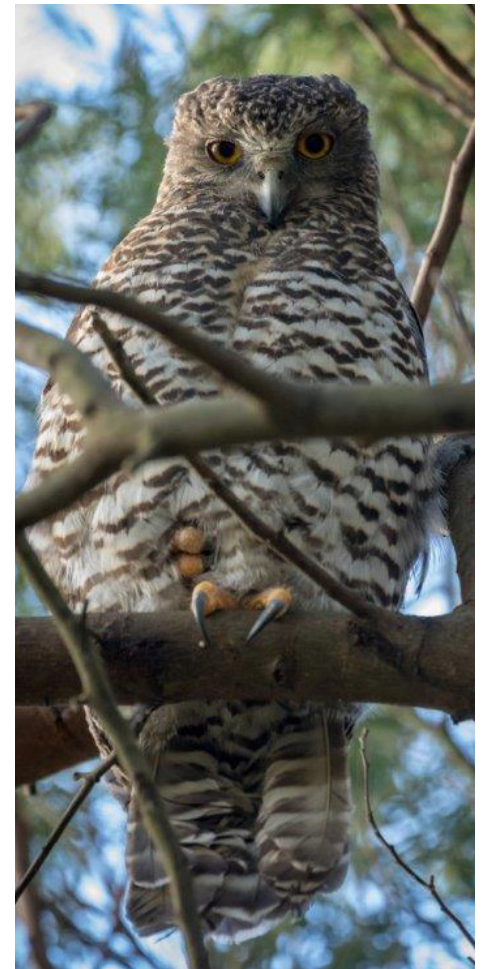
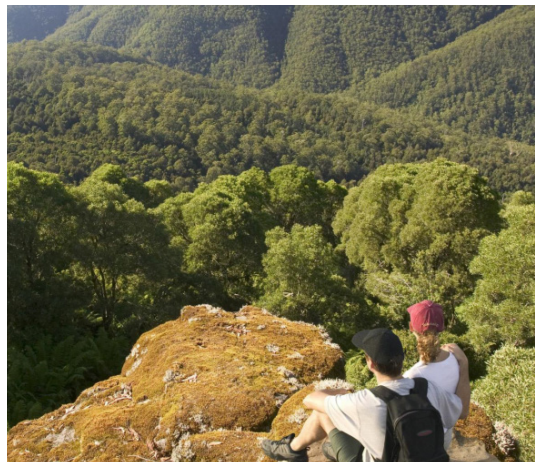


NSW Forest Monitoring and Improvement Program
“Delivering the evidence we need, for the forests we want”

Annual progress report

April 2021



This document has been prepared by the NSW Natural Resources Commission on behalf of the **NSW Forest Monitoring Steering Committee**.



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Acknowledgement of Country

The Natural Resources Commission acknowledges and pays respect to traditional owners and Aboriginal peoples. The Commission recognises and acknowledges that traditional owners have a deep cultural, social, environmental, spiritual and economic connection to their lands and waters. We value and respect their knowledge in natural resource management and the contributions of many generations, including Elders, to this understanding and connection.

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1. Introduction

In 2019, the NSW Government established the Forest Monitoring and Improvement Program (the program) to support ecologically sustainable management of all NSW forests. The Premier asked the Commission to independently oversee the program, collaboratively undertaken by NSW agencies working with universities, private sector scientists, the community and industry.

This is the second annual progress report on the program.

A cross-tenure collaborative science program

The program delivers information to support the strategic management of forests in NSW, on both public and private land. Under the program's terms of reference, all forests in NSW are within scope, including forests in national parks, state forests, plantation forests, private native forestry, forests on private and Crown land.

The program responds to community demand for reliable and transparent evidence for improving the sustainable and balanced management of NSW forests.

The NSW has committed over \$7 million to the program over four years (to 2021/22 FY).

In the previous 12 months, the program has established the foundations to deliver a long-term, science-based approach to forest management which the community can trust.

- **Baselines and long-term monitoring** – adopting a range of scientific approaches to generate evidence to evaluate whether desired outcomes are achieved.
- **Future scenarios and options** – exploring alternative futures and pathways to build fire and climate resilient forests for people and the biodiversity they support.
- **Dialogue and open data** – engaging the community and stakeholders with open data, program design and annual reviews.
- **Partnerships and joined-up science** – engaging experts to build a cost-effective and scientifically robust approach to forest monitoring across tenures.
- **Insight and oversight** – ensuring the program delivers open and transparent information in a timely manner and commitments are tracked and delivered.

The Commission independently chairs the NSW Forest Monitoring Steering Committee (the Committee). The Committee consists of NSW agencies with responsibilities for natural resource and environmental policy, regulation, and science, as well as agencies with a direct role in forest management. The Commission has appointed five independent experts with expertise in biodiversity, forestry, soil and water, Aboriginal natural resource management and social sciences to advise the Committee.

The Committee hosted its second annual community forums via webinars in September 2020, attended by research institutes, industry and environmental group stakeholders.

“...the NSW Forest Monitoring and Improvement Program has been an exemplar for how to develop a complex, long-term, spatially dispersed, multi-platform piece of public infrastructure...It really is a remarkable achievement and one that should be widely acknowledged.”

Professor Patrick Baker

Independent steering committee member. School of Ecosystem and Forest Sciences, University of Melbourne, Charles Bullard Fellow at Harvard Forest, and former Australian Research Council Future Fellow

2. Highlights and achievements

2.1 Establishing the state's first forest ecosystem baselines

The program has drawn on extensive state and national datasets to establish state-wide, cross-tenure baselines and trends for forest ecosystem health, carbon, flora and fauna and forest dependent jobs. In addition, the program will establish indicators to monitor and detect change through time.

These will be the first, large-scale baselines established in NSW for multiple forest values. They will support a range of performance and international reporting, including five yearly reviews for Regional Forest Agreements which have been in place for over 20 years.

During the early design phase, the community insisted the program should make the best use of historical data. In response, the program has draw on both historical and existing datasets including - for example - fauna and forest surveys from the NSW Comprehensive Regional Assessments in the late 1990's, LANDSAT satellite imagery from the 1970's and more recent data such as biodiversity information in BioNet database and soil information in the NSW SPADE database.

“Establishing objective environmental and socioeconomic indicators with baseline data will improve performance reporting and meet community need”

Euan Waller

Independent reviewer, Advice to the NSW and Australian Government on the NSW Regional Forest Agreements

2.2 Partnering with leading scientists and community groups

The program is working with over twenty partners including leading universities and research institutes, community groups, NSW agencies and consultancies to deliver scientifically robust and reliable information for decision making.

Assessment panels selected successful partners through a competitive based grant process to identify innovative approaches and ensure value for money. In some cases, the steering committee actively encouraged parties to join effort so the strength of individual proposals were fully realised in a consortium – for example researchers at Sydney University partnering with scientists at the NSW Department of Planning, Industry and Environment partnered to deliver baselines and trends for soil health.

The program has also partnered with three local Aboriginal land councils to lead post-fire renewal assessments in northern and southern regions of the state. This work is informing a broader stream of work that explores the extent to which Aboriginal values, knowledge and people are involved in forest management and decision making, and how this can be improved into the future.

2.3 Responding to post-fire information demands

In September 2019, the program funded researchers at the Department of Planning, Industry and Environment to improve automated approaches to map fire extent and severity. This work is using latest technology and techniques such as machine learning to analyse remote-sensed data and on-ground verification. It aims to significantly enhance NSW's ability to monitor and report on both wildfire and prescribed fire impacts on forests.

Researchers accelerated their work to meet priority information demands after the summer 2019/20 wildfires. The result is an up-to-date, field-validated fire extent and severity map for fire impacted areas in NSW. The work is now informing post-fire recovery decisions and resource allocation.

The program has also recently funded researchers at University of Wollongong to investigate how predicted changes to fire intensity and regimes risk achieving outcomes under the Coastal Integrated Forestry Operations Approval.

In other research, NSW agency and university scientists have partnered to investigate the impact of the 2019-20 wildfires on koalas and their habitat. This leverages the Commission's existing research on koalas in a cost-effective way to provide priority information for decision making and community stakeholders.

“I must say from my perspective it has been a productive, effective and enjoyable cross-agency collaboration to be involved in.”

Cross-agency Technical Working Group Member

2.4 Establishing the nation's first plan to monitor regional forest agreements

NSW has agreed to maintain a coordinated monitoring and reporting plan for three Regional Forest Agreements. These agreements cover all tenures across the coast, ranges and tablelands in NSW. The Premier tasked the steering committee to deliver the plan, under the terms of reference for this program.

Designed by a cross-agency team, the program has delivered the nation's first dedicated monitoring plan for a regional forest agreement. The plan describes actions and responsibilities for monitoring the ecological, social, cultural and economic outcomes sought under Regional Forest Agreements. The plan is available online to ensure it remains timely, up-to-date, and easy to use for end-users.

In addition, the program has delivered a scientifically robust program to monitor forestry operations and environment protections on state forests. The program will also establish a baseline for wood supply and monitor trends over time.

The monitoring program was developed by cross-agency design teams including technical experts from the NSW Environment Protection Authority, the NSW Department of Primary Industries, the Forestry Corporation of NSW and the Department of Planning, Industry and Environment.

2.5 Harnessing the power of citizen scientists

The program has established a citizen science strategy to harness the power of the citizen science community including their data.

The strategy aims to use existing citizen science data in program projects and scale-up existing citizen science projects. Overall, the program aims to strengthen community participation in evidence-based decision making.

The program has partnered the Australian Citizen Science Association to help it connect with the citizen scientist community and implement the strategy.

The program is now working with citizen science and community groups, including FrogID hosted by the Australian Museum.

“The Citizen Science Strategy which is being proposed here is a first for Australia in terms of a partnership approach to data gathering to support ecologically sustainable forest management...I commend the Natural Resources Commission and the Australian Citizen Science Association for proposing a long term process which will improve significantly not only the environmental management outcomes, but also the attitude of the community to the work of the Forest Monitoring and Improvement Program.”

Libby Hepburn

Co-chair UN Citizen Science for UN Sustainable Development Goals

Baselines and trends in forest extent and health - RFA regions



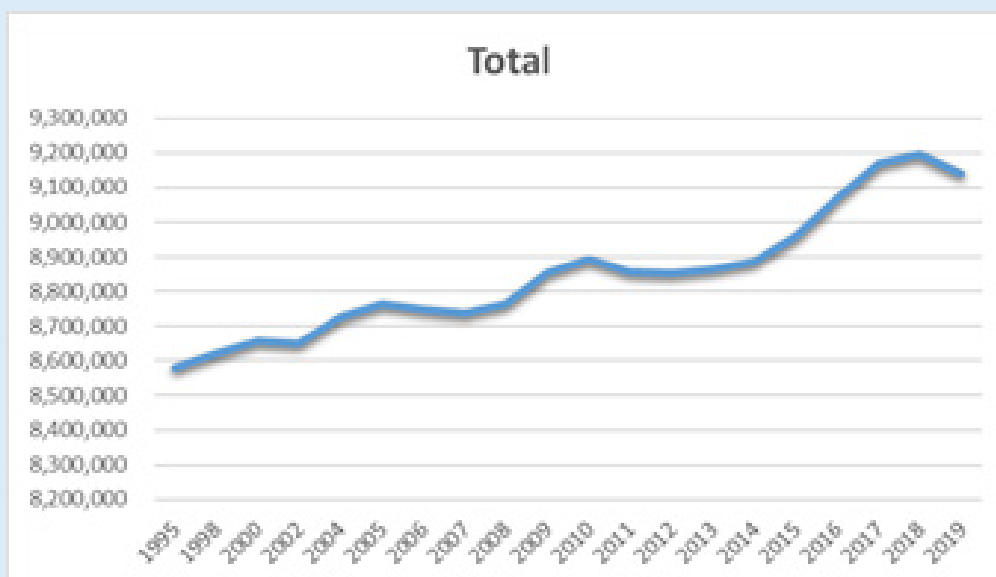
Regional Forest Agreements (RFAs) are bilateral agreements between the Australian and NSW Government. The RFAs seek to balance economic, social and environmental outcomes for forests by setting obligations and commitments for forest management. The RFAs are required to be reviewed to assess progress regarding ecologically sustainable forest management.

An independent reviewer was appointed by the NSW and Australian governments to review the RFAs between 2004 and 2014. Community representatives told the reviewer they were not convinced of the success of the RFAs due the lack of transparent and reliable information. The reviewer determined that the absence of baseline information meant it was not possible to identify whether improvement had occurred over the life of the RFA¹.

The Forest Monitoring and Improvement Program has engaged a consortium of leading scientists to establish baselines and trends for forest extent, condition and health. This will be NSW’s first authoritative baseline dataset that can be used for multiple purposes, including assessing the performance of the RFAs and forecasting future trends.

The group has used the national definition to determine forest extent between 1995-2019 using a range of datasets, including the National Forest and Sparse Woody Vegetation Database, NSW State-wide Landcover and Tree Survey (SLATS) Method, State-wide Vegetation Type Mapping and other datasets.

Note: This data and analysis is only for the NSW RFA regions. Preliminary findings show forest extent has increased since 1995 with a more recent decline since 2018. Most of the increase has occurred on private land. Forest extent in public forests has been mostly stable between 1995-2019. Further work on forest condition, connectivity and drivers of change is underway.



Impacts of fire on koalas and their habitat



Australian National University

PRIMARY INDUSTRIES
Forest Science



WESTERN SYDNEY
UNIVERSITY



The 2019/20 wildfires impacted koala habitat on the North Coast creating a mosaic of burnt and unburnt patches with varying levels of fire severity across state forests and national parks.

The NSW Forest Monitoring Steering Committee seized the opportunity to extend the Natural Resources Commission’s existing koala research program on state forests by funding researchers to investigate the impact of the fires on koalas and their habitat.

Koala occupancy and density, and the nutritional quality of koala habitat was compared pre- and post-fire at several sites. This will provide valuable insights on koala use and re-colonisation of the post-fire landscape and on medium-term impacts of fire on the capacity of feed trees to support koalas. The research includes acoustic surveys of koalas at three state forests (at Bellangry, Bril Bril and Kiwarrak) pre-and post fire, and nutritional analysis of habitat (at Bellangry, Bril Bril, Mt. Boss and Kerewong).

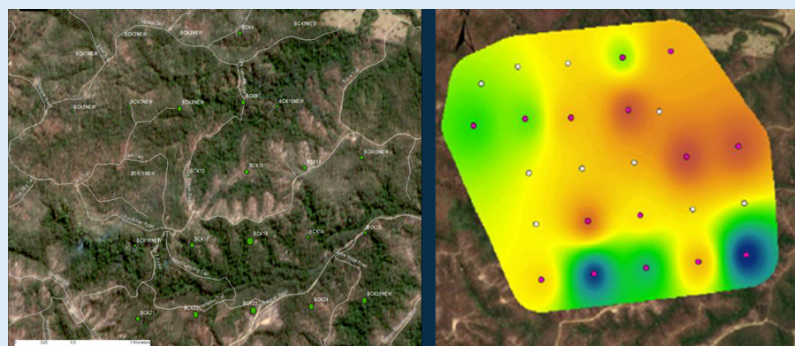
Preliminary findings show koala occupancy at the 25 acoustic sensors, set up at each grid, was impacted by fire to different extents, depending on fire severity. For example:

- koala occupancy remained at 100% after low severity fire impacted Bril Bril State Forest (the same as before the fires)
- koala occupancy at Kiwarrak State Forest remained at 100% before and after moderate severity fire
- no koalas were detected after high severity fire impacted Bellangry State Forest compared to 100% occupancy at the site before the fires.

It would appear that high fire severity causes a decline in koala density, whereas koalas persist where fire severity is low to moderate, based on the preliminary analysis. Further analysis is continuing.

Researchers are now investigating how koalas recolonise habitat at Bril Bril and Bellangry State Forest. The high occupancy level at Kiwarrak State Forest may be due to unburnt refuge areas in the state forest and surrounding landscape which are important for maintaining koala occupancy.

Analysis of habitat nutritional data is underway. Habitat nutritional quality is likely to be impacted by fire through changes in soil nutrients, short-term production of epicormic regrowth, and sustained production of juvenile foliage. The post-fire sampling and analysis will determine whether these impacts are positive or negative.



Koala calling activity immediately after low severity fire at Bril Bril in 2019 - researchers established an array of acoustic song meters (which was originally sampled pre-fire in 2018) after a low severity fire impacted the site during the 2019/20 wildfires. On the left is the location surveyed, with green dots showing placement of acoustic song meters. The image on the right shows koala calling activity recorded by the song meters with blue shading indicating higher calling activity and red indicating lower calling activity

3. Insights and opportunities

3.1 Realising the full potential and value of data

The program has used historical and existing national and state datasets to develop authoritative baselines and historical trend datasets (Section 2.1). Much of this data is archived in either agency databases or public data portals such as the NSW SEED Portal (Sharing and Enabling Environmental Data).

The process demonstrated the wealth and breadth of historical data that is potentially underused to support decision making for today's issues. For example, the work drew heavily on data collected in NSW's regional comprehensive assessments in the late 1990's. This was a significant government investment at the time.

Reliable and trusted data – both historical and new - is a critical asset for government, industry and the community, including the baseline datasets this program has developed. The program has developed good data management practices and governance to ensure quality data can be accessed and used by industry, the community, agencies and research institutes for further use.

“....let me start by complimenting you on the quality NRC NSW-Forests-related outputs to-date, during these difficult times... (the program's work) provide valuable input to our Governments and community groups”

Mike Thompson

Nature Net

3.2 Democratising data and problem solving

Visible and open data is a strategic asset for government and the community. It provides the basis for ongoing insights and innovation to meet challenges for forest management and deliver improved outcomes².

Consistent with NSW's open data policy, the program will make all data and information publicly available on the NSW SEED (Sharing and Enabling Environmental Data) data portal or the NSW Spatial Collaboration data portal.

Data generated by agencies should be open by default. However, the program has found discovering and accessing data from agencies in an easy and timely manner challenging at times. NSW agencies should ensure that available datasets are complete, accurate, accessible and discoverable according to commonly accepted open data standards.

The community could be incentivised to analyse and derive insights from government data through initiatives such as a public 'hackathon' to explore, and potentially solve forest management issues³. The Australian Government hosts such an annual event to provide insights on a variety of challenges facing the community.

“Government ensures that there is a single whole-of-government procurement and acquisition program for imagery and LiDAR and [it] accelerates the building of the State Digital Twin and associated Digital Workbench”

Final Report of the NSW Bushfire Inquiry, 2020

“Cross agency coordination and collaboration is needed to fully and effectively implement RFA obligations. For example, in order for the agencies to monitor the condition of the forest across all land tenures, the agencies need to establish universal benchmarks and coordinated monitoring regimes.”

Euan Waller

Independent reviewer, Advice to the NSW and Australian Government on the NSW Regional Forest Agreements

3.3 Investing in game-changing data

Effectively monitoring the condition and health of 20 million hectares of forests in NSW presents an enormous challenge. Forests are dynamic and diverse, ranging from sub-Alpine woodlands found in Kosciusko national park, red-gum reserves and state forests along the Murray River to Gondwana rainforests found in NSW World Heritage Areas in northern NSW.

To effectively monitor, model and forecast their current and future health, the program is developing a remote sensing and forest monitoring plot network. This will provide timely and accurate information to the public and forest managers. It will also support multiple levels of government and international reporting.

The work is complex. It aims to adopt the latest scientific approaches and use the most up-to-date data and technology. A primary data source for forest monitoring is LiDAR (Light Detection and Ranging). NSW’s existing LiDAR data cover is patchy, varying in quality and age and not universally shared across agencies.

With predicted increases in bushfire intensity and frequency, the demand for LiDAR data, and other spatial imagery is moving to a ‘must have’ from a ‘nice to have’ which has typically driven this type of data collection. This will ensure NSW has reliable and secure access to the data they need to protect communities. In addition, the data will provide forest managers and policy makers with reliable data to understand forest health and productivity for decision making.

3.4 Joining-up is productive but challenging

Achieving outcomes for NSW forests requires collective action including monitoring programs. Experience shows that effective collaboration is more likely when there are clearly established processes and mandates for groups to work together.

Improving coordination and collaboration is a key driver of the program. To support this, the Commission established a cross-agency steering committee that includes agencies responsible for forest policy and management. The early results of this collaboration are evident – for example, delivering NSW’s first cross-agency plan to monitor Regional Forest Agreements and commissioning projects to deliver priority information needs across tenures for community and government.

However, many existing research, monitoring and modelling activities are delivered and funded in silos and have their origins in programs developed decades ago. During the previous twelve months, many new research, monitoring and modelling activities were initiated in response to 2019/20 wildfires. The Commission observed many of these were designed and funded with little coordination at the time.

Opportunities still exist across government to further realise greater synergies and efficiencies by building on existing scientific knowledge and programs to coordinate a truly ‘joined-up’ science approach across NSW management agencies.

4. Priority next steps

4.1 Delivering more data on forest dependent jobs

Information on forest-dependent jobs is typically contested. Often the information reports data collected from a narrow range of jobs – for example timber and wood product jobs - or different method are applied that can over- or underestimate the economic impacts of different proposals. This contest can make it difficult for decision makers to navigate the best course of action or policy response.

The Australian Bureau of Statistics (ABS) have established national methods to account for income, expenditure and products across broad-based industries such as forestry. But these accounts only tell part of the story. NSW forests support regional economies through a broader set of employment such as jobs for non-forest products and recreation and tourism. NSW agencies also employ a significant number of people in regional areas to manage and respond to forest fires, conserve biodiversity and heritage and manage forests for high quality sustainable timber products.

The program is piloting a method in the north coast of NSW to reliably quantify regional forest-dependent jobs across all relevant sectors. Ideally, the method will become an established method alongside existing ABS methods.

This is important work. It will provide decision makers with authoritative data to inform decision making that can improve the prosperity of regional economies.

NSW needs evidence of what has happened in the past, what is happening now and what may happen in the future

4.2 Delivering NSW's first forest monitoring framework to support forecasting

The program has committed to design a state-wide, cross tenure forest monitoring plot network linked to remote sensing. This network will be the centre-piece of a broader modelling and forecasting framework drawing on historical data, field verified data, remote sensed data and existing modelling for climate change predictions.

The Commission is now working with agencies and other experts to pilot the approach, including ensuring a statistically valid design and repurposing existing permanent forest plots.

Importantly, the approach needs to demonstrate the ability to join-up science across broader monitoring and reporting programs across government, such as the Biodiversity Indicator Program, the Biodiversity Conservation Trust control plot network and inventory plots established on state forests.

Roll-out will start on state forests in the first quarter of 2021 to meet coastal IFOA monitoring commitments, expanding across tenures in the area covered by Regional Forest Agreements by end-2022.

4.3 Modelling and evaluating future scenarios

The program aims to strengthen the NSW Government's ability to strategically and adaptively manage forests. This requires evidence of what has happened in the past, what is happening now and what may happen in the future.

The building blocks are being put in place to achieve this. For example, the program is establishing historical baselines and trends to understand what has happened in the past (section 2.1). Large scale, cross-tenure monitoring programs deliver data for models to help us understand what is happening now and likely modelled trajectories.

Scenarios represent possible futures for one or more components of a system. Typically, they work hand-in-hand with models, including existing climate change and fire regime models. Unlike transport⁴ and infrastructure⁵ that has invested time and effort in developing future scenarios, NSW has no ready-to-adopt scenarios to analyse and explore strategic issues related to NSW forests.

In response, the program will adopt a coherent framework to effectively explore and develop future scenarios and provide useful information for decision making. The framework needs to be scientifically robust, can be used often and flexible so the right tools can be selected for the right job. In effect, the program aims to establish an enduring process and legacy for to develop scenarios, as well as the important outputs it will deliver.

This work will support NSW's recent initiatives to develop stronger capabilities to strategically explore and manage for desired futures – for example, the Department of Premier and Cabinet has established a Shaping Futures unit that aims to explore how the NSW Government can best meet the future needs of NSW citizens and support innovation.

Sustainable management of forests requires reliable information over the long-term to ensure forests continue to deliver important services to the citizens of NSW

4.4 Securing ongoing program funding

Government allocated \$7.2 million to the program over four years. Funding for the program ends in 2021/22(FY). The program has used the initial seed funding to establish the foundations for a comprehensive, evidence-based approach to decision-making. However, sustainable management of forests requires reliable information over the long-term to ensure forests continue to deliver important services to the citizens of NSW.

Investors often ask how much funding is necessary for effective monitoring. In 2012, NSW agencies told the Commission around \$26 million per annum would deliver an effective government wide system to monitor environmental, economic and social indicators state-wide associated with natural resource management.

By comparison, a common rule-of-thumb suggests between 5-10 percent of total program investment should be allocated to monitoring and evaluation. Based on the cost of public land management in NSW alone (based on 2017 data), this would equate to allocating between \$17-\$43 million annually to monitor and evaluate environmental, social and economic outcomes for NSW forests and their ecosystems.

It is important to note, innovations in ecological monitoring, including motion capture camera technology, acoustic technologies, remote sensing methods, artificial intelligence and citizen science programs are rapidly increasing the coverage and reducing the cost of monitoring programs.

The committee has agreed funding should continue for the program. The committee will develop a cross-agency business case for government consideration.

Program partners



Endnotes

- 1 Waller, E. (2018) Independent review of the report on progress with the implementation of the New South Wales Regional Forest Agreements for the second and third five-yearly reviews 2004 – 2014. A report to the Commonwealth of Australia and the State of New South Wales, to be tabled in Parliament
- 2 Accelerating R&D in NSW Advisory Council (2021) Action Plan – Turning ideas into jobs: Accelerating research and development in NSW
- 3 Ibid
- 4 See <https://future.transport.nsw.gov.au/technology/roadmap/technology-scenarios>
- 5 See https://insw-sis.visualise.today/documents/about/Development_of_State_Infrastructure_Strategy_Scenarios.pdf