife Advisory Council
- independent review of responses to public comment on draft management plans by the Tasmanian Planning Commission
- adherence to the *Tasmanian Reserve Management Code of Practice 2003*
- development applications subject to detailed environmental impact assessment processes.

The Tasmanian Wilderness World Heritage Area Management Plan was completed and approved in 2016 and covers nearly 25% of Tasmania. Work has continued on a general management plan, to cover all reserves without a statutory management plan (approximately 716). Approximately 65% of protected land managed under the *National Parks and Reserves Management Act 2002* by the Parks and Wildlife Service (PWS) is covered by approved management plans. This measure does not include private sanctuaries or private nature reserves, or the Port Arthur or Coal Mines Historic Sites. The Historic Sites have a management plan in place but are managed by another authority. Protected land includes both reserved inland and marine waters.

An alphabetical list of the main legislation relevant to sustainable forest management in Tasmania is provided in Table 7.1.a.1. In addition to the formal legislation, the Tasmanian and Australian

Governments have a number of regulatory instruments and policies that support sustainable forest management; these are listed in Table 7.1.a.2.

Table 7.1.a.1 Main legislation relevant to sustainable forest management in Tasmania as of 30 June 2021

Legislation[a]	Agency	Purpose	Tenures to which legislation applies
Aboriginal Heritage Act 1975	Department of Natural Resources and Environment	Provides for the identification and protection of all Aboriginal relics (sites)	All tenures
Aboriginal Lands Act 1995 (as amended in 1999)[b]	Department of Natural Resources and Environment	Promotes reconciliation with the Tasmanian Aboriginal community by granting to Aboriginal people certain parcels of land of historic or cultural significance	All tenures
Agriculture and Veterinary Chemicals (Control of use) Act 1995	Department of Natural Resources and Environment	Prevents restricted chemicals being used without apermit, stipulates labelling requirements	All tenures
Crown Lands Act 1976	Department of Natural Resources and Environment	Makes provisions with respect to the management,sale and disposal of the lands of the Crown	Crown lands
Environmental Management and Pollution Control Act 1994	Environmental Protection Authority	Establishes the 'duty of care' principle to prevent orminimise environmental harm. Defines potentially harmful activities requiring assessment and approval. Identifies notification requirements for environmental incidents	All tenures
Environmental Protection and Conservation Act 1999	Australian Government	Directly applies to all non-forestry operations. The RFA provides a means of implementation of the EPBC Act provisions through application of the *Forest Practices Act 1985*, the *Forest Practices Code* and 'agreed procedures' on threatened species management between NRE Tas and the FPA	
Fire Services Act 1979	Department of Police, Fire and Emergency Management	Provides for the control and use of fire in the urbanand rural environment	All tenures
Forest Practices Act 1985	Forest Practices Authority	Establishes the Code and forest practices system to provide for the sustainable management of forests on any land subject to forest operations. Requires production of an annual report and State of the forests report (every five-years). Provides for preparation of Three-Year Plans and forest practices plans. Provides for publication, enforcement and review ofthe *Forest Practices Code.* Provides for the establishment of private timber reserves on private land to provide security of long-term forestry use for landowners. Implements the Permanent Native Forest Estate Policy that controls clearance and conversion of native forest to other non-forest land	All tenures

Legislation[(a)]	Agency	Purpose	Tenures to which legislation applies
Forest Management Act 2013	Department of Natural Resources and Environment	Empowers Sustainable Timber Tasmania to manage and control PTPZ land and to undertake forest operation on that land for the purpose of selling wood products	PTPZ land
Forestry (Fair Contracts Codes) Act 2001	Department of Natural Resources and Environment	Provides for the approval of codes to improve the fairness of contracts within the forest industry, and to give such codes legal effect	All tenures
Forestry (Rebuilding the Forest Industry) Act 2014	Department of Natural Resources and Environment	Establishes and provides for the management of Future Potential Production Forest land and its possible future transfer to PTPZ land. Provides for the development of a special species management	PTPZ and FPPF land
Forestry Rights Registration Act 1990	Department of Natural Resources and Environment	Provides for the registration on land title of certain forestry rights	Any land with title
Historic Cultural Heritage Act 1995	Department of Natural Resources and Environment	Identifies, assesses and protects historic (post settlement) cultural heritage	All tenures
Inland Fisheries Act 1995	Department of Natural Resources and Environment	Provides for the management of inland fisheries and the protection of inland waters from substances likely to be injurious to fish	
Land Use Planning and Approvals Act 1993	Department of Premier and Cabinet	Establishes the Resource Management and Planning System for Tasmania. Forest practices on public land and forest operations on private timber reserves are exempt from the Act	All tenures
Mineral Resources Development Act 1995	Department of State Growth	Provides for the development of mineral resources consistent with sound economic, environmental and land use management. Mineral Resources Tasmania administers the approval of, and ongoing works on, exploration licences, special exploration licences, retention licences, production licences and mining leases under the MRDA	Private and some types of public tenures
Nature Conservation Act 2002	Department of Natural Resources and Environment	Regulates the conservation and protection of flora, fauna and geological diversity within Tasmania; classifies reserved lands in Tasmania and establishes values & objectives for each reserve class and provides for conservation covenants and reservation of private lands. Sets out the processes and criteria for compensation where a forest practices plan has been refused because of the presence of threatened native vegetation communities or threatened species.	All tenures
National Parks and Reserves Management Act 2002	Department of Natural Resources and Environment	Provides for the management of reserves under the *National Parks and Reserves Management Act 2002* according to management objectives for each reserve class	Reserves declared under the *Nature Conservation Act 2002*

Legislation[a]	Agency	Purpose	Tenures to which legislation applies
Natural Resource Management Act 2002	Department of Natural Resources and Environment	Outlines a collaborative framework to provide for effective natural resources management in Tasmania.	All tenures
Private Forests Act 1994	Private Forests Tasmania	Promotes the development of private forestry in Tasmania	Private land
Public Land (Administration and Forests) Act 1991	Department of Natural Resources and Environment	Provides authority to conduct public land use inquiries, approve planning schemes and report on state policies	Public land
Regional Forest Agreement Act 2002	Department of Natural Resources and Environment	Gives effect to certain obligations of the Commonwealth, to certain aspects of the National Forest Policy Statement. Created the Forest and Wood Products Council	All tenures
Regional Forest Agreement (Land Classification) Act 1998	Department of Natural Resources and Environment	Provides for the various categories of reserves	All tenures
Tasmanian Planning Commission Act 1997	Department of Premier and Cabinet	Established the Tasmanian Planning Commission and provides for related matters. The Tasmanian Planning Commission is an independent statutory authority that reviews, advises on, and determines a range of land use and development matters	Public land
Threatened Species Protection Act 1995	Department of Natural Resources and Environment	Provides for the conservation management of scheduled threatened species of flora and fauna	All tenures
Timber Promotion Act 1970	Department of Natural Resources and Environment	Established the Tasmanian Timber Promotions Board to promote the use of wood in Tasmania	-
Water Management Act 1999	Department of Natural Resources and Environment	Provides for the management of groundwater and surface water	All tenures
Weed Management Act 1999	Department of Natural Resources and Environment	Provides for management for weed control	All tenures
Work Health and Safety Act 2012	Department of Justice	Provides for the health and safety of people employed, engaged and affected by industry	All tenures

a) Ordered alphabetically

b) As of 1 August 2022, Aboriginal Heritage and associated legislation moved to the Department of Premier and Cabinet

Table 7.1.a.2 Main policies relating to forest management and conservation

Main policy[(a)]	Agency	Purpose	Tenures to which policy applies
1997 Tasmanian Regional Forest Agreement	Australian and Tasmanian Government	A legally binding 20-year agreement, with a five yearly review period, that applies to all of Tasmania and provides specific actions to create a balance between the environmental, social, economic and heritage values that forests provide	All tenures
2005 Tasmanian Community Forest Agreement	Australian and Tasmanian Government	Is a supplement to, and builds on, the RFA by increasing the reserve system and revitalising the timber industry	All tenures
Australia's Biodiversity Conservation Strategy 2010–2030	Australian Government	A national strategy for the conservation, sustainable use and the fair and equitable sharing of benefits arising from Australia's biodiversity	
Australia's Strategy for the National Reserve System 2009–2030	Australian Government	Provides national guidance to enhance establishment, planning, management, monitoring and community partnerships for the National Reserve System	All tenures
Australia's Sustainable Forest Management Framework of Criteria and Indicators 2008 – Policy Guidelines	Australian Government	Australia's framework of criteria and indicators of sustainable forest management based on the international Montreal Process	All tenures
Burra Charter 2013	Australian Government	Defines the basic principles and procedures to be followed in the conservation of Australian heritage places	All tenures
National Forest Policy Statement 1992	Australian Government	Provides a framework for the future management of forests. It has 11 broad national goals to ensure the community obtains a balanced return from all forest uses	-
Plantations for Australia: the 2020 Vision	Australian Government	Seeks to enhance regional wealth creation and international competitiveness through a sustainable increase in Australia's plantation resources	All tenures
Policy for Maintaining a Permanent Native Forest Estate	NRE Tas	Places a ban on broad scale clearance and conversion of native forest to meet one of the requirements of the Tasmanian RFA	All tenures
State policy on the Protection of Agricultural Land 2009	Tasmanian Planning Commission	Aims to foster sustainable agriculture in Tasmania by ensuring the continued productive capacity of the state's agricultural land resource	Private agricultural lands

a) In numerical then alphabetical order

Indicator 7.1.b Extent to which the institutional framework supports the conservation and sustainable management of forests

This indicator reports the extent to which institutional frameworks support the conservation and sustainable management of forests. It specifically looks at Tasmania's commitment to building community awareness, regional assessment and planning, and includes policy review as an essential basis for continuous improvement of sustainable management of forests.

The Comprehensive, Adequate and Representative (CAR) reserve system for forests and the forest practices system underpin the institutional framework in Tasmania. The maintenance of appropriate levels of human resource skills, the enforcement of laws, regulations and guidelines and the adoption of forest certification are mechanisms that demonstrate Tasmania's commitment to sustainable forest management.

The Comprehensive, Adequate and Representative (CAR) reserve system

Under the Tasmanian RFA, the Tasmanian and Australian Governments agreed to establish a CAR reserve system for forests, which meets the national agreed criteria to ensure the long-term conservation and protection of Tasmania's forest biodiversity, old-growth forest and wilderness values.

The CAR reserve system was built on Tasmania's pre-existing reserve network, through the addition of new reserves on both public and private land. The reserve system has been further extended through a range of programs and agreements. Those relevant to forest management include:

- the 2005 Tasmanian Community Forest Agreement
- the 2010–2013 Tasmanian Forest Agreement process
- the Crown Land Assessment and Classification Project
- various private land conservation programs.

The reserve system extends over land, inland waters, estuaries and marine areas and includes both public and private land.

A Tasmanian Reserve Estate (TRE) spatial layer has been created by NRE Tas to be used as the authoritative source of information on the extent, type and distribution of the reserve system in Tasmania. The business rules for compiling the TRE spatial layer have been documented to ensure the layer is updated in a consistent manner and to provide users with clear information on attributes of the Tasmanian reserve system. The TRE spatial layer includes reserved land managed by the PWS and STT, other reserves on public land, reserves on private land and Wellington Park. As of June 2021, the TRE spatial layer indicated that 3.427 million ha, or 50.3% of the land area of Tasmania, was part of a reserve. Of this, 3.265 million ha of reserves are on public land and the PWS manages 806 reserves covering about 2.860 million ha, or about 40% of the land area of the state (excluding marine areas).

The TRE spatial layer supports natural resource management planning, prioritisation, reporting and decision-making and has been explicitly created to provide the basis of reporting statistics for:

- the CAR reserve system
- state and national State of the Environment and State of the Forests Reports
- the National Reserve System
- Collaborative Australian Protected Area Database (CAPAD)
- Marine Protected Areas reporting

- government annual reports
- the forest practices system.

Development and maintenance of skills

The requirement to develop and maintain essential skills is recognised by Tasmania's forest managers as necessary to support sustainable systems and practices. These skills include relevant tertiary and technical training in forest practices, operational competencies, safety, fire management and visitor services.

Ongoing support for continuing development of existing and new employees' skills is promoted through training opportunities across a wide range of disciplines. Opportunities are provided through Tasmania's public educational institutes (UTAS, Skills Tasmania and TasTAFE), training organisations (such as ForestWorks), and FPA courses. Staff from forest management organisations attend training to ensure skills relevant to conservation and sustainable forest management are current. This includes FPA training courses on subjects such as biodiversity, soil/water and cultural heritage.

The PWS pursues recognised training that is aligned to functional roles, particularly around fire management. Registered Training Organisation (RTO) partners include Handa Training Solutions, Tasmania Fire Service, TasTAFE and several aircraft operators.

Table 7.1.b.1 lists the responsibilities and key policies of major organisations that manage forests on public and private land.

Table 7.1.b.1 Responsibilities and major policies of major organisations which have managed forests during all or part of the reporting period

Name of organisation[(a)]	Responsibilities – forests and tenure	Major non-legislative policies relevant to the organisation
PRIVATE LAND		
Forico Pty Ltd	Eucalypt and pine plantations, and native forest owned by New Forests Pty Ltd and joint ventures with independent private owners	Chain of Custody Standard Environmental Sustainability Policy Work Health and Safety Policy
Norske Skog[(b)]	Pine plantations and forests managed by Norske Skog (Australia) Pty Ltd	Chain of Custody Policy Environmental Policy Forest Management Plan OHS Policy Permanent Forest Estate Policy, Quality Commitment Policy Sustainable Forest Management Policy
Reliance Forest Fibre	Management of eucalypt plantations and native forest on private and public land. Private land component previously managed by RMS and public land previously managed by STT.	RFF Environmental Management Policy RFF Forest Management Policy RFF Occupational Health Safety & Rehabilitation Policy
RMS Timberlands Australia Pty Ltd	PF Olsen (Forest Management)	Clients and Community Policy Environment and Sustainability Policy Good Neighbour Protocol Learning and Continuous Improvement Policy Taswood Special Values Management Plan Taswood Cultural Heritage Management Plan Timberlands Pacific Forest Management Plan

Name of organisation[a]	Responsibilities – forests and tenure	Major non-legislative policies relevant to the organisation
		Workplace Health and Safety Policy
SFM Environmental Solutions	Management of pine plantations and native forest on private and public land previously managed by Norske Skog from 30 June 2020.	SFM Aggregated Plantations Program SFM Environmental Management System SFM Forest Certification SFM Safety Management System
Tasmanian Land Conservancy	Private land purchased for conservation purposes	Formal management plan for each Reserve
PUBLIC LAND		
Norske Skog[b]	Forests managed by Norske Skog (Australia) Pty Ltd	Environment Policy Forest Management Plan Chain of Custody Policy OHS Policy Permanent Forest Estate Policy Quality Commitment Policy Sustainable Forest Management Policy
NRE Tas (Parks and Wildlife Service)	Manages 49 per cent of the land area of Tasmania which includes in excess of 2.9 million hectares of land and water.	Parks and Wildlife Strategic Plan 2018–2021
NRE Tas – Property Services (formerly Crown Land Services)	Future Potential Production Forest land (FPPF)	Reserve Activity Assessment System Environmental Risk Management Policy Tasmanian Reserve Management Code of Practice
Reliance Forest Fibre	Management of eucalypt plantations and native forest on private and public land. Private land component previously managed by RMS and public land previously managed by STT.	RFF Environmental Management Policy RFF Forest Management Policy RFF Occupational Health Safety & Rehabilitation Policy
SFM Environmental Solutions	Management of pine plantations and native forest on private and public land (Lenah Estate) previously managed by Norske Skog. Change in ownership of the private land component and management control of the estate took place on 30 June 2020.	SFM Aggregated Plantations Program SFM Forest Certification SFM Environmental Management system SFM Safety Management System
Sustainable Timber Tasmania	Permanent Timber Production Zone land	Aboriginal Access to Traditional Materials policy Aboriginal Heritage policy Communications & Stakeholder Engagement policy Complaints policy Chain of Custody policy Customer Service Charter Forest Management Plan Giant trees policy Good Neighbour Protocol High Conservation Values Management & Assessment plan Information disclosure policy and procedure Permanent Native Forest policy Pesticide Use policy Public Authority Management Agreement Recruitment and Selection Policy Stakeholder Engagement Operational Approach

Name of organisation[a]	Responsibilities – forests and tenure	Major non-legislative policies relevant to the organisation
		STT, Tasmanian Beekeepers Association & Australian Honey Bee Industry Council Memorandum of Understanding
		Sustainable Forest Management Plan
		Work Health Safety and Wellbeing policy
Timberlands Pacific	Pine plantations managed by Timberlands Pacific on behalf of New Forests	Fuel and Oil Policy
		Safety and Environmental Policy
		Standard Operating Procedures

a) Alphabetical within private and public land

b) As at 30 June 2021 Norske Skog sold their Estate to New Forest. New Forest land is under management by SFM Environmental Solutions.

Forest management by tenure

STT is the Tasmanian Government business enterprise responsible under the *Forest Management Act 2013* for sustainably managing approximately 812,000 ha of public forest on the PTPZ land. All elements of the way that STT manages its lands are described in its Forest Management Plan.

The PWS manages nearly all (~87%) of public reserves in the TRE spatial layer. The Future Potential Production Forest (FPPF) land has been administered by Property Services, an organisational branch within PWS. Management of formal reserves is subject to the N*ational Parks and Reserves Management Act 2002* and National Parks and Reserves Management Regulations 2019. The *Tasmanian Reserve Management Code of Practice 2003* is used in reserve management by the PWS.

Table 7.1.b.2 indicates the extent to which sustainable forest management provisions are integrated within institutional policy frameworks on public and private lands. Overall, there is a strong commitment to integrating such policies irrespective of land tenure. However, there are differences which reflect management objectives and practical issues. The variability of integration of such policies as applied on private forest land reflects the spectrum of forest management systems employed, and is generally more exhaustive.

Over the reporting period, many of the smaller professional forest managers who manage private properties have adopted formal environmental management systems, in common with the larger private industrial companies operating on their own freehold land (see Certification below).

Table 7.1.b.2 Extent[(a)] of the sustainable forest management provisions in institutional policy frameworks

Extent to which the non-legislative policy framework provides for:	PTPZ land	Private land
Accountable management body	Y	P
Dispute resolution process	Y	P
Forest management planning	Y	P
Management review	Y	P
Planning for environmental values	Y	P
Planning review	Y	P
Policy review	Y	Y
Property rights	Y	Y
Periodic assessment of forest related resources	Y	P
Public participation		
Broad based public consultation for forest related policy	Y	Y
Broad based public consultation to develop forest related managementplans	P	P
Publication of specific forest-relatedinformation	Y	P
Allows public access to information related to forests	P	P
Indigenous participation		
Indigenous participation inmanagement	P	P
Indigenous participation in planning	P	P
Recognises cultural values	Y	P
Recognises native title rights	Y	P
Recognises the customary and traditional rights of Indigenous peoples	Y	P
Allows traditional management onrelevant public land (e.g. joint management/ co-management)	P	N
Allows access[(b)] for traditional activities	P	N
Allows access to Indigenous culturalheritage	P	P
Allows the performance of traditional practices	P	P
Allows for the protection of Indigenous intellectual property	Y	Y
Other aspects		
Recognition of scientific values	Y	Y
Recognition of voluntary reserves on private land	-	Y
Regulation of forest clearing	Y	Y
Resource assessment	P	P
Secure land tenure	P	Y
SFM an explicit objective	P	P

a) Y = Yes (SFM is covered fairly comprehensively by policies); P = Partly (SFM is partially covered or has limited application); N = No (SFM is not covered by policies in this tenure)

b) Access includes an ability to enter and undertake activities such as foraging, hunting, or ceremonial.

Cross-sectoral involvement

Cross-sectoral involvement means the cooperation and sharing of information among public agencies, private companies, and the wider community. Table 7.1.b.3 provides a summary of the area for which management plans have been developed and in which cross-sectoral involvement occurs during the development of the plans.

Table 7.1.b.3 Area of land under local and regional management plans, cross-sectoral involvement 2020–2021. (Note: the areas are land area, not forest area)

Forest Manager	Area under management plan (ha)	Does cross- sectoral involvement occur in the development of the plan?	What is the review period for the management plan?	Is the plan integrated with other aspects of resource planning?
Sustainable Timber Tasmania	0.8 million	yes	10 years	yes
Parks and Wildlife	1.7 million	yes	5–10 years	yes
Professional forest management companies	0.3 million	yes	various	yes
Private forest owners	Unknown	NA	NA	NA
Private forest reserve programs (areas under conservation covenant)[a]	109,570	yes	dependent upon program	yes

a) Private Land Conservation Program, NRE Tas (nre.tas.gov.au)

During the reporting period, a total of 10,870 ha of land was newly registered under conservation covenants. This area includes both forest and non-forest vegetation. Forest areas within the private covenant estate are required to be managed in accordance with the individual covenant terms and associated management plans, which typically place restrictions on the clearing of native vegetation and require land management issues such as weeds to be addressed.

Community consultation

Ensuring the community is informed about, and engaged in, public forest management decisions is fundamental to effective institutional forest management and conservation systems.

The *Forest Practices Act 1985* ensures regional consultation and planning through the mechanism of three-year plans. Any entity who anticipates harvesting more than 100,000 t of timber in a given year must prepare a plan detailing the harvest locations, expected timber volumes, cartage routes, and reafforestation measures and provide it to the FPA and local government authorities affected by the harvest or cartage.

Community involvement in private forest management (as defined under the *Forest Practices Act 1985*) is mandatory under Section A3.2 of the *Forest Practices Code 2020*. In addition, provisions under both AFS and FSC certification require community consultation.

Enforcement of laws, regulations and guidelines

Government agencies with legislative authority to undertake investigate and measure compliance against legal instruments include:

- the FPA which undertakes annual audits of a subset of FPPs and investigates potential breaches. It has the authority to apply sanctions where breaches of the *Forest Practices Code 2020* and the plan have been identified. Investigations can be carried out by any Forest Practices Officer (FPO). There were on average 160 FPOs accredited with the Authority during the reporting period 2017–2021 (Table 7.1.b.4)
- NRE Tas (Environment Strategic Business Unit) which employs five (2022) trained Enforcement and Compliance Officers to ensure compliance with its Acts and Regulations
- the PWS which has four dedicated Compliance Officers responsible for major investigations, and the coordination of compliance activities across the state. In addition, there are 280 Authorised Officers trained to undertake compliance duties with PWS, however many of

these officers may not have the capacity to undertake regular compliance duties as part of their role.

Forest Practices Officers (FPOs)

Under the regulatory framework established through the *Forest Practices Act 1985*, the forest industry has a responsibility to adequately supervise and monitor its forestry operations to ensure compliance.

The FPA accredits FPOs who have legislative authority under the *Forest Practices Act 1985* to undertake compliance and enforcement activities across all tenures where forest activities are contrary to the Act or the *Forest Practices Code 2020*. Consistent with the co-regulatory approach, FPOs include employees of private companies and public agencies, private contractors, and self-employed individuals. All FPOs are trained and authorised by the FPA. Most are employed within the industry to plan, supervise and monitor forest practices, although their responsibility when acting as an FPO is to the FPA. Their roles include planning, supervision, monitoring and reporting on forest practices and ensuring that operations comply with the *Forest Practices Act* and the Code.

The number of FPOs accredited and warranted to supervise and monitor forestry operations to ensure that they comply with the *Forest Practices Act 1985* varies over time, according to economic and other factors. The number has remained relatively constant over the current reporting period (Table 7.1.b.4).

Table 7.1.b.4 Number of FPOs authorised to undertake compliance and enforcement activities

Financial year	Number of FPOs
2006–07	220
2007–08	244
2008–09	228
2009–2010	225
2010–2011	234
2011–2012	193
2012–2013	194
2013–2014	196
2014–2015	195
2015–2016	199
2016–2017	150
2017–2018	161
2018–2019	171
2019–2020	158
2020–2021	158

Certificates of Compliance for forest practices plans

Since 1999, compliance reports must be lodged with the FPA within 30 days of the completion of operations prescribed within an FPP. Compliance reporting began in 2001–02. Reports provide evidence that an FPP:

- fully complied with all provisions of the plan
- did not fully comply with all the provisions of the plan
  - no further action required; this generally involves a change in the operation which does not result in any adverse long-term environmental harm, such as the stocking

standard in a plantation being below the target specified in the forest practices plan but still at an adequate level to achieve site occupancy.
  - the matter was resolved through corrective action; this generally means that the FPO undertaking the final compliance check has detected non-compliance and has issued a notice under the Forest Practices Act to require corrective action to ensure compliance with the plan.
  - further action required; this generally involves a non-compliance issue that requires further investigation and action by the FPA.
- or FPP operations did not commence.

Further changes to the *Forest Practices Act 1985* implemented from 1 July 2005 required reports on compliance to be lodged within 30 days of the completion of each discrete operational phase within the FPP. Discrete operational phases include activities such as road construction, harvesting and reforestation.

For the current reporting period, an average of 86% lodgement rate was achieved with a full compliance of 89%: the last two years average was 91% and 92% respectively (Table 7.1.b.6). The *Sustainability Indicators for Tasmanian Forests 2001–07* report (the TasSOFR 2007) documented an unsatisfactory level of lodgement of compliance reports for independent private forest owners. The level of lodgement by independent private forest owners continues to be low (below 50% over the last two years) and provides significant challenges as potential penalties under the Act restrict the FPA's effectiveness in enforcing compliance. In 2021–2022, as part of the move to risk-based approach, the FPA is planning to establish a new monitoring and compliance response which includes issuing of s.41 notices and potential support from the Office of the Public Prosecutor in progressing compliance through the laying of complaints.

Table 7.1.b.5 Number of certificates of compliance (CoCs) lodged with the FPA and their outcomes

	Certificates due and lodged			Compliance (for certificates lodged)			
Year	Due	Lodged[a]	No activity[b]	Fully complied[c]	No further action required	Corrective action required	Further investigation required
2020–2021	1,609	1,464 (91%)	75	1,352 (92%)	33 (2%)	1 (0%)	3 (0%)
2019–2020	1,311	1,192 (91%)	63	1,092 (92%)	35 (3%)	0 (0%)	2 (0%)
2018–2019	1,340	1,107 (83%)	66	1,006 (91%)	30 (3%)	0 (0%)	5 (0%)
2017–2018	607	454 (75%)	17	401 (88%)	30 (7%)	1 (0%)	5 (1%)
2016–2017	1,269	1,139 (90%)	106	926 (81%)	98 (9%)	0 (0%)	9 (1%)
2015–2016	1,609	1,371 (91%)	108	1,240 (83%)	100 (7%)	2 (<0.5%)	6 (0%)
2014–2015	1,079	1,056 (98%)	78	834 (85%)	134 (14%)	1 (0%)	9 (1%)
2013–2014	1,270	1,096 (86%)	71	928 (91%)	85 (8%)	2 (<0.5%)	9 (1%)
2012–2013[d]	747	696 (93%)	29	591 (85%)	66 (9%)	0 (0%)	10 (2%)
2011–2012	970	835 (86%)		702 (84%)	122 (15%)	2 (0%)	8 (1%)
2010–2011	1,047	1,012 (97%)		845 (84%)	139 (14%)	11 (1%)	17 (2%)
2009–2010	821	794 (97%)		673 (85%)	95 (12%)	5 (1%)	21 (3%)
2008–2009	931	925 (99%)		801 (86%)	101 (11%)	3 (<0.5%)	20 (2%)
2007–2008	911	735 (81%)		686 (93%)	41 (6%)	1 (<0.5%)	7 (1%)
2006–2007[e]	3,995	3,081 (77%)		2,417 (78%)	523 (17%)	55 (2%)	86 (3%)

a) Percentages in brackets is proportion of those due
b) The 'no activity' category was added in 2012–2013 to reflect instances where the FPP expired, and no operations had taken place
c) Percentages in brackets is proportion of those lodged
d) Data for 2013 onwards reports on individual discrete operational phases DOPs e.g. roading, harvesting or reforestation, which may all be covered by the one forest practices plan
e) Data for 2007 to 2013 reported on lodgement of final CoCs only, and the 2006–07 data was the number of CoCs for individual (DOPs).

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Annual assessment of forest practices plans

The annual assessment program conducted by the FPA provides an independent and objective instrument, identifying where further improvements can be made to ensure forest planning and operations meet the objectives of the *Forest Practices Act 1985* and the *Forest Practices Code 2020*.

Historically, the FPA undertakes an annual assessment program covering a representative sample of 10–15% of the number of FPPs certified that year. The FPPs are selected by stratified random sample to incorporate all aspects of forest planning and operational practices undertaken by companies and agencies, and individual forest owners or managers. The FPA started to introduce a risk-based approach to the annual assessment program in 2017–2018. In 2020–2021 it adopted a three-tiered approach to the annual compliance audit program that is designed to:

- improve planning by selecting recently certified FPPs to check for procedural issues and poorly worded FPPs

- identify high risk activities at the planning stage for subsequent operational compliance checks
- maintain a representative sampling to monitor general trends.

The results of assessments by tenure from 2015–2016 to 2020–2021 is presented in Table 7.1.b.6. A 'Sound' rating is considered by the FPA as the standard required to meet the requirements of the *Forest Practices Act 1985* and the *Forest Practices Code* 2015. Since 2016–2017, over 90% of all forest operations across all tenures met or exceeded the required minimum standards.

Table 7.1.b.6 Percentage of FPPs achieving performance standards achieved by tenure (2015–2016 to 2020–2021)

Standard	Year	Industrial private forest	Independent private forest	PTPZ land	Annual average	Two-year average
Sound	**2015–2016**	93.5	91.6	94.7	93.3	94.5
	2016–2017	94.9	88.7	96.4	93.3	93.3
	2017–2018	93.2	97.3	96.4	95.6	94.5
	2018–2019	91.7	96.5	95.4	94.5	95.1
	2019–2020[(a)]					94.5
	2020–2021	95	90	96	93.7	93.7
Below Sound	**2015–2016**	6.1	7	4.1	5.7	3.2
	2016–2017	4.8	9.5	3.1	5.8	5.8
	2017–2018	4.7	2.3	2.9	3.3	4.6
	2018–2019	6	2.1	3	3.7	3.5
	2019–2020					3.7
	2020–2021	5	8	4	5.7	5.7
Unacceptable	**2015–2016**	0.3	1.4	1.2	1.0	
	2016–2017	1.8	1.8	0.5	1.8	1.4
	2017–2018	2.1	0.4	0.7	1.1	1.4
	2018–2019	2.3	1.4	1.6	1.8	1.4
	2019–2020					1.8
	2020–2021	0	2	0	0.7	0.7

a) 2019–2020 was a transitional period and the results of the program are inconsistent for the purpose of reporting

Investigation and enforcement

The FPA recognises that a strong partnership between the government, industry and the broader community is required to achieve a broad culture of compliance, and the best environmental and social outcomes are achieved under a co-regulatory system. The forest practices system's function is to ensure forest practices are carried out so as to reasonably protect the environment while taking into account social and economic values. The FPA applies discretion when enforcing the *Forest Practices Act 1985* and exercising its powers when developing standards and encouraging compliance. It also delivers benefits to communities and associated forest-based industries by enforcing the rule of law and applying sanctions where non-compliance is detected. The FPA reports on its actions annually.

The FPA seeks continual improvement in forest practices using information gained from the compliance and research program and consultation with stakeholders.

The FPA's Monitoring and Compliance program undertakes rigorous and independent monitoring and assessments of compliance. It carries out these actions under a continual, risk-based improvement framework. This approach includes:

- Field observations and monitoring assessments to determine the effectiveness of standards and prescriptions applied in forest operations. FPOs are trained in this area.
- Monitoring to assess the level of compliance against specified standards. This is commonly referred to as a Compliance Audit. It is primarily designed to assess the level of compliance achieved against regulatory and Code standards under a certified forest practices plan. Minor issues of non-compliance are usually addressed as soon as they are observed by a forest practices officer through corrective actions that can include formal requests or directives issued under section 41 of the *Forest Practices Act 1985*. Serious non-compliance, such as significant environmental damage that cannot be remedied by simple corrective action, or a deliberate and knowing breach, may result in a referral for investigation.
- Complaints are received by the FPA from a range of sources including forest practices officers, members of the public, other government regulatory agencies and self-reporting by people undertaking forest practices.
- Investigations are undertaken if potential breaches are reported and their purpose is to systematically gather admissible evidence, including intelligence processes, for any subsequent action. Investigations can also generate preventative or deterrent benefits by increasing community awareness that there is active regulatory oversight and a capacity to report. Proven breaches can result in criminal, administrative or disciplinary sanctions.
- Enforcement applies directives to correct or reverse environmental harm and, where the FPA considers necessary, the application of prescribed or a referral to the Courts for prosecution. The Authority applies procedural fairness and natural justice approaches when making enforcement decisions and applying sanctions.

Table 7.1.b.7 shows the number of formal investigations undertaken by the FPA during the reporting period. The level of investigations and actions reflect annual trends and cannot be taken to indicate the effectiveness of the system. The risk-based approached adopted in 2020–2021 has resulted in the introduction of an 'assessment' category, which distinguished it from formal investigations.

Most minor breaches can generally be attributed to human error or lack of knowledge about the requirements of the forest practices system. Most breaches are dealt with by corrective actions, in accordance with the philosophy of the FPA to 'make good' and to effect improvement. Such breaches are no longer reported as 'investigations'.

Table 7.1.b.7 Number of investigations completed by the FPA (2016–2017 to 2020–2021)

Year	Total number formal investigations	No breaches identified	Number of minor[(a)] breaches	Number of major[(b)] breaches
2016–2017	24	7	14	3
2017–2018	10	2	4	4
2018–2019	17	3	9	5
2019–2020	37	1	17	19
2020–2021	18	0	4	14

a) Minor breaches include: notices to rectify; warning, but no further action

b) Major breaches include: penalties; legal action; and breaches where no action was pursued due to insufficient evidence and/or legislative time constraints

Enforcement in Conservation Reserves

The PWS manages 806 reserves covering approximately 2.860 million ha. Over half the area of the reserve system lies within the Tasmanian Wilderness World Heritage Area (TWWHA), one of the largest conservation reserves in Australia (1.584 million ha) which covers approximately 23% of the land area of Tasmania.

The key objective of the PWS is to manage the state's public reserve system to achieve the principal goal of conserving natural and cultural heritage while providing for sustainable use and economic opportunities for the Tasmanian community. Several key advisory groups continue to provide regular and informed community input to reserve management (e.g. the National Parks and Wildlife Advisory Committee, and the Arthur Pieman Advisory Committee). Consultation and liaison with a wide range of local communities and interest groups continues across the state.

Enforcement of relevant Acts and Regulations on reserved land is coordinated by the PWS State Compliance Unit (SCU) comprising three regional coordinators and a statewide manager. The Wildlife Operations Unit of NRE Tas continues to deal with a broad range of natural and cultural heritage enforcement matters, both within and outside the reserve system.

Initial tasks for the SCU have revolved around the simplification and consolidation of PWS compliance procedures, along with authorised officer training and mentoring, to increase the level of compliance activity across the state. Most authorised officers are Rangers or Field Officers, operating from Field Centres throughout Tasmania, and are regularly involved in compliance activities on reserved land. Table 7.1.b.8 indicates the amount of enforcement work undertaken by PWS and NRE Tas field staff.

In 2019, the National Parks and Reserves Management Regulations were revised and included a broader suite of offences for which Prescribed Infringement Notices (PINs) may be issued. Where possible, infringement notices are issued in preference to preparing court files. A large proportion of court files related to the illegal taking of firewood and some significant commercial-scale operations were disrupted as a result. PWS continues with a significant amount of compliance activity surrounding timber theft, including joint operations with Tasmania Police and Transport Inspectors. The SCU staff continue to formulate strategies for a coordinated response to these offences. This activity takes the form of proactive and reactive activities that both identify and prosecute offenders, as well as preventing the occurrence through education and other pressures.

Enhanced remote area technical surveillance continues to facilitate a much higher offence detection rate, with offenders frequently identified through their vehicle details or faces being caught on camera.

Illegal off-road vehicle access accounted for a high percentage of infringement notices and infringement notices for failing to display park entry passes have been largely replaced by a system where offenders are given a notice of breach, giving them seven days to rectify the situation before enforcement action is considered.

Table 7.1.b.8 Cautions and notices[a] issued by PWS and NRE Tas officers (2016–2017 to 2020–2021)

Legislation	2016–2017	2017–2018	2018–2019	2019–2020	2020–2021
National Parks and Reserve Management Act 2002					
Formal Cautions	0	0	0	0	0
Prosecutions[b]	0	2	2	0	0
National Parks and Reserved Land Regulations 2009 and National Parks and Reserves Management Regulations 2019					
Infringement Notice (Caution Only)	58	101	152	304	392
Infringement Notices	85	72	75	16	182
Prosecutions[b]	4	5	7	3	12
Crown Lands Act 1976					
Formal Cautions	0	0	1	2	0
Prosecutions[b]	0	1	2	2	0
Crown Lands Regulations 2001					
Formal Cautions	0	0	0	0	0
Prosecutions[b]	0	0	0	0	0

a) all statistics relate to the number of persons charges, not the number of offences
b) statistics for prosecution are based on the date of the offence

Management for carbon

Some areas of forest are now being managed primarily for carbon (see also Criterion 5), subject to private market- regulatory mechanisms as part of off-market carbon trading schemes. In 2020–2021, two private forests were registered under the national Emissions Reductions Fund. In June 2010 the Tasmanian Land Conservancy (TLC) purchased 28,000 ha of native forest from Gunns Ltd as part of its New Leaf Project. The TLC has subsequently implemented a Carbon Project across 12,130 ha of the purchased land and manages the remainder for ecosystem services. The New Leaf Carbon Project sequesters the equivalent of 15,235 t of carbon from the atmosphere annually across 19 properties. Australian Carbon Credit Units (ACCUs) are generated from the project and traded, both of which are regulated by the Clean Energy Regulator and will run for 25 years (crediting period) through to 2037 (permanence period ends 2041). The TLC's New Leaf properties are managed for nature conservation and carbon values, with a diversity of ecological monitoring and scientific research programs established to inform the conservation management of the values for which they were purchased.

Forest certification

Within developed economies, there is an increased tendency to include production aspects such as animal welfare, labour circumstances, environmental impact etc. on labels of products. Market forces have generally been the principal driver for the adoption of such standards. Certification schemes are based on principles, criteria, and standards that encompass economic, social, and environmental measures. They do not provide on-the-ground prescriptions, being largely outcome based and consequently influence management decisions.

All professional forest management organisations undertake in-house assessment programs to assess standards achieved before, during and after forest operations. All of Tasmania's PTPZ land, and the majority of private industrial forests, are now certified under at least one of a number of voluntary certification systems which recognise environmental, economic, social and cultural forest management performance and sustainability in the forest industry. Increasingly in an internationally competitive trading environment, forest certification provides assurance to purchasers of wood and paper products that they are purchasing products produced under a system of sustainable forest management. Most of Tasmania's commercial forest managers are able to demonstrate their

sustainable management credentials through independent certification under national and international standards such as the Responsible Wood Australian Forestry Standard (AFS; AS 4708, now AS/NZ 4708:2021), Forest Stewardship Council (FSC) and the International Standards for Environment Management Systems (ISO 14001). PWS maintains an environmental management system for public reserves managed under the *National Parks and Reserve Management Act 2002* that is consistent with ISO 14001. The PWS environmental impact assessment process, the Reserve Activity Assessment System, is fully documented and functional.

The AFS is recognised internationally by the Programme for the Endorsement of Forest Certification Scheme (PEFC), the world's largest forest certification body. The AFS is based on ISO 14001 and the Montreal Process Criteria, and is compatible with other international certification schemes. The revised AFS (AS/NZ 4708:2021) and the associated Chain of Custody Standard (AS 4707:2021) were developed in accordance with Standards Australia procedures and have been accepted as Australian Standards®.

The FSC is a global organisation and operates in Australia through the national organisation FSC Australia. During the reporting period 2016–2021 several organisations held Responsible Wood and/or FSC certification. At 30 June 2022, approximately 1 million ha were covered by Responsible Wood's Sustainable Forest Management certification (Table 7.1.b.9), comprising lands under the management control of STT, Reliance Forest Fibre, Timberlands Pacific, and SFM Forest Products on PTPZ land; and Forico, Reliance Forest Fibre, SFM Forest Products, Musketts, PF Olsen, Midway and AKS Forest Solutions on private land.

At 30 June 2022, almost 280,000 ha in Tasmania were covered by FSC Forest Management certification (Table 7.1.b.9), comprising lands under the management control of Norske Skog and Timberlands Pacific on public land; and Forico, Norske Skog and SFM Forest Products on private land.

Table 7.1.b.9 Area (ha)[(a)] of Tasmanian private and public forest covered by the AFS (AS 4708) or FSC forest management certification schemes as at 30 June 2022

Certification scheme	Private forest	Public forest	Total
Australian Forestry Standard (AS 4708)	341,745	744,700	**1,086,445**
Forest Stewardship Council	257,929	28,100	**286,029**
Total	**599,674**	**772,800**	**1,372,473**

a) Note: Due to the dynamic nature of the certification system, these figures are best estimates only and are as at June 2022.

Indicator 7.1.c Extent to which the economic framework supports the conservation and sustainable management of forests

In this indicator, 'economic framework' refers to the economic commitments and policy mechanisms of governments that promote the conservation and sustainable management of forests. In this context, the actions of Government may be ones that facilitate or encourage commercial managers of forests to invest in strategies, technology and processes that improve conservation and sustainable management outcomes. They may also be policies and regulatory frameworks that inhibit or prevent forest managers from taking actions that could result in negative conservation and sustainable management outcomes.

The National Forest Policy Statement and Regional Forest Agreements continue to provide the basis for management of forests to achieve economic, social and environmental outcomes.

The Tasmanian forest practices system continues to play a central role in determining the areas of production forest, on both public and private land, that can be harvested. The continuous improvement model of forest practices secures environmental and conservation benefits, while maintaining access to forests for wood products.

Independent forest management certification links conservation and sustainable forest management to economic decisions, such as market access. In this context, market and consumer preferences, independent of Government, are emerging as a critical element of the economic framework to support conservation and sustainable management of forests.

More broadly, the forest industry and government agencies have continued a process of ongoing improvement that has included:

- continual improvement in management of threatened species, soil and water in production forests
- ongoing community engagement and management of smoke impacts from controlled forest burns
- significant increases in areas of forest from which native forest harvesting is excluded, including transfer of areas of public production forests into the reserve system
- ongoing training in all aspects of forest practices.

Historically, levels of production in Tasmania's forests have enabled the costs of a range of non-commercial forest management activities to be absorbed by commercial forest managers. Significant areas of forest outside of Tasmania's formal reserve system continue to be managed for non-wood production values such as conservation, water quality and fire protection.

However, the structural decrease in the area of public production forest and continuing low- levels of activity on private native forest, have necessitated reconsideration of how the financial costs of forest management for conservation outcomes are apportioned.

The Tasmanian Government has conducted an exhaustive review of STT's business model to identify how the benefits of conservation and sustainable forest management can be best achieved, while maintaining a productive and financially sustainable commercial forestry sector. This has led the Tasmanian Government to determine that the non-commercial and commercial functions of STT should be separated, to provide a more transparent operating model. Forestry operations are expected only to meet the costs associated with commercial functions.

Funding has been invested through Private Forests Tasmania to research and demonstrate the benefits of tree farming, and commercial forestry, on land currently utilised for other primary production. This work is intended to demonstrate to private landowners how appropriate

management of tree lots can be used to increase productivity of agricultural land, while also providing opportunities for additional income streams for timber harvesting.

The transition to greater reliance on plantation resources, and the reduced size of the production native forest estate, necessitate ongoing investment in research and development to maximise productivity (see Indicator 6.2.b).

The Tasmanian and Australian Government each committed $2 million towards the establishment of the National Institute of Forest Products Innovation (NIFPI) in Launceston in 2017 (NIFPI, 2022). NIFPI plays a vital role in fostering collaboration, supporting cutting-edge research, boosting innovation and maintaining jobs. The 2021–2022 Australian Government budget committed $1.3 million to undertake a feasibility study to expand NIFPI to further promote and encourage innovation in Australia's forest and wood products industry. On 21 June 2021, the Australian Forest Products Association (AFPA) and the University of Tasmania (UTAS) launched a joint policy proposal for an Australia-wide National Institute for Forestry Products Innovation (NIFPI), to be headquartered at UTAS's Newnham campus in Launceston. The proposal is based around the establishment of a national research and development hub for Australia's forest industries that would be led by UTAS. The proposal specifically called on the Australian Government to invest $100 million over four years in a national-scale NIFPI, with this funding to be matched by industry.

Emerging challenges also present new opportunities to derive income streams from sustainably managed forests. In 2014, the Australian Government introduced the *Carbon Farming Initiative Amendment Act 2014* and the Emissions Reduction Fund. The Emissions Reduction Fund is a voluntary scheme that aims to provide incentives for a range of organisations and individuals to adopt new practices and technologies to reduce their emissions. It is enacted through the *Carbon Credits (Carbon Farming Initiative) Act 2011*, the Carbon Credits (Carbon Farming Initiative) Regulations 2011 and the Carbon Credits (Carbon Farming Initiative) Rule 2015. This allows businesses to reduce their carbon impact, earn Australian carbon credit units for the reductions they achieve and earn income from selling those units. Examples of eligible activities relevant to forests are listed below:

- protecting native forest by reducing land clearing
- planting trees to grow carbon stocks; and
- regenerating native forest on previously cleared land.

The list of eligible projects is continually being added to.

Indicator 7.1.d Capacity to measure and monitor changes in the conservation and sustainable management of forests

A comprehensive and current measurement and monitoring program provides the basis for all forest planning to support sustainable forest management. This indicator reports the capacity to measure and monitor changes in the conservation and sustainable management of forests.

A capacity to monitor change does not indicate whether such activities are undertaken. Effective monitoring systems also require long-term resources. Monitoring systems in Tasmania reflect resource allocation based on determined priorities. Most data for conservation of reserved forests and future potential production forests are maintained by NRE Tas and the PWS. State forest data are held and managed STT for PTPZ land; while equivalent data for forests on private land are collated by Private Forests Tasmania (PFT).

Government agencies and private industrial forest companies have formal and informal systems in place which contribute to the level of knowledge necessary to measure, monitor and report on the sustainability of forests in Tasmania. Formal systems include voluntary third-party certification schemes such as the Australian Forestry Standard (AFS) and Forest Stewardship Council (FSC) (see Indicator 7.1.b).

Forest Practices Authority

Monitoring has a central role in the Tasmanian forest practices system and is prescribed in Schedule 7 of the *Forest Practices Act 1985*. The Research and Advisory Program of the FPA employs scientists who undertake monitoring and research projects in areas related to cultural heritage, botany, geomorphology, soil science, visual landscape and zoology which contribute to the scientific knowledge underpinning the *Forest Practices Code 2020* provisions for natural and cultural values and associated planning tools. The research undertaken can be categorised as that which assesses the effectiveness of current Code prescriptions or that which assists the development of specific prescriptions and the more strategic and longer-term research that clarifies risks and enables decisions to be taken on a broad range of issues.

Two types of monitoring are undertaken by the FPA:

- implementation monitoring (or monitoring of compliance) – used to determine whether prescribed management is actually conducted.
- effectiveness monitoring – used to determine whether the management specified has achieved its objective and whether the outcome was actually a consequence of management.

Each year the Biodiversity Program of the FPA attempts to implement a number of the priority effectiveness monitoring projects. The actual projects implemented depend on available funds, logistic considerations and staff/student availability. A summary of the findings of biodiversity related projects worked on during the financial year are reported annually (eg., Koch, 2019, Koch, 2020, Koch, 2021, Koch and Munks, 2017). Projects implemented by other researchers are included in the summary reports if the results contribute information that can be used to evaluate the effectiveness of management of biodiversity values, in areas covered by the forest practices system. The outcomes of monitoring projects are also published periodically in scientific journals. For example, a paper was published reporting the results of long-term monitoring of a state-listed threatened plant *Hibbertia calycina* (Turner et al., 2020). Field surveys of the species were done in 1995, 2003–04 and 2017–08. The results suggest the population has remained stable or increased slightly, that severe fire can eliminate populations, and the threat status currently allocated to the species is appropriate.

Monitoring for soil and water and geomorphological values is tailored to address specific issues that arise from time to time, e.g. erosion following unplanned fires, erosion following exceptional rainfall, and reactivation of subsurface conduits (caves) and sinkhole formation following water-table lowering (see Indicator 4.1.b).

Building on the broad-scale monitoring systems in Tasmania, site-specific surveys are also undertaken to ensure non-wood values are assessed before forest disturbance activities commence (as required by the *Forest Practices Code 2020* and the *Tasmanian Reserve Management Code of Practice 2003*). These surveys aim to identify and enable implementation of management prescriptions for historic and Indigenous heritage sites (Criterion 6), geomorphic features (Criterion 4), and threatened species and communities (Criteria 1 and 2). Information from these surveys has contributed to statewide databases for conservation and planning forest practices. These surveys are intended to identify values that may be affected by proposals and any actions to be taken to avoid or mitigate negative impacts and provide a baseline for future monitoring and assessment.

Under the forest practices system, the implementation and effectiveness of a representative sample of forest practice plans must be assessed annually. A formal/stratified sample of up to 10–15% of FPPs across the full range of forest operations on private and public land is assessed independently each year. The assessment rates performance outcomes against 87 specific factors, covering the standard of the plans, forest practices planning and operational performance and is reported in the FPA annual report. A new assessment framework was developed in 2019–2020 which focuses on area of risk and which incorporates a random, base line selection. This new framework does not support maintaining the reporting of individual elements of the audit as risk approaches often exclude certain types of operations and so not statistically valid. (Indicator 7.1.b).

During the reporting period, the FPA reviewed and updated the *Forest Practices Code*. After consultation with the public and stakeholders, amendments were made to the Code including:

- the scope and applicability of the Code was clarified, to allow for its application where a forest practices plan (FPP) is required, whether or not an FPP has been certified. Where a certified FPP is not required, persons carrying out forest practices are encouraged to apply the provisions of this Code where practicable
- an interpretation and explanation of ‘forest practices’ was included in line with the interpretation in the *Forest Practices Act 1985*
- a mandatory statement was included to be placed in all FPPs that references the Code and thus clearly links the Code to an enforceable instrument (the FPP)
- the requirement for a map to be included in a FPP was added and the standard of the map expected was described
- the section describing and illustrating native forest silvicultural systems and native forest stocking standards was expanded.
- new sections were added on restoration of riparian zones rehabilitation of degraded forest landscapes
- a new section was added on stand management that covers routine, low-impact stand maintenance activities that do not require an FPP.
- exemptions for small scale or low-impact forest maintenance operations where an FPP is not needed were identified
- a statement that forest practices should be conducted in a manner that maintains the sequestration and storage of carbon in a reasonably practical manner was added
- the Guiding Policy was replaced with a Preamble and an expanded section A, with some of the commitments made in the Guiding Policy dealt with elsewhere in the Code.

- numerous technical updates were made to remove uncertainty and bring the Code up to date with contemporary practices and technology, such as contemporary harvesting equipment and use of electronic maps and real time geo-location.
- references to other applicable legislation was added, such as those covering fire management, smoke, quarries, pesticide use and noise, without re-iteration of the regulatory requirements

The amended Code, known as the *Forest Practices Code 2020*, was released in October 2020 and came into force on 1 January 2021.

Sustainable Timber Tasmania

As part of their certification requirements, STT and other major forest managers in Tasmania are required to have comprehensive monitoring systems in place. STT also undertakes other monitoring to confirm the condition of other forest values are being maintained (e.g. health, biodiversity, freshwater systems etc.) (Sustainable Timber Tasmania, 2019b).

STT models the sustainable yield from PTPZ land and monitors actual production, to ensure that harvesting of eucalypt native forest and eucalypt plantations is consistent with its statutory obligations and with its objectives for sustainable forest management. The RFA requires a five yearly review of the sustainable yield of high-quality eucalypt sawlogs from PTPZ land. Previous reviews in 1998, 2002, 2007 and 2014 incorporated the effects of successive changes in the resource base over that period. The fifth review of sustainable high quality eucalypt sawlog supply published in 2017 confirmed STT's ability to supply at least 137,000 m^3 per year of high-quality eucalypt sawlogs from PTPZ land, for the next 90 years. However, these yield predictions are generated from biologically based forest estate modelling of productive capacity, and do not imply supply based on economic criteria.

Parks and Wildlife Service

The PWS has developed the Monitoring and Reporting System for Tasmania's National Parks and Reserves (Parks and Wildlife Service, 2013) to track statewide management effectiveness. This jurisdictional performance measurement system is evidence-based, operationally practical, and transparent to stakeholders. There are three types of reporting outputs: (i) brief status and trends reports on key performance areas; (ii) evaluated case studies of the monitored effectiveness of major projects, and (iii) periodic evaluation reports on the effectiveness of reserve management plans.

The Tasmanian Wilderness World Heritage Area (TWWHA) has further key commitments for monitoring, evaluation and reporting under the current Tasmanian World Heritage Area Management Plan 2016. These include:

- preparation of concise State of the TWWHA Reports every three years
- regular status and trends reports
- case studies to evaluate;
  - community partnerships
  - access to Country for Tasmanian Aboriginal people
  - management of the road network
  - monitoring and data collection for priority areas of the walking track network.

The latest *Report on the State of Conservation of the Tasmanian Wilderness World Heritage Area* was published in 2022.

The TWWHA Natural Values Climate Change Adaptation Strategy 2021–31 provides a mechanism to integrate the best available information into management so the impacts of climate change on the natural values of the TWWHA can be ameliorated. This Strategy focuses on delivering practical information, actions and tools to manage risks, reduce impacts and realise benefits to the natural values of TWWHA. It is envisaged that informed decision-making about activities and actions in the TWWHA will enable a best-case trajectory for the condition of natural values within it, while realising opportunities and minimising adverse or compounding outcomes.

This Strategy adds to the climate change work undertaken over the past 15 years, led by the Natural and Cultural Heritage Division of NRE Tas. This program of work has undertaken risk assessments focusing on geodiversity, flora, and fauna values, and has established a suite of monitoring programs to track the condition of values considered to be at greatest risk of climate change impacts.

Private forest companies

SFM Environmental Solutions

SFM Environmental Solutions (SFM) manages forest estates on behalf of third-party interests. They manage both production and conservation across hardwood and softwood plantations and native forest estates. SFM only undertake selective harvesting of native forest on a limited scale. Most native forest under SFM's management is for conservation purposes. SFM is certified to both Responsible Wood (AFS) and FSC.

Monitoring to ensure conservation and sustainable management of forests includes:

- operational measuring/monitoring;
  - estate modelling: annual inventory results used in estate woodflow modelling to determine sustainable cut and harvest schedules
  - audits: undertaken regularly throughout active operations to ensure compliance with provisions of the FPP in management of biodiversity, soil/water, cultural heritage and landscaping values.
  - progressive harvesting assessments: undertaken across plantation thinning/native forest selective operations to ensure retention is compliant with the FPP and damage to retained stock is kept at acceptable levels
  - regeneration surveys: undertaken on native forest selective operations to ensure retention of retained stock and recruitment of new seedlings is compliant with provisions of the FPP
  - post-planting survival surveys: undertaken to ensure maximise commercial capacity of a site is realised
- conservation measuring/monitoring;
  - conservation monitoring program: High Conservation Value(HCV)/formal/informal reserves are monitored for threats and impacts such as weeds, unplanned fires, damage to values by illegal vehicles, flood/storms/drought, illegal removal of forest products, rubbish dumping etc. Issues which are identified are managed under specific programs e.g. weed management programs and rubbish collection programs
  - field verification/VCA: All new estate areas which are certified to forest management standard are assessed for HCV/special biodiversity values. Following desktop review of available data on a given estate area, field verification work is undertaken to confirm presence of identified values and determine overall condition by, for example, vegetation condition assessments. This information is used to benchmark future assessment work and generate a conservation management program appropriate to the long-term conservation of the values identified. Examples include the ecological burning

of Highland Poa (a threatened vegetation community), removal of pine wildings or other identified weeds from Forest Conservation Covenant areas
  - conservation management programs as generated from the two points above: works programs that are reviewed annually to ensure they are adequately resourced
- forest management systems review;
  - each year SFM undertakes a Forest Management Systems review which looks at all aspects of measuring and monitoring i.e., Conservation Monitoring programs, operational audits results, incident reports etc to understand trends in data and implement changes to processes if/where required. This is a highly adaptive management process which is designed to ensure continual conservation and sustainable management of forests under SFM control.

Other private forest companies

Annual monitoring programs are implemented by some other private industrial companies to identify significant changes or disturbance events that may have impacted the natural estate (Box 7.1.d). The monitoring programs typically survey a different subset of monitoring sites each year. Monitoring includes Vegetation Condition Assessments (VCAs), as well as periodic monitoring of established VCA sites to verify previous condition scores. The TASVEG Vegetation Condition Assessment process is a publicly available process developed by NRE Tas for use across all tenures (Michaels, 2006). Threatened flora are also monitored where known locations indicate the existence or likelihood of significant populations. Any new localities of threatened flora and fauna, and field-verified remapping of vegetation community boundaries, are provided to NRE Tas for inclusion in relevant databases (Department of Natural Resources and Environment Tasmania, 2022e, Department of Natural Resources and Environment Tasmania, 2022c).

Box 7.1.d Monitoring and managing threats to Ptunarra brown butterfly in a plantation estate

Ptunarra brown butterfly (*Oreixenica ptunarra*) is a threatened Tasmanian butterfly restricted to *Poa* dominated grasslands and grassy woodlands between 400 and 1000m altitude. In the 1990s, habitat loss was considered a key threat to the species though more recently predation by the introduced European wasp (*Vespula germanica*) has been recognised as a major threat, particularly in areas where surface soil has been disturbed, such as young plantations.

Population monitoring of Ptunarra brown has been conducted on Surrey Hills hardwood plantation estate in the north-west of Tasmania since 1998 (Bell, 2022). Over this period local extinctions and an overall decline in the abundance of butterflies was observed. The decline in abundance of butterflies corresponded with an overall upward trend in the abundance and extent of wasps.

A project funded by Forico Pty Limited at Surrey Hills to identify and implement actions to reduce predation of the butterfly by the introduced wasps is currently in its 6th year. The project moved into a management phase in 2021 focusing on actions to reduce the abundance of wasps in young plantations, thereby reducing the predation rate of wasps on butterflies in neighbouring *Poa* grasslands. Surveys of Ptunarra brown on Surrey Hills in 2022 indicated that the overall abundance of butterflies remains low but signs of recovery are evident at some grasslands (Bell, 2022).

Trials in 2020 showed that searching for and destroying wasp nests in young plantation was an effective means of reducing the abundance of wasps in adjacent grassland. In 2021, the abundance of wasps was monitored at the interface between young plantation and native grassland at several locations across Surrey Hills. Wasp abundance in the 2021 Ptunarra brown flying period remained low across Surrey Hills so wasp nest detection and destruction was not warranted. In contrast, in 2022 the abundance of wasps increased rapidly so nest detection and destruction activities were prioritised in early March, prior to the Ptunarra brown flying season.

Ptunarra brown butterfly (*Oreixenica ptunarra*) on orange everlasting (*Xerochrysum subundulatum*) (Image: Phil Bell)

Indicator 7.1.e Capacity to conduct and apply research and development aimed at improving forest management and delivery of forest goods and services

This indicator reports on the scientific understanding of the characteristics and functions of Australian forest ecosystem needed to underpin sustainable forest management. Research, inventory and the development of assessment methodologies provide the basis for sustainable forest management.

Context

Research and development (R&D) provides the basis for biological surveys and forest inventories, forest management, the silvicultural regime for harvesting forests, forest health surveillance, and the development of methods for assessing sustainable forest management. This indicator examines the institutional capacity for forest-related R&D; Indicator 6.2b quantified investments in R&D over the reporting period.

Australia has gained a good level of scientific understanding of the characteristics and functions of its unique forest ecosystems, based on more than 100 years of research in a broad range of forest areas. This knowledge is required to underpin sustainable forest management. However, since 2007 Australia's capacity to conduct and apply R&D to improve the scientific understanding of forests and delivery of forest products has progressively decreased. Significant changes in R&D capacity have occurred at the national, state and territory levels of government, and within the Commonwealth Scientific and Industrial Research Organisation (CSIRO) and academic institutions. Many of these changes reflect either general changes in overall government priorities or specific changes in government priorities for science-based R&D.

'Forestry' R&D covers research in relation to commercial management and protection of forests, including environmental and ecological considerations. It does not cover research on areas managed specifically for conservation (e.g. forest areas in nature conservation reserves), or programs monitoring growth, health, nutrition and biodiversity. 'Forest products' R&D covers research on value-adding to wood in its broadest sense, but not work on final product development (e.g. furniture production), production runs in mills, environmental monitoring or quality control assessment. These categories have been stable across several industry surveys and TasSOFR reporting periods.

The capacity to conduct and apply research and development can be measured by the number of personnel engaged in this activity and related expenditure (Indicator 6.2b). Current staff numbers in state agencies were sourced from STT, the FPA, and NRE Tas and compared (Table 7.1.e.1) with TasSOFR 2017 (FPA 2017a).

Table 7.1.e.1 Tasmanian Government agency forestry and forest products research and development capacity (FTE staff)

Agency	2015–2016	2020–2021
Sustainable Timber Tasmania	4.8	2.5
Forest Practices Authority	2.0	2.0
Other state agency	2.5	0
Total	**9.3**	**4.5**

In 2020–2021, Tasmania reported a total of 4.5 FTE forest researchers in government agencies. This is a substantial reduction from the 43.6 FTE forest researchers in government agencies reported for 2010–2011 (TasSOFR 2013), and a further halving of research capacity since 2015–2016. In previous

reporting periods, much of the Tasmanian forest-related research effort occurred through the CRC for Forestry, which operated from July 2005 to June 2013. More recently, collaborative research has been carried out through the National Institute for Forest Products Innovation (NIFPI), with two rounds of projects commencing in 2018 and 2021 respectively. NIFPI research hubs are in Tasmania, Victoria and South Australia (Indicators 6.2b, 7.1c).

Sustainable Timber Tasmania

STT's Forest Management Branch undertakes, and collaborates in, research into native forest silviculture, plantation silviculture, biology and conservation (including forest health surveillance), and together with the PWS, manages the Warra Long-term Ecological Research Site in southern Tasmania (Box 7.1.e). At least one-third of STT's research expenditure is devoted to development and extension work involved in the strategic or operational uptake of research. STT's research has in recent years focused on collaboration with research providers. Research has been focused on plantation wood properties research, management of ecosystems in a changing climate, fire management and ecological (including fauna and flora) research (Sustainable Timber Tasmania, 2016-2022).

Box 7.1.e Warra Long-term Ecological Research TERN Site

Warra is a complete land observatory within Australia's Terrestrial Ecosystem Research Network (TERN), monitoring the environment at all three of the spatial scales at which TERN infrastructure operates. At the finest scale is the Warra Supersite, consisting of an 80-metre-tall, instrumented tower and adjoining 1-ha plot, which provides the intensive measurements needed to monitor ecosystem processes. At the intermediate ecosystem landscapes scale, Warra hosts four 1-ha plots in the AusPlots Forest Network, which are used to characterise and detect changes in soil characteristics and in the composition and structure of the vegetation. At the widest scale, Warra operates as a calibration and validation site for the TERN Landscape Platform, which provides TERN's remote-sensing capability to monitor changes at the continental scale. All measurements in the TERN platforms at Warra are done using nationally consistent methods and all data are quality checked before being lodged on TERN's data portal for free access and use by stakeholders.

In January 2019, much of the southern and eastern sections of the Warra site were burnt by bushfire. All of the 'Icon' studies and TERN infrastructure were damaged by the fire. Monitoring equipment on the 80-metre tower was quickly reinstated (by May 2019), the four burnt 1-ha plots were remeasured, and new LiDAR and hyperspectral datasets were acquired for the 5 × 5 km calibration and validation plot for the TERN Landscapes Platform. A severe windstorm in September 2021 caused a large tree to fall across cables supporting the instrumented tower at Warra causing it to collapse and destroying all instruments. Efforts are underway to reinstate an instrumented tower Warra, hopefully by late 2022 or early 2023.

Warra continues to support research activity. Over 220 research projects have now been conducted at Warra and many are on-going. This research has generated 430 reports and publications – over 140 of these in international peer-reviewed journals. Forty publications using data obtained from Warra were produced in the current five-year reporting period. The drivers of the research carried out at Warra have changed. Questions relating to the management of the forests for wood production now drive much less of the research and the focus has shifted much more towards understanding disturbances from fire and from climate change in ecosystems at Warra, particularly the *Eucalyptus obliqua* tall forest ecosystem, and how risks of adverse effects from these disturbances may be managed.

http://www.warra.com

Forest Practices Authority

The FPA has a list of priority research and monitoring topics categorised into two general areas: monitoring the implementation and effectiveness of the *Forest Practices Code 2020* and research on the occurrence and conservation status of natural and cultural values and the potential and actual impact of forest management on these values. FPA research is done in collaboration with researchers, students and staff in government departments, institutions, private consultants and companies including UTAS; Technical University of Munich; Murdoch University; University of Queensland; Australian National University; University of the Fraser Valley, BC Canada; University of Waikato, New Zealand; Victoria University of Wellington, New Zealand; DPIPWE; STT; Private Forests Tasmania; Timberlands Pacific Pty Ltd.; Forico Pty Ltd.; and Norske-Skog (now Lenah Estate). FPA researchers have also provided technical and scientific assistance to researchers working in similar fields in Papua New Guinea and the USA.

FPA research in the earth sciences and cultural heritage fields in the last five years has concentrated on landscape-scale erosion history and erosion risks, determining the influence of Aboriginal-lit fires on vegetation and landscape character, stream monitoring, determining the principles of carbon sequestration in Tasmanian native forest, determining the causes of serious erosion and reactivation of karst processes in a lowland plantation underlain by limestone, recording and characterising geoconservation sites, and improving procedures for systematic recording and protection of cultural heritage.

A summary of FPA research in the biodiversity area is provided in Table 2.1.2 in each of the FPA annual reports 2016 through 2021 (FPA, 2016-2021). Some of these projects have informed the development of novel monitoring techniques for threatened species. For example, a collaborative study was completed that identified a species-specific probe-based assay that could detect traces of giant freshwater crayfish (*Astacopsis gouldi*) DNA in environmental samples (Trujillo-Gonzalez et al., 2021). This means that water samples can be collected and tested for *A. gouldi* DNA as a non-invasive tool for monitoring this threatened species.

Current research projects include:

- assessing the effectiveness of management for wedge-tailed eagles, Tasmanian devils, Lake Fenton trapdoor spiders and slender treeferns
- assessing implementation of management for masked owls and giant freshwater crayfish
- assessing the habitat requirements of grey goshawks and masked owls.

ARC Centre for Forest Value

Research aimed at improving forest management in Tasmanian forests is being conducted by UTAS as well as several other research institutions nationwide, including CSIRO, the University of Melbourne, Australian National University, and the University of Southern Queensland. In the current reporting period, much of Tasmanian forest-related research effort occurred through the ARC Centre for Forest Value (ARC CFV) situated on the University of Tasmania's Hobart campus (2016–2021). The ARC CFV was funded by the Australian Research Council's Industrial Transformation Training Centres scheme with additional funding from industry partners and UTAS. Industry partners included Forico, Greening Australia, SFM Forest Products, STT, Neville Smith Forest Products, Forest and Wood Products Australia, Private Forests Tasmania, and the FPA. Further support was provided in 2020 by Forest and Wood Products Australia through the Forest Growers Research Program.

The research effort of the ARC CFV is structured into three themes that span the forest supply chain: sustainable forest production and certification; product and manufacturing and supply chain

integration; and information management. Research questions addressed by the students at the ARC CFV are structured around these themes (see highlights in Indicator 6.2.b). Numerous PhD candidates, postdocs and industry, academic and affiliated researchers participate in the projects undertaken by the Centre. Some of these projects are ongoing (University of Tasmania, 2022a).

National Institute for Forest Products Innovation (NIFPI)

The National Institute for Forest Products Innovation (NIFPI) aims to promote innovation in Australia's forest and wood products industry. NIFPI was established in 2018 by a combined initial commitment of $12 million from the Australian, South Australian, Tasmanian and Victorian Governments to establish Innovation Hubs in South Australia, Tasmania and Victoria. Additional financial support contributed by industry. The Institute aims to grow Australia's forest and forest products industry by exploring and facilitating innovation in the forest products sector in areas such as forest management, timber processing, wood fibre recovery, value adding, advanced manufacturing and the bio-economy.

In Tasmania, the Launceston Centre of the National Institute for Forest Products has supported two rounds of projects with budgets totalling approximately $10 million (see Indicator 6.2.b). The majority of projects have focused on timber processing, with others in areas such as forest operations, natural capital assessment, biodiversity monitoring and pest management.

Private forest management organisations

Private forest managers participate in several research projects either financially or through in-kind support. The research projects aim to investigate conservation and sustainable forest management principles. For example, SFM Environmental Solutions is currently involved in studies looking at the effectiveness of the management for wedge-tailed eagles and Tasmanian devils, habitat requirements for the grey goshawk and masked owl, implementation of management of freshwater crayfish and conserving biodiversity in timber production forests.

APPENDIX 1. Ecosystem diversity

RFA forest vegetation community	Land classification (tenure)[a]				Total (k ha)	Change in area since 1996 (%)	Change[d] in area since 2015 (%)
	Conservation reserves (k ha)[b]	PTPZ land (k ha)[c]	Other publicly managed land (k ha)	Private freehold land (k ha)			
Dry eucalypt forests							
Coastal *E. amygdalina* dry sclerophyll forest	61	32	26	57	175	-8.0	-0.9
Dry *E. delegatensis* forest	82	67	39	92	281	-3.1	-0.2
Dry *E. nitida* forest	137	5	12	5	159	-0.7	-0.1
Dry *E. obliqua* forest	43	38	28	46	154	-6.0	-0.6
E. amygdalina forest on dolerite	23	11	13	123	169	-5.4	-0.6
E. amygdalina forest on sandstone	5	4	4	17	29	-3.0	-0.5
E. morrisbyi forest	20	0	0	0	20	0.0	0.0
E. pauciflora on Jurassic dolerite	2	2	1	13	18	-3.7	-0.1
E. pauciflora on sediments	5	1	500	8	15	-6.4	-0.2
E. pulchella / *globulus* / *viminalis* grassy shrubby dry sclerophyll forest	27	7	16	97	147	-3.0	-0.6
E. risdonii forest	200	0	20	200	400	-0.1	0.0
E. rodwayi forest	200	300	100	8	8	-2.9	-0.4
E. sieberi forest on granite	4	5	7	2	17	-1.2	-0.2
E. sieberi on other substrates	9	14	16	7	45	-2.0	0.0
E. tenuiramis on dolerite	5	1	1	700	8	-0.8	-0.1
E. tenuiramis on granite	3	0	40	200	3	-0.5	-0.2
E. viminalis and/or *E. globulus* coastal shrubby forest	300	10	20	900	1	-1.9	-0.7
E. viminalis / ovata / amygdalina / obliqua damp sclerophyll forest	10	9	4	13	37	-9.8	-0.5
Furneaux *E. nitida* forest	20	0	300	9	29	-1.5	-0.1
Furneaux *E. viminalis* forest	100	0	0	20	100	0.0	0.0
Grassy *E. globulus* forest	6	200	400	7	14	-3.3	-0.8
Grassy *E. viminalis* forest	3	1	600	101	105	-7.0	-0.7
Inland *E. amygdalina* forest	2	900	900	18	22	-14.1	-1.1
Inland *E. tenuiramis* forest	8	1	300	44	53	-3.9	-1.0
Shrubby *E. ovata* forest	300	200	200	5	6	-19.3	-1.9
Wet eucalypt forests							
E. brookeriana wet forest	1	1	500	1	4	-11.8	-1.2
E. regnans forest	17	34	10	4	66	-13.2	-0.2
King Island *E. globulus / brookeriana / viminalis* forest	200	400	30	2	2	-3.2	-1.5
Tall *E.* delegatensis forest	91	110	28	39	268	-6.3	-0.1
Tall *E. nitida* forest	68	2	3	500	74	-0.5	0.0
Tall *E. obliqua* forest	109	159	58	60	385	-9.5	-0.3

RFA forest vegetation community	Land classification (tenure)[a] Conservation reserves (k ha)[b]	PTPZ land (k ha)[c]	Other publicly managed land (k ha)	Private freehold land (k ha)	Total (k ha)	Change in area since 1996 (%)	Change[d] in area since 2015 (%)
Wet *E. viminalis* forest on basalt	700	600	30	2	3	-26.9	-0.9
Sub-alpine eucalypt forests							
E. coccifera dry forest	41	3	5	7	55	0.0	0.0
E. subcrenulata forest	10	200	50	10	10	0.0	0.0
Non-eucalypt forests							
Acacia melanoxylon forest on flats	2	5	700	1	9	-4.9	-0.7
Acacia melanoxylon forest on rises	4	4	2	3	12	-8.3	-0.6
Allocasuarina verticillata forest	600	0	60	700	1	-2.5	-0.8
Banksia serrata woodland	100	0	0	40	200	-1.9	-0.1
Callidendrous and thamnic rainforest on fertile sites	119	27	28	10	185	-3.8	-0.1
Callitris rhomboidea forest	400	0	100	300	800	-0.3	-0.3
Huon pine forest	8	1	90	10	9	-0.2	-0.2
King Billy pine forest	17	1	2	10	20	-0.1	0.0
King Billy pine with deciduous beech	800	20	30	0	800	-0.1	0.0
Leptospermum sp./ *Melaleuca* squarrosa swamp forest	11	2	900	4	18	-4.5	-0.6
Melaleuca ericifolia forest	400	10	0	200	600	-1.4	0.0
Notelaea ligustrina and/or *Pomaderris apetala* forest	200	20	10	30	300	-3.4	-0.2
Pencil pine forest	300	0	0	0	300	-0.3	-0.3
Pencil pine with deciduous beech	200	0	0	0	200	0.0	0.0
Silver wattle (*Acacia dealbata*) forest	9	17	9	15	49	-10.0	-0.3
Thamnic rainforest on less fertile sites	291	33	40	10	375	-0.9	0.0
Plantation							
Hardwood plantation[d]	200	55	800	146	202	92.5	-6.6
Softwood plantation[d]	1	52	500	26	79		
Total	**1 256**	**706**	**358**	**1 005**	**3 327**	**-0.8**	**-0.9**

a) Forest extent is as at the first quarter of 2020 and tenure is as at 30 June 2021
b) Nature Conservation Act and Crown Lands Act Reserves
c) Includes Multiple-Use Forest
d) For the comparison with 2015 extents, the new 2015 baseline has been used

APPENDIX 2. Area[a] of forest in high quality wilderness

High Quality Wilderness (HQW) Area	Total HQW[b] (ha)	1996 reserved (ha & %)	2021[c] Formal reserves (ha)	Informal & private reserves (ha)	Total reserved (ha & %)	Changes[d] since 1996 (ha & %)	Total[e] forest in HQW (ha)	Forest reserved in HQW (ha)
Ben Lomond	10,300	9,800 (95%)	9,800	500	10,300 (100%)	500 (5%)	4,300	4,300
Cradle - Central Plateau	376,100	338,900 (90%)	371,300	2,400	373,700 (99%)	34,800 (9%)	149,100	147,900
Donaldson	53,200	5,100 (10%)	41,500	10,900	52 400 (99%)	47,300 (89%)	40,500	39,800
Douglas Apsley	10,100	10,000 (99%)	9,900	100	10,100 (100%)	100 (1%)	9,500	9,400
Freycinet	8,500	8,500 (100%)	8,400	0	8,400 (99%)	- 100 (-1%)	4,200	4,200
Henty	24,000	1,800 (8%)	23,600	200	23,900 (100%)	22,100 (92%)	12,000	11,900
Little Henty	9,100	700 (8%)	1,200	7,900	9,000 (100%)	8,300 (92%)	5,600	5,600
Maria	8,500	8,500 (100%)	8,400	0	8,400 (99%)	- 100 (-1%)	6,800	6,800
Meredith Range	63,400	15,200 (24%)	59,100	3,800	62,900 (99%)	47,700 (75%)	40,900	40,400
Mt Field	15,400	13,600 (88%)	14,500	300	14,800 (96%)	1,200 (8%)	9,000	8,400
Mt Heemskirk	10,900	0 (0%)	10,700	200	10,900 (100%)	10,900 (100%)	900	900
Mt William	7,700	7,200 (93%)	7,100	0	7,100 (93%)	- 100 (<-1%)	4,900	4,500
Norfolk Range	92,300	80,100 (87%)	89,900	1,400	91,300 (99%)	10,900 (12%)	26,300	25,500
Savage	51,600	32,200 (62%)	46,700	4,200	50,900 (99%)	18,700 (36%)	45,500	44,900
South-west	1,182,300	1,117,100 (94%)	1,171,800	2,000	1,173,800 (99%)	56,700 (5%)	451,500	446,500
Sumac	14,000	10,800 (77%)	10,800	2,600	13,400 (95%)	2,600 (18%)	12,300	11,700
Total HQ Wilderness	**1,937,900**	**1 659,600 (86%)**	**1,884,600**	**36,600**	**1,921,200 (99%)**	**261,600 (13%)**	**823,200**	**813,000**

c) Areas are rounded to the nearest 100 ha to reflect the spatial resolution of the wilderness mapping, which was based on 1km × 1km units

d) The extent of some wilderness areas published in the 1996 CRA and 1997 RFA included areas of sea (e.g. Bathurst Harbour); these are excluded in the above table

e) The 2021 reserve data is as at 30 June 2021

f) Some calculations for the increase in reserved area may appear to be erroneous. This is due to rounding errors

g) There were no updates to the wilderness inventory during the review period. Originally mapped wilderness areas are likely to have been reduced and these losses have not been accounted for in the total area

APPENDIX 3. Genetic resource conservation research output 2016–2021

Research from the five-year period with relevance to genetic resource conservation includes (from most recent to oldest):

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- Costa e Silva, J., Potts, B.M. and Harrison, P.A., 2020. Population divergence along a genetic line of least resistance in the tree species *Eucalyptus globulus*. *Genes*, *11*(9), p.1095.
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